

## **Value of Social Capital to Mid-sized Northern Plains Farms**

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## **Abstract**

As farms increase in size, operators face the decision of remaining loyal to local merchants or obtaining volume discounts from distant input suppliers. When farmers bypass local merchants and buy inputs in volume, they often realize price discounts but forego many services including credit forbearance. When farmers buy locally, they pay higher prices, which decreases profits and increases financial risk, but generates social capital which can be drawn upon during periods of economic adversity. A theoretical model of farm financial risk evaluates borrower behavior in light of cash flow constraints, volume discounts, and social capital. Results delineate financial risks involved and value of social capital.

**Keywords:** Capital, financial risk, simulation, social, stochastic

## **Value of Social Capital to Mid-sized Northern Plains Farms**

Northern Plains agriculture is undergoing rapid change as mid-sized farms continue to either: 1) consolidate and expand in size in an effort to capture size economies, or 2) downsize and seek off-farm income to maintain rural lifestyles. With the exception of a few areas bordering metropolitan cities, off-farm income opportunities are quite limited in most areas of the region. Thus, many mid-sized farms in the Northern Plains have chosen consolidation. As a result, rural communities have experienced great hardship as rural residents decline in number and demand fewer goods and services.

As farms increase in size, operators often face the difficult decision of remaining loyal to local merchants or obtaining volume discounts from more distant input suppliers. When farmers bypass local merchants and buy inputs in volume from a wholesaler, they often realize a price discount – even after search and transportation costs are considered. This discount translates into lower costs of production and increased income for the farm unit. Since financial pressures initially motivated many of these firms to increase in size, not only do larger farms benefit from unit discounts, the larger margin further enhances long-term survivability as profits increase.

However, when farmers bypass local merchants and buy in volume, they often forego many services provided by local suppliers (e.g., ability to return unused goods, counsel/advice). One service that is especially important to mid-sized firms experiencing financial hardship is credit forbearance. When farmers are unable to repay borrowed funds, local merchants will frequently extend the repayment period, reduce interest charges, or even re-negotiate outstanding debt in an effort to increase the probability of collection. In essence, when farmers buy locally, they pay higher prices, which decreases profits and increases financial risk, but generates social

capital which can be drawn upon during periods of economic adversity later. The availability of social capital enhances long-term survivability of the farm unit. Thus, farm operators must evaluate the trade-offs between obtaining volume discounts versus building social capital as a risk management strategy.

This article develops a theoretical model of farm financial risk that evaluates borrower behavior in light of cash flow constraints, volume discounts, and social capital. Monte-Carlo simulation is used to empirically apply the model to a representative 2,000-acre Northern Plains crop farm. The stochastic simulation model embodies local price and yield distributions, tax policy, and financial repayment risks. A survey of local retail and distant wholesale input suppliers and lenders provides key information on levels of price discount and credit forbearance.

Results of the analysis delineate the financial risks involved. The distribution of year-end available funds when inputs are purchased locally has a slightly lower mean and longer left tail. While a longer and bulkier left tail appears to present the farm with additional financial risk, it is actually the result of additional borrowing arising from credit forbearance. If forbearance were not available, the firm would be bankrupt. In this model, bankruptcy occurs with 2.6 percent frequency. Personal exemptions provided under statutory bankruptcy provisions alter the shape of the left tail.

## **Social Capital**

Economists have recently focused increased attention on the role of social capital in financial markets (Guiso, Sapienza, and Zingales). Special sessions at the 2003 American Agricultural Economics Association and NCT-194 regional research annual meetings have emphasized the need to further understand the important role social capital and other informal credit arrangements play in agriculture and rural financial markets. Informal discussions at these meetings described several local financial markets in minority/low income neighborhoods. Social capital among agents in these markets resulted in peer pressure that insured timely repayment of financial obligations. Fetting and Rolnick summarize a similar role of social capital in the inner-city Hmong neighborhoods of Minneapolis and St. Paul, MN. Local residents patronize neighborhood shops, which outwardly appear inefficient and duplicative of national chains. But, such activity preserves both the culture and financial viability of the neighborhood.

Although definitions of social capital vary among professions, Robison, Siles, and Schmid advance a definition that is particularly well-suited for this study, "... a person's or group's sympathy toward another person or group that may produce a potential benefit, advantage, and preferential treatment for another person or group of persons beyond that expected in an exchange relationship" (p.19). Credit forbearance would certainly constitute an unexpected benefit beyond a normal transaction.

Gustafson, Saxowsky, and Braaten describe the economic impact of credit forbearance during the 1980's farm financial crisis. Lenders at the time granted distressed farm borrowers a number of concessions ranging from extensions, partial repayment, exemptions, and redemption rights. While many of these provisions were codified in statutes, lenders often conceded more in

negotiated settlements when their initial bargaining position was weakened. Non-delinquent borrowers of a financial institution often tolerated higher interest rates and lower capital availability, thus providing the necessary social capital that assured continued functioning of their financial market.

Measurement of social capital is a complex task, due in part to the professional discourse that exists on means of creation, ownership, and stability over time. Several studies view social capital as “externally given.” Narayan and Pritchett; Maluccio, Haddad, and May; and Grootaert shared this view when examining the impact of household membership in groups on household expenditures. More recent studies, however, view social capital in the context of asset theory, whereby social capital can be created through investment and depreciate if not maintained (Mogues and Carter; Shideler). Wilson argues that social capital, as an asset, can even be transferred among agents and firms in an economy.

Another point of contention relates to whether social capital is a group or individual asset. Collier views social capital as an externality created from social interaction. If an individual foregoes work and invests scarce time in a social network, they may eventually reap an economic benefit because membership serves as social collateral that can be used to secure loan funds which would otherwise be unattainable among group members who individually are not creditworthy. If the individual defaults, groups can impose sanctions up to and including expulsion. Mogues and Carter find that social capital differences among groups deepens economic inequality.

Alternatively, Shideler finds that agents can create social capital apart from group interaction. “Repeated transactions between a merchant and a consumer (the social interaction),

allows for opportunistic knowledge (stock of social capital) to be acquired by both individuals, potentially generating trust (benefit of social capital) between them.” This trust then reduces transaction costs of doing business. Siles, Robison, and Hanson interviewed bankers and bank customers to evaluate the strength of social capital in lending relationships and resulting economic effects. They found that social capital increased frequency of loan approval, yielded improved terms of trade, substituted for other information in credit approval, and resulted in less bank switching when interest rates rose.

Often, only indirect measures of social capital value are attainable. In their review of literature, Guiso, Sapienza and Zingales find previous measures of social capital are outcome-based (e.g., level of trust or level of economic cooperation). The limitation of these measures is that they are often contaminated with other variables. In their study, they use two outcome-based measures that are free of this criticism – electoral participation and blood donation. Neither is motivated by economic or legal incentives. They are only driven by social pressure and group norms. They find that social capital is strongest where legal enforcement is weakest and among less educated people. Although their measure of social capital is free of contamination, it assumes that agents have only one unified measure of social commitment – of equal value in both altruistic and economic activity.

Robison and Flora note that if the influence of social capital and social-emotional goods alters the price of a physical good involved in an exchange, the change in price is an indirect measure of social capital’s influence. This procedure is the metric employed in this study to determine the value of social capital conveyed to farmers who patronize local vendors.

One measure of social capital developed in this study will be the premium farmers pay when they patronize local input suppliers. In essence, this transaction creates a credit in the farmer's social capital account with the vendor, from which the farmer may withdraw in the future. This measure of social capital is consistent with both the asset and individual definitions of social capital described above.

Withdrawals from or debits to the social capital account are an alternative means of valuation. The value of credit forbearance extended to farmers in periods of financial stress can also be measured. Comparing both the "debit" and "credit" amounts provides insight into social capital transactions. If social capital markets are complete, efficient and all debits/credits accounted for, one would expect debits to equal credits, less depreciation. However, in this study, credit forbearance is only one of many possible uses of social capital. Since the study does not attempt to value all possible debits (from product returns, counsel/advice, etc.), it is expected that social capital credits will exceed estimates of credit forbearance debits.

### **Theoretical Development**

Robison and Barry develop an elegant model of borrower behavior when cash flow is constrained. The rate of return  $r + \varepsilon$  on assets is stochastic where  $\varepsilon$  is a random variable with mean zero and variance  $r$ . At critical return rate  $\varepsilon_0$  where the firm has fully utilized its credit reserve and change in equity for the period is defined as:

$$(1) \quad \Delta E(\varepsilon_0) = (r + \varepsilon_0 - i) D_0 + (r + \varepsilon_0) E_0 - W$$



where  $i$  is the interest rate paid on debt  $D_0$  borrowed in the period,  $E_0$  is the initial level of equity at the beginning of the period, and  $W$  is the level of withdrawals for consumption and other uses. This relationship can be modified to include social capital  $sc$  and forbearance  $f$ .

At the beginning of the period, an agent can check available price discounts and decide whether or not to patronize a local vendor. If price discounts are large enough, the agent chooses to bypass a local vendor and forego creation of social capital,  $sc$ . In doing so, they are able to realize a unit discount and enhance their return margin by  $s$ . Utilizing Robison and Flora's definition of social capital, these two measures are assumed to equate (e.g.,  $sc = s$ ). However, when they bypass a local vendor, they also lose credit forbearance which increases their borrowing cost by  $f$ . Therefore, borrowers are now assumed to follow:

$$(2) \quad \Delta E (\varepsilon_0) = (r + \{S + \varepsilon_0\} - \{i + f\}) D_0 + (r + \varepsilon_0) E_0 - W \quad (2)$$

When credit is constrained, the agent begins the period at the point of maximum borrowing:

$$(3) \quad D_0 = \zeta E_0 \quad (3)$$

where  $\zeta E_0$  is the maximum debt ratio. We can then add the expected change in equity to each side of the equation to estimate returns at the end of the period:

$$(4) \quad D_0 - \Delta E (\varepsilon_0) = \zeta [E_0 + \Delta E (\varepsilon_0)] \quad (4)$$

Substituting (1) into (4) and solving yields:

$$(5) \quad \varepsilon_0 = \frac{D_0 - \zeta E_0}{(1 + \zeta)(D_0 + E_0)} + \frac{W + (i + f) D_0}{D_0 + E_0} - (r + s) \quad (5)$$

With first order conditions:

$$(6) \quad \begin{aligned} \frac{d\varepsilon_0}{dr} &= -1 < 0 \\ \frac{d\varepsilon_0}{dE_0} &= \frac{-[(1 + \{i + f\}) D_0 + W]}{(D_0 + E_0)^2} < 0 \\ \frac{d\varepsilon_0}{di} &= \frac{D_0}{D_0 + E_0} > 0 \quad \text{for } D_0 > 0 \\ \frac{d\varepsilon_0}{d\zeta} &= \frac{-1}{(1 + \zeta)^2} < 0 \\ \frac{d\varepsilon_0}{dW_d} &= \frac{1}{D_0 + E_0} > 0 \\ \frac{d\varepsilon_0}{dD_0} &= \frac{[1 + (i + f)] E_0 - W}{(D_0 + E_0)^2} < 0 \\ \frac{d\varepsilon_0}{dS} &= -1 + f' f \frac{D_0}{D_0 + E_0} > 0 \\ \frac{d\varepsilon_0}{df} &= \frac{D_0}{D_0 + E_0} > 0 \quad \text{for } D_0 > 0 \end{aligned} \quad (6)$$

The results are similar to those of Robison and Barry and show that increases in  $i$  and  $W$  require higher  $\varepsilon_0$  to avoid exhausting credit. Likewise, increasing  $r$ ,  $E_0$  or  $\zeta$  allow the agent to earn a lower  $\varepsilon_0$ , but yet avoid exhausting credit. Of special interest in this study are the direction and magnitude of changes in  $s$  and  $f$ . Similar to  $i$ , and increase in  $f$  requires a higher  $\varepsilon_0$

to preserve credit. Increasing  $s$  has an ambiguous effect on  $\xi_0$  because of the secondary impact of forbearance cost changes.

### **Simulation Approach and Empirical Data**

A farm financial risk simulation model is constructed to evaluate financial performance and social capital in light of borrowing constraints, forbearance, and volume discounts. The goal of the simulation is to delineate differences in financial characteristics and bankruptcy frequency depending on whether or not a farmer patronizes a local input supplier.

The chosen model is loosely adapted from Ellinger's Farm Financial Simulation Model (FFSM). FFSM is a deterministic set of coordinated financial statements. Model input includes initial levels of assets and liabilities, acreage, yields, number of livestock, input costs, rental arrangements, loan repayment costs and schedules, overhead costs, commodity prices, living expenses, expected investment, inflation, and taxes. Output of the model is displayed in the detailed income statement, balance sheet, flow of funds, and cash availability financial statements.

The original model was updated to include new tax policy and transformed into a Monte-Carlo simulation model using *@Risk* (Palisade). Stochastic variables include crop yields and prices. In addition, the simulation model was expanded to include volume discounts for seed, chemical and fertilizer purchases, lender forbearance, and a bankruptcy function to model the social capital considerations developed above. As depicted in Figure 1, the firm begins with an initial financial position. During the year, the firm's production activity can either generate sufficient cash flow to meet all needs or experience a shortfall. If a shortfall exists, the firm may

be able to obtain additional financing to cover the deficit. If so, the net worth of the firm is reduced by the borrowing costs incurred. If the firm is not creditworthy and additional funding is not forthcoming, the only alternative is bankruptcy. However, the hypothesis that bankruptcy is avoided when  $S > 0$  is tested in this study.

Data to estimate the model was obtained from the North Dakota Farm Business Management Association. A representative 2,000-acre cash grain farm in Foster county, North Dakota, was formulated with the record information. Crop acreage consists of 1,000 acres of both soybeans and wheat which is typical of farming operations in the area. One half of the land is cash rented at \$50/acre, the prevailing rate. Input amounts/costs and the machinery complement are based on averages of selected farm records. Only routine investment in new assets is permitted. Any additional cash generated is saved at year end. A minimum of \$22,025 must be withdrawn for family living. Family living withdrawals are also not permitted to exceed \$52,949 as any excess amount is saved. The farm's initial financial situation was also based on record averages. The farm had current, intermediate, and long-term debt that resulted in a beginning current ratio of 1.088 and debt-to-asset ratio of 0.475. Although this situation does not reflect severe financial stress, it is expected the firm would be sensitive to cash flow margin, financial repayment risks, and forbearance considerations.

Historical price and yield data from the U.S. Department of Agriculture's National Agricultural Statistics Service was used to estimate price and yield distributions for the representative farm. Twenty years of annual season average prices received by farmers were used for estimation. Twenty years of harvested yield per acre data for soybeans and 30 years of harvested yield per acre data for wheat were used. Soybeans are a more recent crop in the region

and lack longer historical time-series observations. Chosen distributions based on the Kolmogorov-Smirnov (KS) test are shown in Table 1. At the local farm level, yield and price distributions are assumed independent.

A survey of local input suppliers and regional wholesalers provides key information on levels of price discount and credit forbearance. Extension weed science experts were first contacted to identify types/brands and application rates of fertilizer, herbicides, and seed that a representative farm in the geographic area of interest would commonly apply. Five local input suppliers in the county and two regional wholesalers were then contacted and asked to provide prices and credit terms.

Surprisingly, retail/wholesale margins were less than expected. One survey respondent remarked that chemical pricing is the most competitive. No “upfront” profit margin exists. Instead, they rely heavily on “backside” program monies paid by manufacturers. Their average margin on chemical sales was 3-4 percent compared with 5-7 percent margins on fertilizer and seed. Respondents also remarked that custom application of chemical products is lucrative, but is not considered in this analysis. Profit margins on seed vary depending on whether the variety is public or private. In this study, wheat seed was assumed to be public, whereas soybean seed was assumed to be a private genetically-modified variety. Based on the survey responses, the following volume discounts were calculated, wheat chemicals – 1.3 percent, soybean chemicals – .9 percent, fertilizer – 6 percent, wheat seed – 0 percent, and soybean seed – 7.8 percent. These differentials are not directly comparable to the margins discussed above because the price structure for wholesalers and retailers varies depending on volume, etc.

With respect to credit terms, both wholesalers and local suppliers charged 18 percent interest, net 30 days. The highest priced local supplier offered a modest discount (0.75 percent) if payment was received net 10 days. Wholesalers imposed credit service charges (\$75 per late payment) and late fees (\$50 if more than 15 days late). Wholesalers were reluctant to provide any forbearance beyond stated credit terms. Both firms surveyed indicated they have followed delinquent accounts through bankruptcy. Forbearance terms extended by local suppliers were nebulous as considerable flexibility existed. An important consideration was customer's historical level of patronage and future repayment prospects. Given difficulty quantifying forbearance terms extended by local suppliers, a policy was developed based on terms reported by Gustafson, Saxowsky, and Braaten in their study of costs associated with delinquent farm loans. When farmers are unable to repay credit, local suppliers often extend the repayment periods and attempt to collect interest plus associated financing costs. When computing ending net worth in the simulation model, this charge is deducted when determining the year-end financial position.

Wholesalers are assumed to offer no forbearance, based on their survey responses. Thus, farmers with inability to pay face the prospect of bankruptcy. Again, following Gustafson, Saxowsky, and Braaten, personal exemptions and other benefits provided under state law permit farmers to retain approximately \$100,000 of personal assets. The distribution of the year-end financial position in the simulation model is then computed as the greater of actual net worth less costs of bankruptcy (including value of forfeited assets) or \$100,000.

## Results

The financial performance of the representative farm was simulated for 1,000 iterations under each scenario – purchasing inputs locally vs. wholesale. The distributions of available funds, net income, and net worth for each scenario are compared in Figures 2 through 4, respectively.

Although many financial indicators could be used to measure the difference between scenarios, available cash flow at the end of the year was deemed most instructive because a deficit triggers either additional borrowing, forbearance, or bankruptcy. Unlike net income, available cash flow includes changes in cash balances due to borrowing and withdrawals for family living, which are allowed to vary with net income earned. Balance sheet measures were also found to mask the firm's actual well-being because debt forbearance understated debt obligations.

The distribution of year-end available cash flows for the scenarios where inputs are purchased locally and wholesale is compared in Figure 2. Recall that when farmers purchase chemical, seed, and fertilizer inputs at full price locally, they generate social capital with the input supplier in the form of credit forbearance. In periods of insufficient cash flow, the farm is allowed to extend repayment periods and only pay interest plus financing charges, providing the firm remains solvent. Insolvency did not occur in any of the simulations where inputs were purchased locally.

The distribution of year-end available cash flows when inputs are purchased locally has a mean value of \$30,145. However, considerable kurtosis exists as depicted by the long right tail. This indicates that, in most years, only modest cash flows are generated by the farm unit.

However, considerable upside potential exists periodically. Available cash flows exceed \$119,924 with 5 percent probability.

A deficit in year-end available cash flows with inputs purchased locally occurs with 39.92 percent frequency. The firm benefits from credit forbearance extended by the input suppliers during these periods. Although the magnitude of individual shortfalls is relatively small, the forbearance mitigates bankruptcy proceedings. The marginal cost of additional borrowing that is associated with the input suppliers' forbearance is included as an additional cost when computing net income below.

Downside risk exposure also can be quantified using value-at-risk (VAR). Under this criterion, the firm can expect year-end available cash flows with inputs purchased locally to be less than \$6,663 with 5 percent frequency.

The distribution of year-end available cash flows when inputs are purchased wholesale has a mean value of \$34,012. Volume discounts not only shift the distribution right due to lower costs, but the shape changes due to lower financing costs and taxes. Again, considerable kurtosis exists as depicted by the long right tail. Available cash flows exceed \$125,942 with 5 percent probability.

A deficit in year-end available cash flows with inputs purchased wholesale occurs with 34.21 percent frequency. Unlike the scenario where inputs are purchased locally, the firm does not benefit from credit forbearance. If a shortfall exists, the farmer must either borrow additional funds if he/she is creditworthy or file bankruptcy. Like above, marginal costs of additional borrowing are included as an additional cost when computing net income. If bankruptcy occurs, year-end net worth is restated to be \$100,000, the level of personal



exemptions provided by state law. Again, although the magnitude of individual year-end available fund deficits is relatively small, they do pose a bankruptcy risk to the firm. When a deficit occurs and the firm cannot borrow additional funding from a creditor, wholesale input suppliers proceed with bankruptcy action instead of offering forbearance. In this simulation, bankruptcy does occur with 2.6 percent frequency. VAR for year-end available cash flows with inputs purchased wholesale is \$6,580 with 5 percent frequency.

Distributions of net income when inputs are purchased locally and wholesale are shown in Figure 3. Although the profiles are relatively similar, the distribution of net income when inputs are purchased locally has a slightly lower mean and longer tail than the distribution of inputs purchased wholesale. This happens for two reasons. First, when inputs are purchased locally, the farm does not benefit from volume discounts. Second, when the farm ends the year with an available funds deficit and is not creditworthy, it receives forbearance from local input suppliers. Although small, these additional borrowing costs add mass to the lower end of the distribution. Thus, while a longer and bulkier left tail appears to present the farm with additional risk, it is actually the result of additional borrowing arising from credit forbearance. If this were not available, the firm would be bankrupt.

Similar shifts are depicted in Figure 4 showing distributions of changes in year-end net worth for the two situations. The mean value of ending net worth for inputs purchased locally is nearly \$7,000 less than the situation where inputs are purchased wholesale. Likewise, the left tail of the distribution for inputs purchased locally is longer and has greater mass. In addition though, the shape of the left tail of the distribution for inputs purchased wholesale changes due to periodic bankruptcy. When bankruptcy does occur, net worth is completely eroded, with the

exception of personal exemptions permitted under statutory law. Thus, large losses are truncated, leaving the farm with minimal net worth.

## **Conclusions**

This article developed a theoretical model of farm financial risk that evaluated borrow behavior in light of cash flow constraints, volume discounts, and social capital. Monte-Carlo simulation was used to empirically apply the model to a representative 2,000-acre Northern Plains crop farm. The stochastic simulation model embodied local price and yield distributions, tax policy, and financial repayment risks. A survey of local input suppliers and lenders provided key information on levels of price discount and credit forbearance. Competition among suppliers resulted in less difference between retail and wholesale prices than expected a priori.

Results of the analysis delineated the financial risks involved and value of social capital received in the form of credit forbearance. The distribution of year-end available funds when inputs were purchased locally had a slightly lower mean and longer left tail. While a longer and bulkier left tail appeared to present the farm with additional financial risk, it was actually the result of additional borrowing arising from credit forbearance. If forbearance were not available, the firm would have been bankrupt. In this model, bankruptcy occurred with 2.6 percent frequency. Personal exemptions provided under statutory bankruptcy provisions altered the shape of the left tail.

There are several implications of this study. First, social capital arising from market transactions with individual private agents was found to have important risk management implications for farmers. Past studies have primarily studied social capital arising from collective group action. Second, results of this study create the potential for significant adverse

selection problems as riskier farmers gravitate towards local input suppliers who offer credit forbearance. As local suppliers offer forbearance to great numbers of farmers, the financial health of their businesses becomes jeopardized because of tardy repayment – compounding their efforts to trim margins and compete with wholesale suppliers. To date though, farm numbers in the Northern Plains have generally declined, not increased, resulting in a mutually dependent relationship. If the agricultural sector continues to evolve and concentrate, wholesalers and farmers most likely will develop long-term relationships, leading to creation of social capital at another level. Unique features of this relationship warrant monitoring, especially as even larger farmers begin to bypass wholesale suppliers.

Results of this study could be usefully extended by applying the analysis to other geographic areas and/or farming situations/types. Moreover, this abstract model only considered one form of social capital. Additional studies are needed to quantify the value of advice, counsel, and other services such as return policy provided by local merchants.

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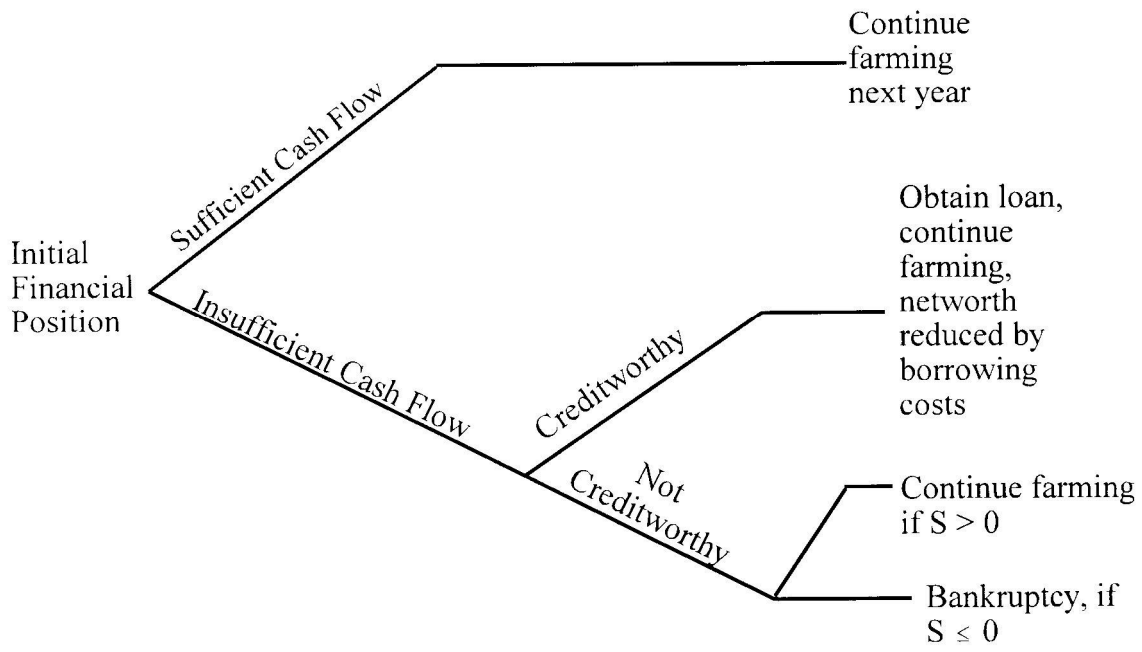
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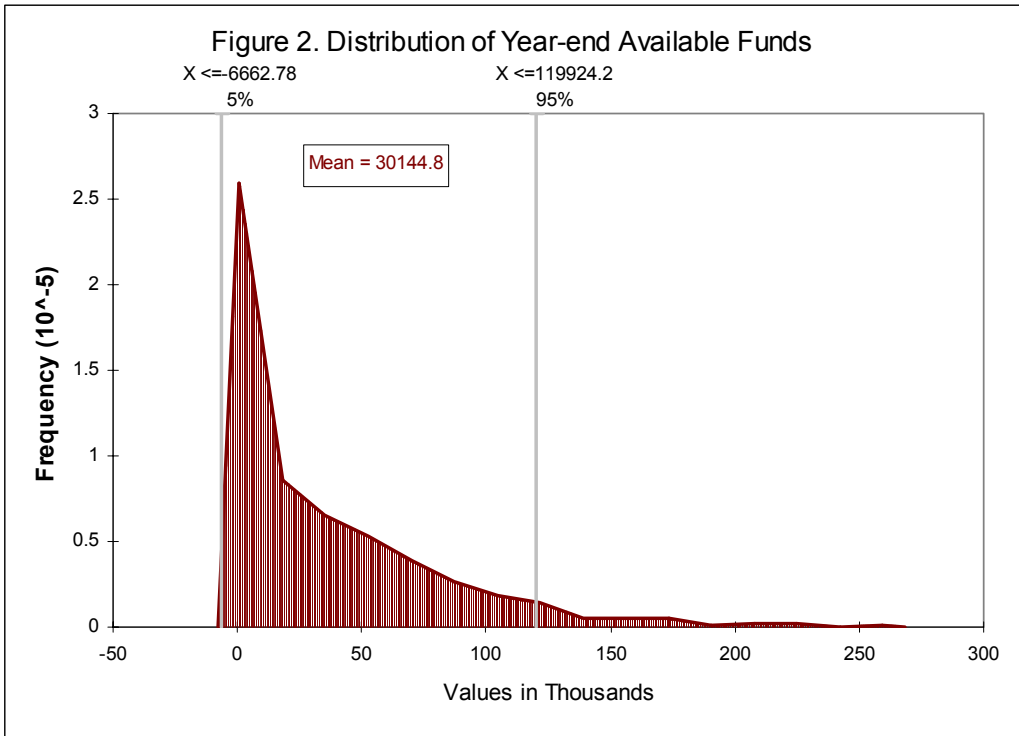
Table 1. Simulation Model Yield and Price

Crop	Function	Mean	Variance
Soybean Price	Logistic	\$5.60/bu	0.61
Wheat Price	Logistic	\$3.43/bu	0.37
Soybean Yield	Normal	21.62 bu/a	6.98
Wheat Yield	Logistic	30.67 bu/a	4.09

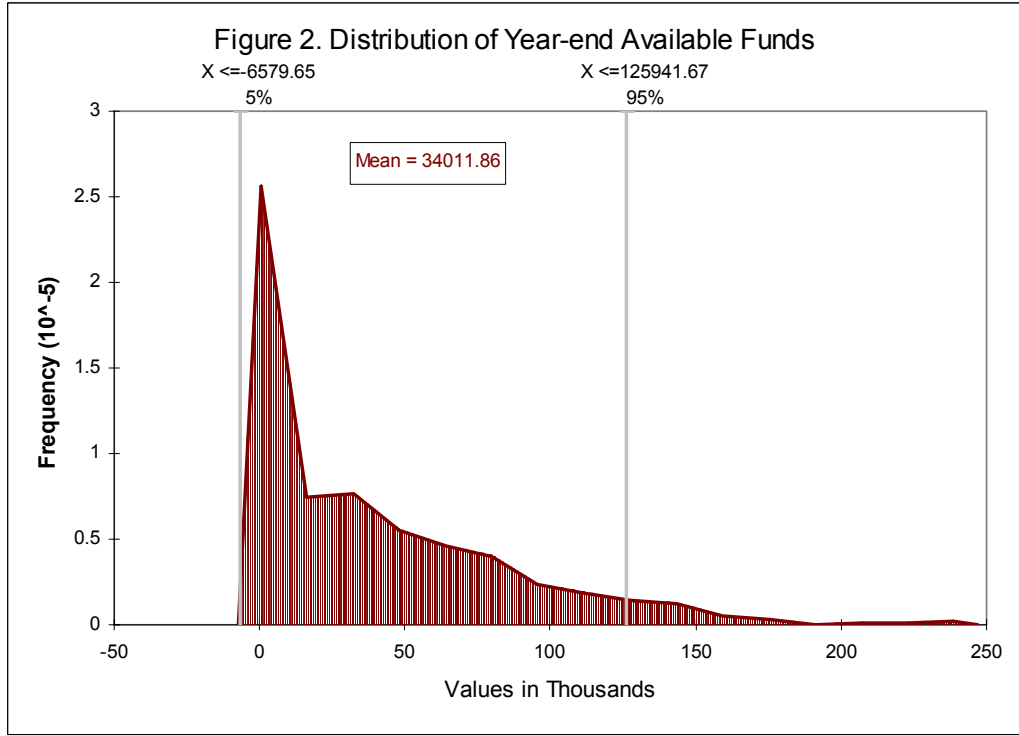


**Figure 1. Possible Year-end Outcomes**

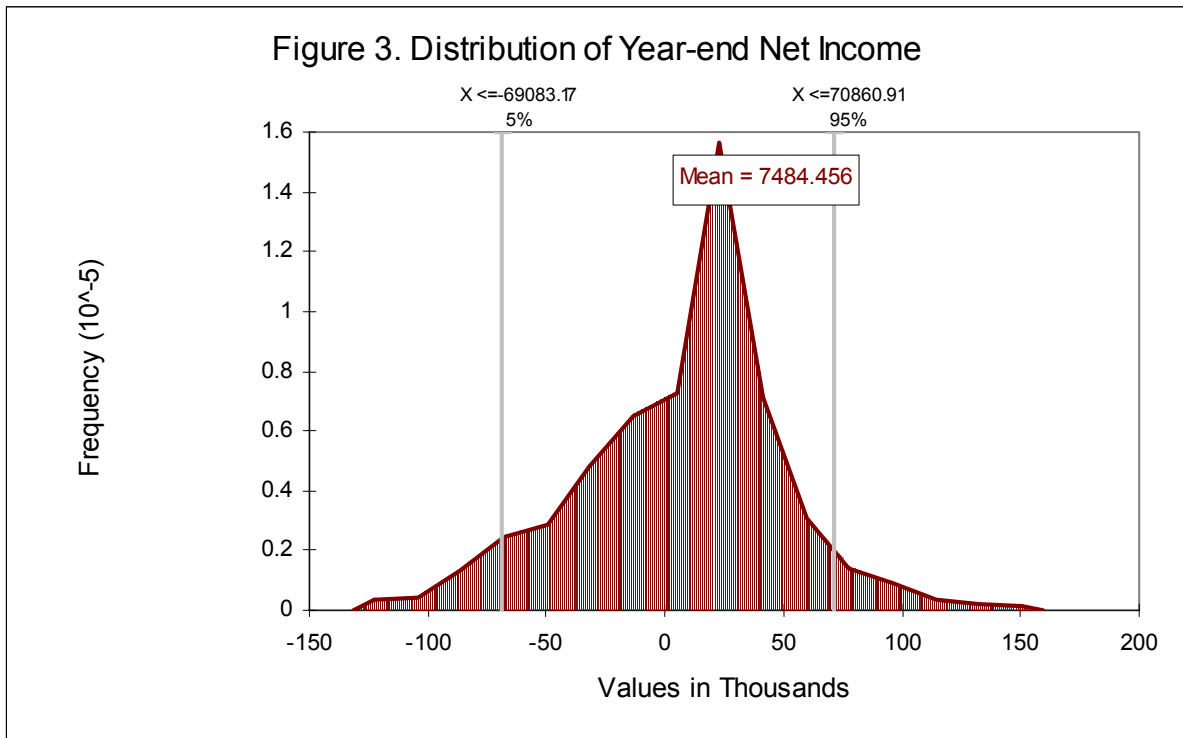




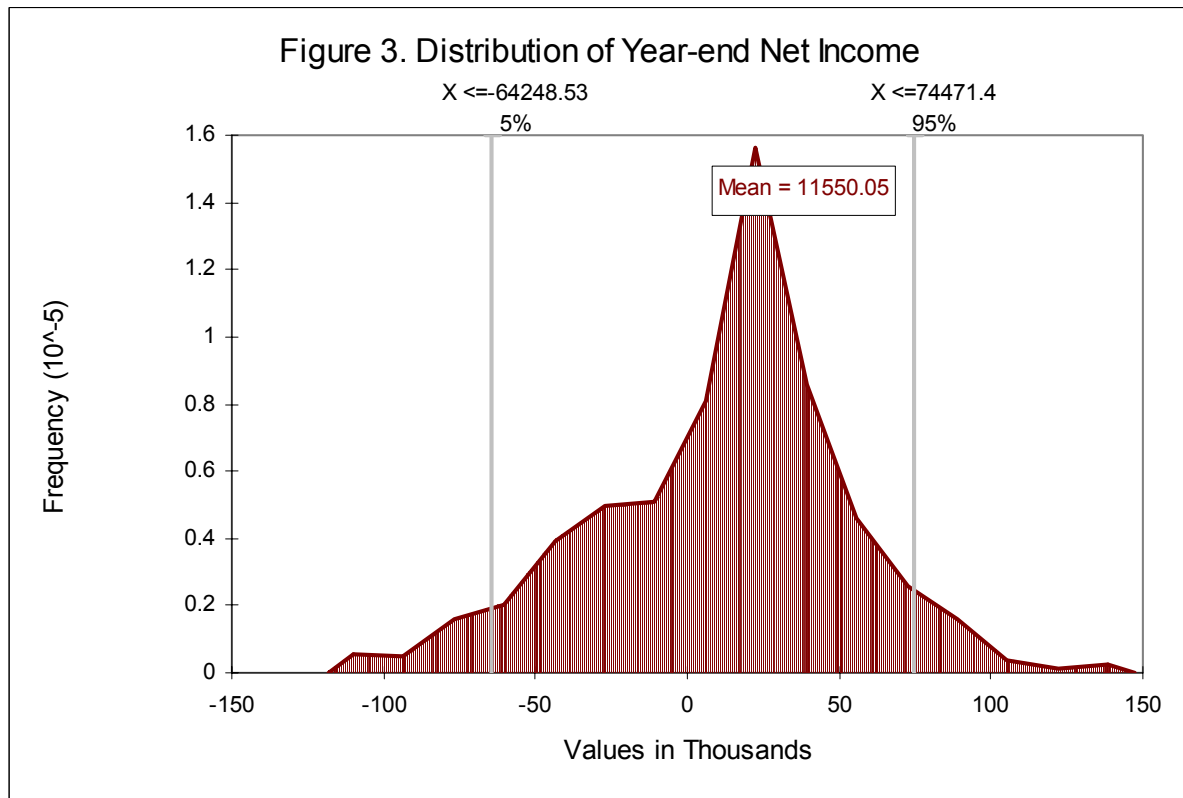
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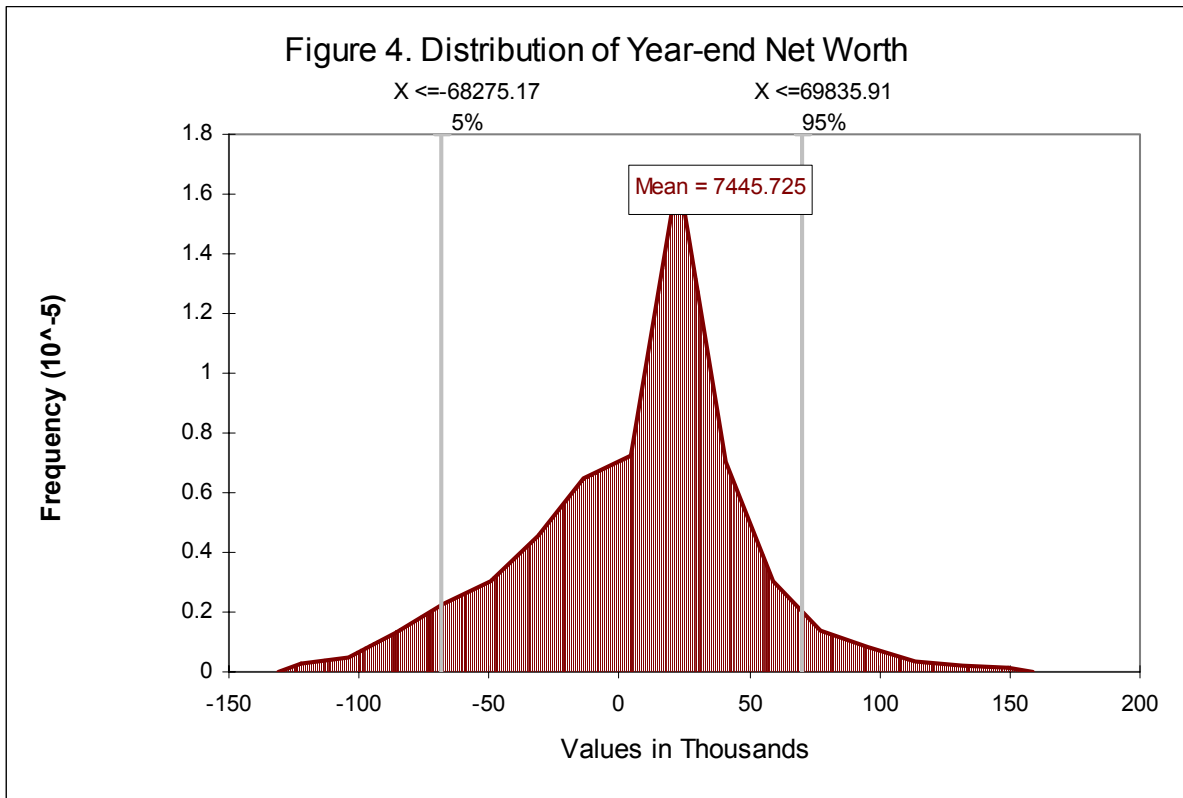
b) Inputs Purchased Wholesale



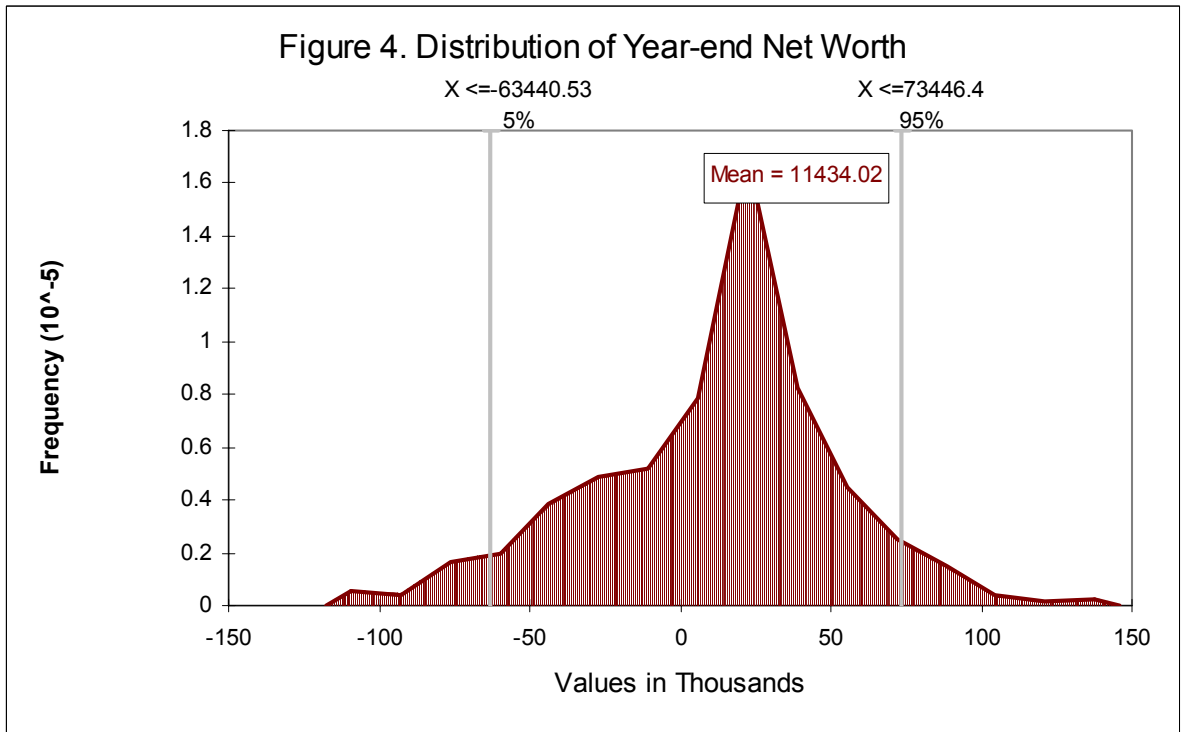
a) Inputs Purchased Locally



b) Inputs Purchased Wholesale



a) Inputs Purchased Locally



b) Inputs Purchased Wholesale