RISK MANAGEMENT FOR FARMERS

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Abstract

Risk is present in all decisions, though often its assessment is skewed to the negative effects. This paper presents material on the sources of risk in agriculture, procedures for managing two types of risks (operational and strategic) and the interaction of time and risk.

Keywords: procedures, sources of risk, strategic risk, operational risk, decision tools

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I. Risk – What Is It?

Everybody talks about it. Farmers and their lenders say it is increasing in agriculture. Lenders lose sleep over it. What is this phenomenon called risk?

Most lenders and farmers think about potential losses when they think about risk. These losses can be in various forms, but the common denominator in most cases is a significant financial loss or setback. This focus on the consequences of risk, and particularly the adverse consequences, is a little one-sided given the history of risk. Peter Bernstein, in his best-selling book, *Against the Gods, the Remarkable Story of Risk*, reminds us that the word "risk" was derived from the early Italian word *risicare*, which means "to dare." In this context the word risk implies an element of choice and is more action-oriented, which is as it should be. It is important to not lose sight of the potential reward associated with risk and daring to farm. And, it is helpful to avoid associating risk with fate or victimization. Risk may be unavoidable for business operators due to the very nature of engaging in business, which is a risk-taking activity; but it is imminently manageable.

One often hears managers or lenders say that a particular option involves more risk compared to other options or strategies. What does it mean when we say that one alternative has more risk than another does? There are three possible interpretations of this phrase. First, more risk might refer to a higher likelihood or probability of an adverse outcome, a hazard or peril, or a potential loss. Second, it might refer to the magnitude or size of the loss if it were to occur. Some future events might result in relatively modest losses, whereas other events could result in bankruptcy of the firm. Third, more risk might refer to the expected value of the potential loss. Expected value is the product of multiplying the chances or odds of the adverse outcome occurring times the magnitude or size of the loss resulting from the undesirable event summed over all expected outcomes.

Although these differences in interpretation may seem academic, they are very important in real-world measurement and management of risk. Unacceptable risk may result from an event that has a very low probability of occurrence but a large magnitude of loss. For example, a loss from a judgment in a tort liability case could be large enough to wipe out the entire capital base of a business. This would clearly be an unacceptable risk. Fortunately, it may also have a low probability of actually happening or may easily be worked around by appropriate management. Conversely, unacceptable risk may also result from a relatively modest size of loss that has a high probability of occurring or even a relatively small loss that keeps on recurring.

II. Sources of Risk in Agriculture

The risks that farmers face result from numerous sources of change or uncertainty. Some of these are related directly to the farm business and would not exist were it not for the farm. Others are related to our involvement in a farm business as individuals. These risks, such as the

risk of a heart attack, may exist even if we don't farm, but may have particularly important implications for risk management relative to the farm business. Others are related to the environments (natural, social, institutional) in which our farm business and we as human beings operate. In the discussion that follows, we will describe the various sources of risk and uncertainty, and will use the terms risk and uncertainty interchangeably in that discussion.

Production Risk

Production uncertainty in crop enterprises is caused by variations in weather and by disease, insects, and other biological pests. Livestock enterprises also involve production uncertainty. Death losses from disease and adverse weather conditions are common. Losses from contagious disease may strike an individual farm unusually hard. Losses from bad weather conditions at calving or lambing time also affect production.

Price Risk

Closely associated with weather and other natural hazards is the risk of price fluctuations. In the aggregate, low levels of grain production are generally associated with higher grain prices, resulting in a natural hedge; however, this generalization may not hold for the individual farmer. Price uncertainty has always been a major consideration in farming, and farm commodity prices have fluctuated dramatically in recent years.

With technological change, more of the inputs involved in production are purchased. Some production processes formerly performed on the farm have been transferred to the processor. The combined effect of such forces is that a high proportion of gross income is required to pay for purchased inputs. As a result, the farmer is particularly vulnerable to fluctuations in farm input and product prices.

Casualty Risk

Property losses due to fire, flood, windstorms, theft, etc., are sources of risk in any business. The magnitude of property losses in agriculture has been increasing steadily due to increases in asset values and because of technological advances that have led to larger investments in machinery and buildings. Casualty losses can generally be covered by insurance; however, income may still be reduced by the interruption of normal business activity that often follows a major loss.

Technological Risk

Another type of uncertainty arises from the constant development and adoption of new techniques or methods of production. Technological uncertainty is oftentimes viewed as a contributor to production risk, but is an important source of uncertainty in its own right. New crop varieties, chemicals, feed combinations, models of machines, and the like, are continually being introduced. While the potential benefits of these new developments may have been "proven" in experimental trials and on-farm demonstrations, the benefits actually realized will usually vary from farm to farm and under varying conditions on a given farm.

The rapidity of technological change can also contribute to uncertainty**.** A new method may be adopted, but a still better method may follow close behind, making the first investment

obsolete. The first GPS systems were soon made obsolete by improved models; the same was true of cotton pickers, combines, and corn pickers. In such cases a substantial portion of the value of a machine disappears as soon as the new model comes on the market. Remember when self-propelled combines replaced the tractor-pulled harvesters. This phenomenon is called technological obsolescence. It makes the question of when to buy into a particular technology just as important as what technology to buy. Early adopters of technological changes are the biggest beneficiaries of the new technology, but many new technologies don't pan out or are quickly replaced by newer and better technologies. In such cases, the early adopter may end up the proud owner of an expensive dinosaur.

A third type of uncertainty associated with technological change stems from the possibility of being left behind by not adopting new techniques and adjusting the business to make full use of them. GPS is in many ways a fledgling technology and we are still trying to figure out how to analyze all the data. It may be very tempting to wait to buy into this technology and let the early adopters work out the bugs and work on the data analysis problem. But, the question that in hindsight may turn out to be crucial is how will we make up for lost time, if this problem of how to analyze and use the data is ultimately solved? Can we recover data that is lost and gone forever, because it was not collected when it was available?

Uncertainty Caused by the Actions of Other People, Businesses, and Institutions

The course of action followed by firms, people, and agencies with which the farmer does business (or employs) causes uncertainty. If the farmer acquires part of his capital by renting, for example, the possible future action of the landlord increases uncertainty. The landlord may decide to increase the rent, rent to a relative, or sell the farm. Similarly, if the farmer obtains capital by borrowing, uncertainty may be caused by not knowing just what the lender will do. The actions of government agencies, legislative bodies, and court systems are also a major source of uncertainty for farmers.

Legal Uncertainty

Another type of uncertainty that results from interaction with other people and institutions is the possibility of lawsuits or administrative compliance or enforcement proceedings. Farmers are especially vulnerable to large legal liability claims, because their assets are highly visible. In the vernacular of the legal profession, many farmers are perceived to have "deep pockets." Administrative proceedings, such as an IRS audit, can lead to large unexpected costs. Laws and administrative rulings can be so complex and difficult to comply with that even the wisdom of Solomon is not enough to protect one from unpleasant surprises.

Personal Uncertainty – Sickness, Injury and Death

No one knows what the future health of family members will be, i.e., when a serious illness may occur or when family members who are important to the farm business operation might die. Medical and hospital expenses caused by a major illness may be substantial. When the farm operator is incapacitated, income suffers from loss of labor and management in the business; if death results, a prime asset of the business is lost. How does a farm business manage the risk of losing a "key" person?

III. What Are the Risks?

As implied by the earlier discussion, the risks faced by agriculture have often been classified into such categories as production, marketing, financial, legal and human risks. This taxonomy follows to a large extent directly from the sources of uncertainty that we just described. Useful references on risks, when categorized in this manner, can be found on the Federal Risk Management Agency's website and in the National Ag Risk Education Library. The addresses for these two Internet sites are, respectively: www.rma.usda.gov/ and www.agrisk.umn.edu. Publications on risk are also available from the USDA. Two that deserve consideration are: Introduction to Risk Management – Understanding Agricultural Risks: Production Marketing, Financial, Legal, and Human Resources (Risk Management Agency, December 1997) and Managing Risks in Farming: Concepts, Research, and Analysis (Economic Research Service, Agricultural Economic Report No. 774, March 1999). Publications on risk management are also available from Cooperative Extension Service county offices.

An alternative and possibly more useful taxonomy is to categorize risk as either operational risk or strategic risk. As agriculture becomes more industrialized, strategic risks are likely to become increasingly important, and, as we will contend, are typically more difficult to manage.

Operational Risks

The traditional risks associated with operating farm and agribusiness firms can be categorized as business risk and financial risk. Business risk is commonly defined as the inherent uncertainty in the financial performance of a firm independent of the way it is financed. Thus, business risk includes those sources that would be present with 100 percent equity financing. The major sources in any production period are price, cost, and production uncertainty; a number of factors may affect price, cost, and production variability over time.

Financial risk is defined as the added variability of net returns that results from the financial obligation associated with debt financing. This risk results primarily from the use of debt as reflected by leverage. Leverage multiplies the potential financial return or loss that will be generated with different levels of operating performance. Furthermore, there are other risks inherent in using debt. Uncertainty associated with the cost and availability of debt is reflected partly in interest rate fluctuations for loans and partly through non-price sources. Non-price sources, a type of institutional uncertainty, include differing loan limits, security requirements, and maturities, depending on the availability of loan funds over time. Thus, financial risk also includes uncertain interest rates and uncertain loan availability.

Strategic Risks

Most of the risk analysis in the agricultural sector has focused on the operational risks that are associated with production, costs, or debt use. Recently, however, strategic risk is receiving more emphasis. The focus of strategic risk is the sensitivity of the strategic direction and the ultimate value of a company to uncertainties in the business climate. These uncertainties include: 1) political, government policy, macro-economic, social and natural contingencies, and 2) industry dynamics involving input markets, product markets, and competitive and technological uncertainties. Several examples of strategic risks are summarized in Figure 1.

Operational risk is easier to manage than strategic risk. Operational risks are oftentimes one-dimensional and are generally associated with less ambiguity than strategic risks. This makes it easier to measure or quantify operational risks, which facilitates their transfer through the use, for example, of risk transfer techniques such as crop insurance and hedging.

Most strategic risks cannot be managed or transferred through conventional futures or insurance instruments or markets. Strategic risk is multidimensional, so managers cannot assume the simple one-to-one mapping between exposures and hedging or insurance instruments. Creative strategies must be developed to manage strategic risk exposure; approaches include flexibility, adaptability, and diversification. In essence, managing strategic risk requires the development of

Figure 1. Potential Strategic Risk Factors in Agriculture

Source	Hypothetical Examples
International	• Political unrest in another country or region leads to economic sanctions against importers of U.S. farm products • Instability in foreign financial markets reduces exports of U.S. farm products.
Government Policy	• A new administration enacts a Farm Bill that eliminates or drastically alters payments to agricultural producers. • The U.S. reduces its efforts to liberalize international trade.
Government Regulation	• Environmental regulatory agencies limit nitrogen use on farm fields. • NRCS prohibits a popular tillage or cropping practice in order to implement more stringent standards for maintaining crop residue.
Macro-Economics	• Comparative advantage for large-scale pork production shifts to areas outside the U.S. • Value of the dollar rises relative to other currencies.
Social	• U.S. citizens decide that a popular animal production practice is not humane. • Farming is perceived as the reason that water quality continues to decline.
Natural	• Continued loss of effective antibiotics for treatment of human disease sharply curtails the use of antibiotics in animal production. • Access to irrigation water is threatened by demands of fast growing cities.
Industrialization	• Changes in the way the pork production process is managed cause older production systems to become obsolete. • Contract production limits the access of independent producers to high value markets.
Technological Uncertainty	• Patenting of biotechnological breakthroughs and proprietary management of information limit the access of independent producers to the best information and technology. • The tools farmers need to evaluate the causes and effects associated with site specific farming databases are never developed.
Competitive Conditions	• Increasing influence of regional trading blocs, non-tariff trade barriers, and private trade initiatives put U.S. producers at a disadvantage in world markets. • Competition for farmland reduces the opportunity for share rental arrangements.

alternatives or contingency plans. And one of the better techniques for doing this planning is to do "what if" analysis (i.e., what is my best response if a particular event occurs?).

For illustrative purposes, think about one strategic risk that is increasingly important because of the industrialization occurring in agriculture, which is contractual or relationship risk. The expanding use of contractual agreements and other forms of negotiation-based linkages between the various stages within the agricultural production and distribution system results in traditional price risk being replaced by relationship or contractual risk for many businesses. A grower may have a contract that guarantees a price for the crop, but *what if* the processor goes bankrupt? *What if* the processor finds suppliers in other areas who can satisfy their needs at a lower price? *What if* I lose my contract?

Another strategic risk that seems to be increasing in recent years is that of regulatory risk. Farm firms are facing increasing regulation in all aspects of their business transactions. Added to the traditional areas of regulation concerned with transportation, taxation, and labor use are two rapidly growing regulatory areas: food safety and the environment. Strategic risk analyses would ask for example: *What if* the regulations change and my waste handling and disposal system no longer is in compliance with the new regulations? Developing a contingency plan for these risks will be increasingly important for the long-run survivability of many farm businesses.

The Universe of Risk

When viewed from the broader perspective of both strategic and operational risks, the total risk that farm and agribusiness firms face is much more complex and more pervasive than is often perceived. In fact, as the agricultural sector increasingly exhibits the characteristics of an industrial model, the types of risks it will face will also change. A taxonomy of the broader dimensions of risk that farm and agribusiness firms will be facing in the future is presented in Figure 2. From both an analytical and managerial perspective, a major challenge in the future will be to quantify both the frequency and probability of occurrence and the magnitude of exposure from each of these potential sources of risk.

Figure 2. The Universe of Risk: Taxonomy of Risks Facing Firms and Agribusinesses

Categories of Risk	Illustrative Sources of Risk
Financing and financial structure	Debt servicing capacity, leverage, debt structure, non-equity financing, liquidity, solvency, profitability
Market prices and terms of trade	Product price volatility, input price volatility, cost structure, contract terms, market outlets and access
Business partners and partnerships	Interdependency, confidentiality, cultural conflict, contractual risks
Competitors and competition	Market share, pricing wars, industrial espionage, antitrust allegations
Customers and customer relations	Product liability, credit risk, poor market timing, inadequate customer support
Distribution systems and channels	Transportation, service availability, cost, dependence on distributors
People and human resources	Employees, independent contractors, training, staffing adequacy
Political factors	Civil unrest, war, terrorism, enforcement of intellectual property rights, change in leadership that revises economic policies
Regulatory and legislative factors	Export licensing, jurisdiction, reporting and compliance, environmental
Reputation and image	Corporate image, brands, reputations of key employees
Strategic position and flexibility	Mergers and acquisitions, joint ventures and alliances, resource allocation and planning, organizational agility
Technological factors	Complexity, obsolescence, the year-2000 problem, workforce skill-sets
Financial markets and instruments	Foreign exchange, portfolio, cash, interest rate
Operations and business practices	Facilities, contractual risks, natural hazards, internal processes and controls

Source: Adapted from Teach, "Microsoft's Universe of Risk," *CFO*, March 1997.

IV. General Procedures for Managing Operational and Strategic Risk

Economic theory suggests a tradeoff between risk and returns, i.e. people who accept higher risk should expect higher returns assuming there are no other alternatives with equal returns less risky. Selecting the appropriate risk-return tradeoff is a critical management decision. Those who are particularly adverse to risk will desire alternatives where little risk is incurred and/or the reward (return) is very high relative to the amount of risk taken. Those who are less risk adverse will be willing to accept risk without expecting as big a payoff in return and will likely consider alternatives that more risk adverse managers may consider totally unacceptable from the perspective of risk-reward tradeoff.

Managers have a variety of mechanisms for managing risk. The best method(s) of managing risk depends upon the nature of the risk involved. Four general procedures for managing risk are: (1) avoidance, (2) reduction, (3) assumption/retention, and (4) transfer. A discussion of each follows.

Avoidance

Avoidance is the process of structuring the business so that certain types of risk are nonexistent. For example in swine production, there are considerable risks associated with farrowing operations including disease, low conception rates, death loss of newborn pigs, and others. The farrow-to-finish hog producer can not avoid these risks, although producers buying feeder pigs and finishing them out could avoid such risks. The problem for the producer buying feeder pigs in the past was that it introduced the risks associated with buying feeder pigs from various sources. The quality of the pigs was highly variable, genetics were mixed, and disease may have been a problem. Swine finish operations producing in an integrated system can largely avoid these risks, although other sources of risk may result and returns may be altered.

Reduction

Reduction is the process of lowering the risks associated with the business venture. Consider the following example from the crop production side. A grain producer can hire crop scouts to spot disease, nutritional imbalances, and pest control problems. This helps reduce the risk of poor yields, but the risk is not eliminated completely. In an industrialized form of agriculture, there are often good opportunities for producers to reduce these risks. Contractors for grain and livestock production may, for example, supply experts who help the producer reduce production risks through timely advice. Again, this reduction of risk may result in implicit or explicit reductions in net returns.

Another common way for producers to reduce risk is to diversify across different enterprises. For example, traditional independent swine producers are often diversified across crop and livestock enterprises. For industrialized agriculture, risk reduction through enterprise diversification is seldom a driving force. Rather, industrialized agriculture often involves specialized production as a means of achieving economies of size in one particular enterprise.

Assumption/Retention

Assumption/retention is the process of retaining or accepting risks with the objective that assuming this increased risk is to maintain control and/or enhance overall profitability. Assumption may occur simply because we cannot transfer it, rather than accepting in willingly. However, by accepting/retaining it we do assess and catalogue it. Integrators in both crop and livestock production may retain ownership of products being produced under contract. Consider for example, an integrator who contracts with growers to finish hogs. The grower is often responsible for providing the grow-out facilities, for a fixed or minimum guaranteed fee, while the contractor retains ownership of the market hogs. Since the grow-out facilities are not recorded on the balance sheet of the contractor, traditional measures of financial leverage (such as the debt/asset ratio) may not reveal the risks associated with this arrangement. Because the contractor retains ownership of the animals and has a signed contract with the grower, one can think of this arrangement as a pseudo guarantee by the contractor for the loan taken out by the grower. The integrator is retaining more risk with the expectation of enhanced profits.

Transfer

Transfers of risk occur when one party lowers their risk by shifting that risk to someone else, often for fee. There are numerous methods in agricultural production to shift risks in this

manner. Common examples include futures and options contracts, crop insurance, and fire and hail insurance. These transfers are accomplished with a known cost, i.e. the cost of insurance, options contracts or the like.

Risk transfer can also occur in situations in which the "cost" of the transfer is more disguised or vague. For example, grain farmers can transfer price risk through forward contracts. Likewise, a contract producer of vegetables may be able to transfer price risk to the contractor. The monetary and non-monetary costs of such risk transfer are often in the form of lost opportunities (the unexpected price rise) and are less clear.

Industrialized agriculture tends to alter the mechanisms for managing risk. Producers who operate under contract may have better opportunities for yield and price risk avoidance, reduction, and transfer than do traditional independent producers. However, these opportunities may be offset by increases in less traditional risks such as relationship risks and strategic risks. Integrators, on the other hand, have opportunities to assume more risk in the new industrialized forms of agriculture. Of course, higher returns are expected for accepting such risks.

General Procedures Are Applicable to Both Operational and Strategic Risks

The distinction made earlier between operating risks and strategic risks and their management in no way diminishes the usefulness of these generalized procedures of managing risk. These four general procedures for managing risk are equally applicable to both strategic and operating risks.

For example, it might at first appear incongruous to even think in terms of assuming/retaining a strategic risk. But, in fact, embracing strategic risk may be not only necessary, but absolutely essential for a firm to survive and prosper. It is the nature of competitive industries that firms constantly seek opportunities to redefine themselves and are quite willing to assume the strategic risks inherent in such changes in direction. Remember the classic example of buggy whip manufacturers. How many of those buggy whip firms that failed to adopt a new strategic direction and embrace it survived? Likewise, avoidance, reduction, and transfer strategies will be no less important in the realm of strategic risk management than in the realm of operational risk management. They may be harder to accomplish, and may look a lot different in terms of the specifics of how they are accomplished; but they will be no less important.

Because of the multidimensional nature of many strategic risks, managers should expect that all four of the general risk management procedures might end up playing a role in any particular risk situation. Risks in business are interdependent; the managers should expect that a change in a single risk management procedure might have a ripple effect with impacts on the effectiveness of other procedures – either increasing or reducing their effectiveness. Risk in business involves dynamic interrelationships between strategic and operational consequences, as an example described earlier in this document illustrated, where traditional price risk declined in response to production contracts and relationship risk increased in response to the same change in the way of doing business. The example in the accompanying textbox of the risk management implications of investing in irrigation provides additional illustration of both the multiple dimensions of strategic risks and the dynamic interrelationships between strategic and

operational risks and the actions taken to manage those risks. In such a dynamic environment, it may be extremely difficult to define and distinguish the role and relative contribution of each of our four general procedures for managing risk. It is much easier to think in terms of specific strategies for managing either operational or strategic risks, which is where we will focus our attention next.

The Dynamic Relationship Between Operational and Strategic Risks: An Example

Irrigation has been a popular means of reducing production variability in many areas of the U.S. It might properly be classified as a specific production strategy for reducing operational risk. Irrigation certainly has the potential to reduce production uncertainty. However, it also generally involves substantial investment, which may increase financial risk, another operational risk. From strictly an operational risk management perspective, the question of whether the irrigation will do more than substitute one operational risk for another deserves consideration. But, the investment may also totally redefine the potential set of strategic directions available to the farm firm. For example, the superb non-irrigated producer who couldn't find any company that would offer him/her a seed corn contract may be besieged by calls from specialty crop contractors of all types once the center pivot is installed.

So now we not only have to consider competing operational risks, but also how the firm's new opportunities might change the product focus of the farm. That, in turn, will impact on our operational risks. Notice that the investment in irrigation in our example will do little if anything to decrease the farm's strategic risk. Arguably, it increases the strategic risk in our example. What if, for example, the irrigation well ran dry every time it was pumped for more than three days straight during the first year of using the irrigation system? One could argue that a strategic risk has been substituted for an operational risk with potentially disastrous results. Unfortunately, one of the nasty characteristics of strategic risks is their tendency to blindside managers. Notice that managing this strategic risk will require specific strategies that have nothing to do with the irrigation investment made with the intent of managing an operational risk.

Similarly, it may be far too easy to classify irrigation as a production strategy for reducing operating risk. Is there potentially a strategic dimension to the investment in irrigation in terms of its impact on production and production variability? Absolutely. To illustrate, let us think about which of the following scenarios might involve strategic risk?

A. The irrigation system has been used an average of one time per season in each of the first three years. Average yields have been slightly higher, and average yield variability has been slightly lower. Net income has been slightly lower, but more stable. Original expectations were that the irrigation would only produce significantly higher yields in one of eight years.
B. The irrigation system led to unexpected disease and pest problems, lower production, significantly increased costs, and lower yield variability around the mean yield. This situation is now expected to recur every year except severe drought years.

Alternative A reduced production uncertainty, but at the price of modestly lower profitability. This would be appear to be the desired result of an "irrigation as insurance strategy", and will probably work well as long as the annual cost of the irrigation isn't too high. The farm's change in direction in favor of relying more on irrigation has very likely worked out exactly as planned given the results to date, and strategic risks are not a concern at this point. Alternative B reduced production variability and thus production uncertainty. But, the likelihood of lower yields and significantly higher costs on a continuing basis may subject the farm firm to strategic risk even though yield variability, an operational risk, has been reduced. The problem here is that the irrigation is undoubtedly performing at a level that, had it been anticipated when the investment decision was being made, would have eliminated the irrigation project before the investment was made. The irrigation well failure described earlier obviously had strategic implications hard to ignore. Some action would almost certainly be taken to try to reduce or eliminate the strategic risk involved. Unfortunately, the strategic risk posed by Alternative B is much more likely to be tolerated, rather than corrected, which may end up being just as disastrous over the long haul.

V. Strategies for Managing Operational Risks

Obviously, risk and uncertainty cannot be totally eliminated. In fact, doing so could result in elimination of the chance for a profit, since by definition one of the components of profit is a reward for risk-taking. However, some risks can be reduced, and there are several strategies for improving one's ability to withstand adverse business conditions. Our discussion in this section on strategies for managing operational risks will be relatively brief since a number of other sources of information on these strategies are available on the Internet and in publication form.

This and the following section of this document describe several specific risk management strategies. Look closely, as you read through these specific strategies to see if you recognize any of the general risk management procedures (avoidance, reduction, assumption/retention and transfer) described earlier at work in these specific strategies.

Financial Strategies

One way of reducing the consequences of adversity is to carry adequate reserves. Most people carry some reserves of cash or savings for a "rainy day". Farmers can carry other resources in reserve besides cash and savings — most livestock farmers hold carryover feed supplies to protect them against low crop yields and/or high prices for purchased feeds. Some farmers have excess machinery capacity to protect against crop losses in unusually wet planting and harvesting seasons.

Another way of using finance for risk management is the ability and willingness to adjust investment and withdrawal decisions. Adjusting the timing of capital purchases to the financial condition of the business is one strategy. If the farm business encounters periods of low income or losses, the manager may delay a planned expansion or the scheduled replacement of

machinery and equipment. Alternatively, a producer might reduce family withdrawals or even sell noncritical or underused business assets to meet financial obligations.

Finally, properly structured debt and detailed financial planning can be used to protect against risk and uncertainty. Maintaining an appropriate balance between short-term, intermediate-term and long-term debts will help to insure that cash inflows are adequate to cover financial commitments even when yields and/or prices fall below normal.

Marketing Strategies

Many producers use strategies such as hedging, options, and forward contracting to protect themselves against price changes. Hedging on the futures market allows farmers to establish now the prices of products they intend to buy or sell on some future date. While hedging reduces the chances of lower prices, it also eliminates any chance to gain from an increase in market prices or a decline in input prices. Commodity options offer sellers and buyers an opportunity to insure against adverse price movements without eliminating the possible gains from favorable price movements.

Forward contracting is another method of locking in prices. For many farmers forwarding contracting has some important advantages over hedging or options, because problems such as an unstable basis, margin calls, premiums, or the minimum size of the contract are eliminated. However, forward contracts are less flexible, because delivery of the crop is generally the only means to fulfill them, while a hedge can be lifted at any time.

Production Strategies

In addition to financial and marketing strategies, production strategies such as diversification, geographic dispersion, variety selection, timeliness, drainage, the use of cultural practices best suited to particular areas, etc. are important ways to manage risk. Diversification has been one of the more common methods used to reduce risk and uncertainty. By having more than one enterprise in the farm business, the chance of a large loss from a given hazard is reduced. But for diversification to be most effective, enterprises included in the business should not be subject to the same hazards — or at least not to the same degree. Possibilities for risk reduction exist only if the returns from alternative individual investments or enterprises are affected by different forces or are basically more stable than those already in the business. Furthermore, diversification may also incur significant costs in the form of reduced efficiencies and scale economies that are foregone, when resources are diverted from a core business or a specialized operation to a new and very different business venture. Various hybrid forward contracts such as hedge-to-arrive contracts, basis contracts and minimum pricing contracts can allow more pricing flexibility. However, this flexibility may be accompanied with increased risk.

Insurance

A common method used to reduce the financial consequences of adverse events is to buy insurance. The fundamental principle of insurance is to pay a premium for someone else to take the risk. Insurance programs are commonly used to manage health and medical risk, casualty risk, accident risk, liability risk, weather risk, etc. For most major commodity crops such as corn, soybeans and wheat, crop insurance is available to reduce the risk exposures due to price and

yield variability. The number of alternative crop insurance programs has expanded rapidly in recent years, and in many cases some form of crop insurance is a very cost-effective method of protecting the business from production or price risk in crop production. It is important to evaluate the full range of products that are available, because no one product works the best for all producers.

VI. How to Manage Strategic Risks

As we have noted earlier, strategic risks are typically less predictable, and may not even be very likely, but the consequences can be catastrophic. Furthermore, strategic risks are typically difficult to manage by transferring them to others by purchasing insurance, use of futures markets or similar techniques. Consequently, managing strategic risks requires more creative strategies.

Given the multidimensional nature of strategic risks, many of the specific management strategies involve using farm planning, decision making, implementation, and control processes. Strategic risk is ever-present when the direction of the business is not sensitive to the realities of the marketplace, competitive conditions, and the farmers own wants and needs. Positioning is a planning process that involves establishing direction for the farm firm. How change is implemented on the farm can significantly impact the exposure to strategic risk. Implementation strategies therefore represent another way to manage strategic risk. If strategic risks are assumed/retained by the farm manager, then processes to monitor and control the risk must be adopted. Strategic risks are too important to ignore once they are assumed.

Recognize that the following discussion of specific strategies for managing strategic risks is not intended to be exhaustively comprehensive. One could argue that the farming industry is just starting an era that will make the term “strategic risk” as familiar as the terms “crop insurance” or “futures contract.” With that in mind, farmers are just beginning to explore and understand the specific ways that strategic risks can be reduced, avoided, assumed, or transferred.

Positioning for Flexibility

Strategic risk management requires the capability to be flexible. Flexibility is the managerial/organizational capacity to change in response to changing circumstances. To be flexible a firm must have the resources and skills to successfully change strategies regarding key strategic business choices, such as business enterprise focus, financial/organizational structure, marketing and channel linkages, growth/downsizing, etc.

Flexibility has some advantages over diversification in contributing to stability and dependability of income. As time passes and added information is obtained, a flexible business can be adjusted to meet new circumstances, whereas a diversified but inflexible one allows little room for change. Flexibility can be increased in many ways. For example, flexibility can be increased with a total cost structure that favors variable rather than fixed costs. Other examples include investing in fixed assets that are less specialized, and can be used in more than one way or can be easily re-marketed, and participating in enterprises that have a shorter time to market such as poultry and pork.

Strategic risk management also requires adaptability. Adaptability is a behavioral characteristic that requires the willingness to change and the ability to change when change is needed. Flexibility and adaptability are pervasive concepts in the context of the management processes required to effectively manage strategic risks. That is, flexibility and adaptability are required no matter what specific approach or technique we are talking about. It is not likely that any of the following strategies and techniques will be entirely successful if these organizational/behavioral characteristics are inadequate or could be put on hold.

Positioning for flexibility starts with planning and decision making processes. Some people mistakenly believe that planning actually impedes flexibility (even when it enhances adaptability). Presumably, this mistaken belief stems from the idea that the purpose of the strategic planning is to prepare and implement a strategic plan, as in one forever immutable plan. Ironically, just the opposite result is more likely. That is, the process of establishing strategic direction doesn't lock management into one way to move in that direction. The consideration of strategic fit, firm competencies, opportunities and threats, etc., tends to increase the firm's capability to recognize when strategic adjustments are necessary. The evaluation of alternative ways to implement firm strategy gives farm managers a better idea of what adjustments are likely to be most effective, if needed. Finally, establishing direction and aligning particular strategies and tactics with that direction need not be an infrequent periodic event in the life of a farm firm. Strategic positioning is much more effective if it becomes an on-going process.

Positioning to Avoid

A common strategy to manage strategic risk is to avoid it completely. Choosing activities or business practices that are not characterized by the specific strategic risk can do this. For example, the strategic risk of being terminated as a contract grower or qualified supplier for a particular packer or processor (a relationship risk) can be avoided by choosing to not enter into contract production. The strategic risk of an environmental spill from a lagoon can be avoided by using alternative waste disposal technologies that don't rely on a lagoon. The risk associated the potential disappearance of niche markets can be avoided by concentrating on commodity products where demand may be more stable. Avoiding the strategic risk completely by choosing various technologies, different enterprises, or alternative ways of doing business is a common way of managing strategic risk.

Positioning to Absorb

A second technique to manage strategic risk is to position the business so that it can absorb the uncertain events without having a catastrophic impact. For example, the financial structure of the business might include less debt or more liquidity so that highly unlikely events such as a business interruption or facility shutdown due to an environmental spill do not destroy the business. The catastrophic consequences of a major hailstorm or a hurricane might be managed through geographic dispersion of the farming enterprises over a wider set of locales including multiple counties or even multiple states. Similar examples of strategies that allow the business to absorb the risk without suffering catastrophic consequences could be identified.

Contingency Planning

Developing contingency plans for different possible events or business scenarios is one way to

position for flexibility. For example, a strategic risk might be that consumers or processors decide that they no longer want to purchase some products such as grain produced with GMO inputs or pork produced with some feed additives. One way to manage this risk is to develop contingency plans including the identification of alternative market outlets for these products if they are produced. Contingency plans and possibly even formalized adjustments in the rental contract might be part of the bidding strategy in renting farmland to respond to the risk of changes in government policy. For example, the rental payment might be adjusted as a function of government payments, or a clause might be included in the rental agreement that allows renegotiation of the rental arrangement if government programs are changed during the rental period. Backup strategies might be part of the planning to allow adjustments if a leased piece of property is lost to another operator; this contingency plan might include an element of flexibility whereby part of the machinery and equipment line is obtained on a short-term operating lease or the services acquired from a custom operator so that there is flexibility in adjusting machinery cost if a parcel of land is lost in a cash rent bidding contest. In an environment of important and costly strategic risks, backup strategies and contingency plans are essential to reduce the consequences of these important risks and protect the survivability and longevity of the farm business.

Implementing Flexibility

Flexibility might be implemented in the form of acquiring production facilities or technology that can be readily adapted to different products — for example machinery that can be used with minor modifications to harvest or plant different crops, or storage facilities that can be easily converted from storing machinery to storing grain. Flexibility might be achieved through the strategy used to manage relationship and contract risk. Rather than having a long-term contract with a packer or producer, the contract terms might be shorter so that you can make changes if the relationship is not profitable or does not provide a satisfactory financial return. Renting land on an annual crop share lease arrangement provides more flexibility than buying land; obtaining extra harvesting capacity by hiring a custom operator or negotiating an operating lease on a combine provides more flexibility than buying that excess capacity in the form of an extra combine or a larger machine.

Flexibility is commonly built into strategies for managing strategic risk. Flexibility may come at a cost. Flexible buildings and facilities are typically not as efficient as specialized facilities, and maintaining flexibility may not allow you to capture some of the benefits of more specialized and committed production systems, technologies or ways of doing business. Rewards must be sacrificed to reduce risk, and flexibility that reduces risks can be expected to reduce rewards.

The Decision and Risk Analysis Model (D&RA)

The D&RA model is based on the premise that businesses have a tendency to rush to judgement when deciding on a strategy and then focus their efforts on justifying that strategy. Research on how business managers make decisions supports this idea. Because managers are very action oriented, taking too little time to develop alternative strategies and making too little effort to make an unbiased evaluation of all alternatives is a very common problem. Oftentimes the manager looks at other businesses he or she admires and latches onto the first good idea that appears to be working for those firms without carefully evaluating all of the different factors and

forces that will determine successful application of the idea on their farm. Again, the multidimensional nature of strategic risks suggests that this approach is going to lead to more problems than it solves. D&RA facilitates avoiding the strategic risks associated with premature and ultimately bad decisions. D&RA emphasizes the importance of carefully framing the problem faced by the firm, developing a logical and balanced analysis of competing alternatives, and connecting the decision to existing operations. The steps in completing D&RA will be discussed in detail in the next section.

Implementing Change Incrementally

Another strategy for managing strategic risk is to make incremental changes and adopt new technologies or ways of doing business in a sequential manner — to experiment and learn before you have to fully commit. Most major changes made in a farming operation can be time-sequenced so that experience and information is obtained before the full commitment is made. In the industrial sector, it is not uncommon to build a "pilot plant" before the full scale plant is constructed; in corn production producers will typically plant a new hybrid on only part of their acreage to obtain practical personal experience before they make further commitments to this hybrid. The same is true when introducing specialty crop production into a farming business — rarely is the entire acreage converted to the new crop, but instead a few acres are committed. If the experiment is successful, the acreage is expanded.

This concept of incremental change combined with "learning by doing" and managing the delay or time in making major changes in the strategic direction of the business is a logical process for managing strategic risk. Note that we are not talking about procrastination — strategic delays involve concrete learning and information gathering processes with "trigger points" that will precipitate a decision to move ahead or to change direction. This is quite different than the "let's wait and see what happens" procrastination approach for managing strategic risk.

Intervention

Intervention is an important management strategy for re-establishing or altering strategic direction. Managers intervene by first comparing current performance to benchmarks, standards, or expectations that point out the need for improvement, then offering ways to improve. Intervention is very much about communicating reasons for changes in the day-to-day management of the farm. Intervention is intended to get everyone to pull together to accomplish the firm's objectives. As such, it isn't necessarily directed only at firm employees. Other family members, service/product suppliers, and even customers may be on the receiving end of the managers intervention tactics. Intervention is an important technique for developing a culture where everybody understands what the firm is about and where it is headed. The alternative is for everyone to be in the dark except the farm owner-operator. In that environment, people are going to be most comfortable doing what they have done in the past, and needed changes are less likely to happen.

Control Strategies

Control requires the systematic comparison of actual results to planned results. The potential for exposure to strategic risk cannot be entirely avoided by planning and decision-making or even incremental implementation. Too often the best-laid plans produce results that

fall short of expectation. The only way to manage that risk is to clearly define expectations before a project is implemented in terms of the factors that will be critical to project success, to monitor progress in relation to those expectations, and to make adjustments when expectations are not being met. This is an on-going process.

A key element in this process is establishing what constitutes a strategic shortfall relative to expectations. For example, if the timetable for putting in the new livestock facility calls for completion in eight months, will a one-month delay place the project in jeopardy? Once in full production, will a one full-turn shortfall in facility use each year jeopardize performance to the point that major adjustments must be considered? Is the throughput associated with full-turns of groups of animals through the facility a factor critical to the success of the project long-term. From a strategic standpoint, it is very important to remember that a one-time large divergence from planned results may be an aberration or at least not strategically significant unless it is repeated. On the other hand, persistent divergences from planned results may constitute strategically unacceptable results. It will be impossible to recognize shortfalls in situations where planning was inadequate to identify the critical success factors and to establish minimum acceptable performance levels. Obviously, the management information systems needed to monitor critical success factors are a prerequisite for achieving strategic risk management through control processes.

As farmers begin to see their farms as a biological manufacturing plant, they should be able to take advantage of operations analysis and process control techniques for enhancing strategic risk management. At first glance production process monitoring and control might appear to be a topic better suited to the earlier discussion of operational risks. But clearly, persistent production problems can have strategically important consequences for farm firms. The strategic problem from a control perspective is how to sort out information that indicates a real problem from the normal variation inherent in manufacturing processes. In particular, statistical process control, which is discussed in more detail later in this document, appears to have a lot of potential for distinguishing between variability in production processes that is outside the norm and thus potentially responsive to management intervention. The normal variability that is inherent in production processes may not be very manageable, short of altering the process, even if it has strategic implications.

Risk Assessment

One question that arises in regard to control strategies for managing strategic risk is do our monitoring and control systems cover all the bases? Successful business management involves management of products, processes, and people. Strategic risks can arise directly from the fact that performance measurement is too narrowly focused and therefore overlooks critical concerns relative to the management of products, processes, and people. The balanced scorecard approach to measuring business performance is “balanced” in the sense that it explicitly pushes the manager to think in broader terms when defining what needs to be measured. Where the firm may have focused entirely on financial performance measures, the balanced scorecard approach adds people and process performance measures. Some of these may be very operational in their perspective and focus on customers, processes, and organizational issues. But, there is usually a distinctly strategic feel to balanced scorecards, as reflected in measures that are intended to ensure that the farm firm will achieve its vision by moving in the desired strategic direction.

Strategic measures are oftentimes easily recognized because they deal with the competitive strengths and weaknesses of the business or they focus on opportunities and threats facing the business. The balanced scorecard approach to monitoring and measuring business performance and assessing strategic, as well as operational risk, will be discussed in more detail in the next section.

Exit Strategies

And finally a critical and essential strategy for managing strategic risk is to identify both exit strategies and the trigger points that will activate exit decisions. Exiting is frequently overlooked as a legitimate business strategy because it may be misinterpreted as being related to failure. But smart exiting strategies may be as important as entry and growth strategies in risky environments where losses may compound or markets disappear.

Note that we are not necessarily talking here about "quitting farming." One form of strategic exit involves discontinuing particular business operations (for example, shutting down a farrow-finish business or transitioning from the production of one specialty crop such as high-oil corn to an alternative crop such as white corn). This exit involves recognizing that the activity in question is no longer a strategic fit or may be tying up resources that could be put to better use in another way. The basic characteristic of this exit strategy is that the larger business continues and hopefully is better off.

Another type of exit that may become more common in farming in the future involves "going public." Going public means selling ownership interests in the farm business to unrelated parties. This oftentimes involves a dilution of one's ownership interest in the business and possibly a reduced role in firm management. Large commercial farms will likely have strong incentives in the future to look at a wider range of alternatives for structuring farm business ownership and management arrangements. These arrangements shouldn't be limited to the "closely held" business model that has been predominant in agriculture in the past. The advantages of alternative arrangements may be decidedly strategic. For example, the involvement of others in management may reduce the key person risk that is a major strategic concern for some closely held businesses including farms. "Going public" could be an important exit strategy in the future for some farmers, and it may be an even more important growth strategy for other farmers.

Exit strategies can take a number of different forms. For many farm businesses inter-generational transfers of property ownership and management control, and ultimately retirement, have enormous strategic implications. During the mid-1980's land and other farm asset values dropped markedly. Some farmers recognized and took advantage of the strategic opportunity this period provided to lock in these low values for future estate tax purposes by making lifetime gifts of property interests. Most of these farmers continued to farm for several more years before retiring. Timing is a critically important factor in determining the value of farm assets. Managing the timing of when estate tax value is established (in this case at the time of the gift) can have far-reaching consequences for the farmer, farming heirs, and non-farming heirs.

More recently, farmers who plan to sell farm assets in order to fund their retirement have been faced with the problem of establishing the "trigger point" for selling out particular assets.

Some farm asset values are currently very much at risk from the general weakness of the farm economy and fears that the weakness may be prolonged. A sale and leaseback, for example, is one alternative that might be used by some farmers to reduce the risk of continuing to farm until they reach normal retirement age.

Developing exit strategies involves thinking about the techniques that will be used to exit a business or a particular business operation and what events will trigger that exit decision. Thinking strategically about exit techniques and timing allows the farm manager to make more rational and reasoned choices concerning business continuation and business termination. Quitting or exiting is always a difficult decision, even when the farm as a whole will continue; but, it is nonetheless a critical consideration in managing strategic risk.

VII. Time and Risk

Time Delays, Learning and Information

In a decision environment characterized by risk or uncertainty, time can be a virtue – time can have real value. One effective way to manage time in a risky environment is to use time delays to gather additional information. This information might be in any one of the following four forms;

1. Additional information about odds or chances (more formally the probability distribution) concerning the risky events that might occur, thus giving the decision maker more confidence in the original estimates of the probability distribution;
2. Changes in the environment surrounding the decision problem which alters the original probability distribution with some events becoming more likely and other events less likely;
3. Changes in the accuracy of estimating the payoffs or consequences so that a more accurate decision problem and payoff matrix is used in the final analysis, and
4. Changes in the environment which actually alter the results or consequences of various decisions and thus increase or decrease the actual payoffs used in the analysis.

These four potential types of new information that might be obtained during a time delay are identified because they will impact the optimal allocation of information gathering and search activities during the delay period. For example, resources and energy might be allocated during the delay to obtain more accurate estimates of the probability distributions associated with an uncertain event. Or they might be allocated to monitor the environment to determine if business and economic conditions have changed sufficiently that some events that were highly unlikely before might now be more likely. For example, rainfall patterns in South American have evolved such that the probability of a drought has been significantly reduced compared to earlier forecasts. Alternatively, the manager's resources during the time delay might be allocated to getting more accurate cost estimates or yield information, so that he or she has more confidence in the payoff estimates. Or an event might occur during the delay, such as a change in government policy or regulation, such that the previous estimates of payoffs are now inaccurate and must be modified to more accurately reflect the risky decision problem. So delays provide an opportunity; and, the time associated with that opportunity must be managed carefully and systematically.

A related benefit of time delays is the learning that might occur during that delay. This concept of learning is beyond that of obtaining new information about the payoffs and the consequences. Learning involves new ways of thinking about the decision problem, new ways of framing and specifying the problem, new events that should be recognized, new sources of cost and revenues that should be considered in estimating the payoffs, or new uncontrollable variables that might impact the probability distribution. Learning activities thus can result in 1) respecification of the problem, 2) identification of new events or respecification of events, 3) estimation of new probability distributions for the events or the revision of those probability distributions, 4) identification of new actions or respecifications of actions, or 5) identification of new consequences or payoffs or the respecification of payoffs. In essence, learning goes beyond obtaining new information, because it may result in the identification and definition of a new decision problem rather than simply a more accurate specification of the current problem.

Clearly, there is a continuum from obtaining new information to learning, and the specific activities that fall in each category is not critical. But it is important to allocate time in an efficient way to both the information gathering and the learning activities, when the opportunity for sequential decision making arises. And specific allocations of time to the four information gathering activities, as well as the five learning activities, is essential to improve the decision process.

Options As An Approach to Managing Risk

As we have noted earlier, many business decisions are time dimensioned or sequenced, whether they be in the form of phased-in investment projects, sequenced expansion strategies, or joint ventures or strategic alliances that eventually lead to acquisitions or mergers. An important benefit of this time dimension of many investment and strategic decisions is that it provides one technique to maintain and manage flexibility. When future events are uncertain, the conventional wisdom of keeping your options open, and identifying smart exit strategies and/or "back doors" is one way to manage that risk and uncertainty. Common sense says "don't burn your bridges", but how do you explicitly capture this common sense in decision making? How do you value flexibility? What are the benefits of maintaining options or alternatives? Can you place a value on this flexibility in a systematic way, and how might it impact the pay-off of a project that includes both time delays and risk? One technique that is increasingly popular to systematically capture the benefits of flexibility or maintaining options in a risky decision environment is to use the techniques and concepts of options theory.

What is this concept of options theory, and how can it be applied to risky investment and strategic decision making? A place to start in understanding options might be to use the terminology common to financial and commodity markets that involve options trading. In the context of financial or agricultural commodities, an option is the right, but not the obligation, to buy or sell an asset at a predetermined price (the strike price) within a specified time period (the expiration date). As an example, a *call* option on a specific futures contract is the right, but not the obligation, to *buy* that futures contract at the predetermined strike price, regardless of the actual price at which the underlying futures contract is trading. Similarly, a *put* option is the right but not the obligation to *sell* a futures contract at a predetermined price.

The owner of an option must pay a fee (the premium) for the right to buy or sell the underlying asset. Importantly, the option premium must be paid even if the option is not exercised.

Option premiums are determined via an auction at the financial or commodity exchange. This premium can be decomposed into two parts, intrinsic value and time value. An option's intrinsic value is its return if the option were exercised today. Thus, an option with no intrinsic value would not be profitable to exercise. The second component of an option premium is its time value. Time value captures the probability that the option may become profitable prior to its expiration date. Even if an option has no intrinsic value, it may still have time value and option holders are willing to pay a premium based upon this expectation. As might be expected, the time value of an option decreases as the expiration date approaches.

An alternative way to think about options is to consider the benefits of delaying a decision or financial commitment in an uncertain environment. The basic premise of real options theory is that many investments (as well as most strategic decisions) involve risk and uncertainty concerning future payoffs and costs, but they can often be divided into stages and sequenced so that more information is available after the first stage or phase, which will influence the probability as well as the potential size of the expected payoff. In these circumstances, the initial stage investment or commitment is much like buying an option, i.e., the opportunity but not the obligation to make additional investments or commitments at a later stage.

In essence, there are two financial benefits of any delay in committing funds. First is the interest or earnings received on those funds not committed but instead invested elsewhere while you wait. This savings from delaying an investment grows with the length of the delay because of compounding – the longer the time we can delay, the larger the value of the option to wait. And this benefit accrues no matter what happens to the risk or uncertainty during the delay.

A second benefit of delaying is that in most cases we will be able to gather additional information or complete a more detailed analysis that will increase the certainty about the future costs and benefits that result from the decision or investment commitment. The value of this benefit of delaying or waiting to make the decision or investment depends significantly on the amount of risk and uncertainty that currently characterizes that decision or investment. If there is little risk or uncertainty about the future payoffs of an investment or decision, a delay in making that decision will do little to reduce that risk and therefore the risk reduction benefits of waiting are relatively small. However, if the risk and uncertainty concerning future payoffs is very large and a delay will allow us to obtain more accurate and/or more certain estimates of that payoff, the value of waiting is much larger. So, the more uncertain the future benefits, the higher the value of the option to wait.

This result is obvious if the delay provides information that the benefits are higher than originally expected, and so the payoff of the investment is increased. But what if the delay indicates to us that the benefits are lower than expected? Doesn't that reduce the value of waiting? The counter-intuitive answer is no – even in the case where we find out that the benefits are less than originally expected, there is a positive value of waiting or a delay because we have avoided the mistake of investing when the payoff in reality is lower than originally expected. So

delaying has a benefit irrespective of what we find out about the payoff – whether it is bigger than we originally thought or smaller than we originally anticipated. And the more uncertainty there is about that payoff (whether negative or positive), the larger the value of the option to delay making the investment or decision.

A project that has high risk as measured by the variability in the potential payoff or benefits might be rejected if a decision has to be made today because the expected returns are insufficient to justify absorbing that amount of risk. However, if part or all of the commitment for that project can be delayed, the project value may increase because of the value of waiting associated with that delay. This value or benefit of delaying a commitment to reduce the uncertainty can be described as the value of an option or the option premium. And, the more risk or volatility a project or investment exhibits, the more option value associated with the delay. Delaying a decision to have more certainty about either good or bad events in the future has value today for two reasons: 1) to capture the benefits by completing the investment if they are higher than expected, and 2) maintaining the flexibility to avoid a mistake if the benefits are not as high as expected. In essence, having the opportunity to obtain more accurate information about the future is valuable today even if that future is negative. If one includes the option value of delaying a decision in the analysis, what might appear to be a very undesirable investment may in fact be very desirable. This is particularly the case if the decision can be made in phases or sequenced such that additional information is obtained after the initial commitment – information which will shape subsequent commitments to further investment if the probability of high payoffs increase, and no further investment or abandonment if probabilities of low payoff increase during the period of delay.

Using Options Thinking to make Decisions and Manage Risk

So what is the pragmatic application of these option concepts to risk assessment and decision making in farming? Consider the strategy of a producer who has two alternatives:

1. Buy a parcel of farmland that has been rented for the last five years, or
2. Continue to rent that farmland for another year and purchase it after a year has transpired.

Because of the uncertainty associated with recovery of market prices, the size of future government payments, the potential of other buyers, declines in land values, etc. the flexibility associated with waiting to purchase the property has a value. That value is sometimes reflected by the producer making a payment for the seller to give him a right to buy in the future - a purchase option. Or the value of waiting to purchase might justify a higher rental payment this year to not only buy time to obtain more certainty about market prices and government payments (irrespective of whether they are higher or lower), but also to maintain a relationship with the current landlord which may increase the chances of being the successful purchaser when the property is sold. And the more uncertainty about future market prices and government payments, the higher the option premium that the renter would be willing to pay to maintain a rental arrangement rather than purchase the property or lose the lease. Consequently, cash rents may be perceived to be irrationally high in periods of great uncertainty because of this sizeable option premium that is being paid to buy flexibility.

Options concepts may also be useful in making decisions to enter new businesses such as the production of specialty crops. In most cases, transitioning from commodity crop production to

specialty crop production involves sequential investments in increasingly specialized machinery and equipment in an uncertain environment concerning future growth in demand, price premiums, yield drag, etc. If the required investment must be made up-front with limited capacity to make adjustments, the expected benefit stream or the expected payoff may not justify the outlay. But if critical investments such as storage facilities for identity preservation can be made in the first year – and specialized planting, pest control and harvesting equipment investments delayed for a year or two until new information is available on the magnitude of the price premium or yield drag for example, the option value of delaying part of the investment outlay plus buying time to obtain more certainty about future payoffs may convert an unacceptable business venture into one that is acceptable. An example of sequential expansion in livestock facilities would be constructing finishing barns initially, and then a breeding/gestation/nursery unit two or three years later if initial uncertainty concerning pork prices and feed costs subsequently suggests that margins will be on the higher end of the original probability distribution function rather than the lower end of that function. These examples suggest not only the benefits of using the options approach to making investment or strategic decisions, but also indicate the value of making such decisions sequentially when possible. Thus a fundamental management strategy that should be considered in any capital investment or strategic decision is how to structure that decision to "buy time" and take advantage of the benefits of sequential decision making – to recast the decision problem as a time-sequenced options problem.

Estimating the Value of an Option

How explicitly can one compute the value of a delay – in essence the premium to pay for and option to wait. And once an option premium is computed, how do we include it in the analysis? In essence the procedure is to separate the sequenced investment decision into the current outlay (Phase I) and the delayed outlay (Phase II). The value of the investment is then computed as the net present value of Phase I plus the option value of Phase II.

Sophisticated computational procedures can be used to determine the option value associated with delays in making a decision. A first approximation of those option values is summarized in Table 1 as a function of the length of the time delay and the riskiness or variability in the original estimate of the payoff from that decision. These option premiums are expressed as a percentage of the expected value of the future payoff, and thus reflect the additional value that is generated by the time value of money and the increased certainty that comes from delaying an investment decision. Another way of interpreting these values in Table 1 is the premium that can be paid to delay the commitment of funds depending on the length of the time delay (T) and the amount of risk or variability (R) of the project. Not surprisingly, these premiums and the option value increase when you have more variability, a longer time delay or both.

How do we get the values of T and R so we can use Table 1 to estimate the option premium for a time sequenced project or decision. The procedure we describe here is an approximation procedure B it will provide an estimate of the option premium that alternatively could be computed more precisely using the Black-Scholes Model of options pricing. T measures the benefit of the time delay; it is calculated as the ratio of the present value of the incremental net benefit stream from the project resulting from the delayed investment divided by the discounted incremental investment outlay – discounted because of the delay in making that outlay. With higher interest rates (and thus discount rates) and longer delays to invest, T will increase – thus reflecting the time benefits of delaying and increasing the option premium.

R measures the impact of uncertainty or risk on the option value. The impact of variability depends on both the amount of variation or uncertainty in future benefits and the time we can delay in making commitments. Since variation is measured per period, the more periods we delay, the more the uncertainty. One way to measure this is to determine the cumulative risk or uncertainty. If risk or variation per period is measured as the standard deviation of the future probabilistic benefit stream, cumulative risk or volatility can be calculated as the standard deviation multiplied times the square root of the number of periods of delay. Measuring standard deviation may not be easy, but there are numerous ways it can be done; see the Computing Risk box. With increases in cumulative risk or volatility, either because of longer delays in investing or more variability per period (or both), the option premium increases. In essence with more risk, there is more benefit in waiting to make a commitment and that benefit results in a higher option premium.

We will use the following example to illustrate how an option premium can be calculated for a project and used to analyze an investment. Assume that a farmer is considering a new business venture, the production of a specialty grain such as white corn. The new venture will require a capital outlay for harvesting equipment and storage facilities, but the investment in harvesting equipment could be delayed for a year because the crop could be harvested by a custom operator the first year. The future revenue stream from this new enterprise is uncertain because although there is a premium being paid for white corn now, that premium may be lower or higher in the future.

Let=s assume the capital outlay for the harvesting equipment (Phase II) is $125,000, and the storage facilities (Phase I) require a $75,000 outlay. Using expected prices and yields (i.e. ignoring risk), the computed discounted value of the net revenue stream (discounting at a rate of 10 percent) is less than the capital outlay by $2000 (i.e. the project has a net present value (NPV) of -$2,000), so it doesn't appear to be a good investment. But what if we explicitly take into account the benefits of delaying part of the outlay and Abuy time@ to find out more about the potential price premiums before we invest in harvesting equipment.

Using the option valuation procedure, we first identify which investments can be delayed – in this case the harvesting investment of $125,000. Next we determine the annual cash income or benefits associated with that incremental investment B in this case the reduced costs of custom combining and the reduced field losses of more timely harvest less the operating costs of using our own machine. Computing the present value of this benefit stream (discounting all future year=s net savings back to today or time 0) results in a value of $118,000. Computing the discounted or present value of the $125,000 combine investment (discounting this outlay back to today or year 0) results in a value of $113,637. So the value of T to use in Table 1 is $113,637 divided by 118,000 which equals 1.04. Looking at the numbers in Table 1 for the column where T is 1.04, we can see that there is a premium that can be paid for the option to delay the combine investment.

Now the question to be answered is how much value is there in delaying the combine investment because of the risk in price premiums for white corn. Let=s assume that data on the variability of white corn prices indicates that it exhibits a standard deviation of 40 percent (see the Computing Risk box for procedures to obtain this standard deviation). Since we are delaying the investment for only one year, we multiple this standard deviation times the square root of 1 (which is 1). So the cumulative risk (R) is .40 times 1 or .40; this number indicates the appropriate row to use in Table 1 to determine the option value resulting from risk.

Now if we use the values of T (1.04) and R (.40) computed earlier to enter Table 1, we obtain an option premium of 17.5 percent B this is the value of the flexibility to delay the combine investment for a year in the risky environment of uncertain white corn prices. This premium is in essence the incremental value of the benefit stream of the combine investment because of the delay in making the commitment to purchase the combine. So the option premium is calculated as $118,000 (the present value of combine

benefit stream) multiplied times 17.5 percent or $20,650. Note that this option premium is the value of waiting, but we do not have to make a cash payment to the dealer to hold the combine for a year. We are simply using this procedure to estimate the value of waiting so that we can accurately determine if delaying part of the investment commitment for this project influences its true value in a risky environment.

Using the logic of NPV, the net present value of the combine investment by itself is $118,000 minus $113,637 or $+4,363. Since the net present value of the combine and the storage facilities of $-2,000 can be viewed as the sum of the net present value of each, the net benefit of the storage facilities wiped out the benefits of the combine and generated an additional $-2,000 net present value. So the net present value of the storage investment by itself is $-6,363.

One might argue that these numbers suggest that you should make the combine purchase, but not invest in storage facilities. But remember that these are not independent decisions B we are attempting to enter a new business of specialty grain production where both investments are critical to its long-run success, but they can be made in sequence. So our focus is on whether we should enter this new uncertain business through a time sequenced investment, or we should invest somewhere else.

Completing the analysis, a more accurate assessment of the net present value of ($-6,363) this sequenced investment project is the $-6,363 net present value of the storage facilities of Phase I plus the option value of $+20,650 of the combine of Phase II or $+14,287. In contrast to the analysis ignoring option value that resulted in a negative net present value (NPV), this positive net present value indicates that the white corn venture should be undertaken, the storage facilities purchased, and the combine purchase made next year if white corn prices are high and not made if they are low.

References

Peter Bernstein, *Against the Gods: the Remarkable Story of Risk*, Wiley, 1996.

Teach, "Microsoft's Universe of Risk," *CFO*, March 1997.