Risk Management by Farmers, Agribusinesses, and Lenders
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Abstract
Producers and lenders seek to avoid agricultural production-related risks through various managerial and institutional mechanisms. For individual farmers and agribusinesses, risk management involves choosing among alternatives for reducing the effects of risk on the firm, thereby affecting the firm's welfare. Risk management often requires the evaluation of tradeoffs between changes in risk, expected returns, entrepreneurial freedom, and other factors. Research on risk management issues in agriculture has been among the main topics of interest of the Regional Research Committee for Financing Agriculture in a Changing Environment: Macro, Market, Policy, and Management Issues, and its predecessors. This paper revises and summarizes much of the Committee's work and provides a discussion of related topics of interest for prospective future research.

Key words: firm financial performance, federal subsidies, risk-management tools

In order to discuss risk management issues in agriculture or any other industry, it is essential to define the concept of risk. For the purposes of this study, risk is defined as the uncertainty faced by a firm (be it an individual, agribusiness, or lender) that affects its welfare. Specifically, risk is often associated with adversity and loss by the firm, and the ability of the farm, as a business, risk is uncertainty that affects an individual's welfare, and is often associated with adversity and loss. Risk is uncertainty that "matters" and may involve the probability of losing money. Agricultural production is risky because it is subject to unpredictable, random shocks caused by weather events, pests, damages, diseases, and other natural disasters. The relative frequency of such events (e.g., drought, fire, hail, hurricanes, and drought) is believed to generate significant yield instability. Firms in agriculture are usually exposed to substantial price volatility, usually much more so than firms in other sectors of the economy. The sizable volatility of agricultural prices stems in large part from the significant randomness in supply coupled with the inelastic demand which characterizes most agricultural products.

Gabriel and Baker (1960) define two types of risk in agriculture. First, business risk—risk associated with production and price risk—generally is reflected in the variability of net operating income or net cash flow. This would also include technological risk, institutional risk, and so on...

1 Others use the notion of returns on assets as an alternative measure of business risk.
can only lose risk, legal risk, and human resource risk. Second, financial risk is a source of risk that is very real and has potential effects on the solvency of firms in agriculture. Financial risk differs from yield and price risk in that it results from the way the firm's capital is obtained and financed. A farmer may be subject to fluctuations in interest rates on borrowed capital, or face cash flow difficulties if there are insufficient funds to repay creditors. The use of borrowed capital means that a share of the returns from the business must be allocated to meet debt payments.

In short, risk is prevalent in the agricultural sector. Further, there is strong evidence showing farmers are typically risk-averse (Just and Pope, 2001; Illes and Arrindilhe, 2004; Leibowitz, Nutt, and Anderson, 1997) and that they seek to avoid risk through various managerial and institutional mechanisms (Bouwmeester and Barry, 1987). The incidence of risk and risk-averse behavior in farming is important to policy makers for various reasons. For example, fluctuating farm incomes and, particularly the risk of catastrophic losses, may prevent welfare problems for farmers and their families. Farmers exposed to severe risk are also more likely to default on bank loans, which they lose to bad debts and farm foreclosures. In the case of epidemic risks (e.g., when catastrophic losses are experienced by many farmers simultaneously), farm failures may trigger failures of other agribusinesses and lenders.

For individual farmers and agribusinesses, risk management involves choosing among alternatives for reducing the effects of risk on the firm, thereby affecting the firm's welfare position. Risk management often requires the evaluation of tradeoffs between changes in risk, expected returns, entrepreneurial freedom, and other factors. Some risk management strategies reduce risk within the firm's operation, others transfer risk outside the firm, and still others hold the firm's capacity to bear risk (such as maintaining liquid assets).

Just and Pope (2001) point out that farmers have different attitudes toward risk, which is consistent with the findings of Goodchild and Raskiss (1983); Illes and Arrindilhe (2004); and Barry and Baker (1984). Therefore, the "one-size-fits-all" paradigm does not apply in the analysis and implementation of risk management strategies by farmers. For an individual farmer, risk management involves finding the preferred combination of activities with uncertain outcomes and varying levels of expected return. Surprisingly, one might note that risk management involves choosing among alternatives for reducing the effects of risk on a firm, and in so doing, affecting the farm's welfare position.

In the present study, risk management strategies are classified into two main categories: "within-firm" strategies and "risk-sharing" strategies. Within-firm strategies include, among others, (a) on-farm enterprise diversification; (b) on-farm enterprise diversification; (c) diversification; (d) diversification; (e) diversification; (f) diversification; (g) diversification; (h) diversification; (i) diversification; (j) diversification; (k) diversification; (l) diversification; (m) diversification; (n) diversification; (o) diversification; (p) diversification; (q) diversification; (r) diversification; (s) diversification; (t) diversification; (u) diversification; (v) diversification; (w) diversification; (x) diversification; (y) diversification; (z) diversification.

Among risk-sharing strategies, the following are of special note: (a) buying insurance (e.g., crop insurance, revenue insurance, insurance on buildings and/or machinery, etc.); (b) hedging using contracts traded in derivatives markets (e.g., futures and options contracts); (c) diversification; (d) diversification; (e) diversification; (f) diversification; (g) diversification; (h) diversification; (i) diversification; (j) diversification; (k) diversification; (l) diversification; (m) diversification; (n) diversification; (o) diversification; (p) diversification; (q) diversification; (r) diversification; (s) diversification; (t) diversification; (u) diversification; (v) diversification; (w) diversification; (x) diversification; (y) diversification; (z) diversification.

Product liability risks often an unexpected phenomenon that has major impact on output. Risk management requires investing in assets that can contain loss, so that any productivity losses.
(e) producing under production and marketing contracts; (f) leasing inputs and hiring custom work; and (g) obtaining off-farm sources of income (e.g., off-farm employment by the operator, the spouse, or both).

To evaluate whether various risk-management tools and strategies are effective in achieving managerial goals regarding risk, it is essential to express risks in quantitative terms. Substantial research has been conducted estimating the prior and yield risk faced by farmers (Geodin and Kitz, 1968; Goodwin, 1994; Ker and Cable, 2003). The exact distribution of these risks has been a topic of much discussion for many years. Economists have used various alternative approaches to model decision making in situations involving risks. These approaches are based on the notion that each risk strategy offers producers a different probability distribution of income, and that determining the best strategy involves describing the different distributions and developing rules to choose among them.

Research on risk-management issues in agriculture has been among the main topics of interest of the Regional Research Committee for Financing Agriculture in a Changing Environment: Macro, Market, Policy, and Management Issues, and its predecessors. Given the wealth of research performed by the Committee over the years, the purpose of the present study is to review and summarize such work, and to discuss related topics of interest for future research.

The first two sections of the study focus on the research insights gleaned from the papers presented over the past 20 years at the annual meetings of the Committee which dealt with risk-management issues in agriculture. For this purpose, studies are grouped according to the main type of risk-management strategy addressed, by following the previously identified strategy classifications—i.e., within-firm strategies and risk-sharing strategies. The final section is devoted to a discussion of research topics of potential interest which agricultural economists could undertake over the next few years.

Within-Firm Risk-Management Strategies

Diversification

The Farm Credit System expanded its agricultural debt in the 1970s compared to other lenders. Farm financial stress during the 1980s placed agricultural financial intermediaries in a precarious situation. Since the Farm Credit System was the largest farm real estate lender, it was the most severely affected financial intermediary during periods of farm stress. McKee and Featherstone (1988) examined the possibilities of diversification opportunities within the Farm Credit System. Using the Arbitrage Pricing Theory to test whether risk-free profits could be obtained by arranging loans between the districts of the Farm Credit System, they concluded that additional diversification within the Farm Credit System was not likely, and thus trading loans between districts would not result in risk-free profits.

More recently, Katcheva (2002) conducted an empirical examination of the effect of diversification across agricultural activities on profitability. She found that crop/stock diversified farms had lower average value and lower average return on equity than a combination of a specialized crop farm and a specialized livestock farm with similar overall output. Katcheva's results imply diversification in agriculture does not make sense as a strategy to enhance value, but the results do not rule out diversification as an effective strategy to reduce risks. However, because of the data used in her analysis, Katcheva's findings should be interpreted with caution.
The author used farm-level data from Illinois, where most farms tend to be large and specialized in cash grains. Therefore, benefits of diversification could be more pronounced, but elsewhere (under different agronomic conditions), enterprise diversification could be more beneficial.

In another study, Mauer, El Osta, and Sardulskis (2004) investigated enterprise diversification by U.S. farmers as a self-insuring strategy. In particular, the authors examined various farm, operator, and household characteristics on the level of off-farm enterprise diversification. The study found that large farms were more specialized, and that farms located near urban areas, farmers who participated in off-farm work, and farms with higher debt-to-asset ratios were less likely to diversify. Further, the findings suggest a positive relationship between diversification and participation in crop insurance and direct government payments.

Information

In a Purdue University survey study of large-scale farms, agricultural lenders, and professional farm managers, Ulrich and Patrick (2000) summarized sources of information, sources of advice, and responses to risk, and the willingness of farmers, lenders, and farm managers to pay for risks. The authors reported that all three groups ranked information sources as important in making production decisions. For sources of information, the three types of professionals differed in their rankings. Ulrich and Patrick reported significant differences among the three groups in the individual's self-assessed willingness to take risk. Results of the survey also indicated no significant differences in risk aversion between farm managers and agricultural bankers.

The use of business information by farmers was examined by Gloy and LaDue (2002), who looked at the business analysis techniques used by a group of New York dairy farms and their respective financial performance. The most commonly used business analysis method employed by these farms was trend analysis. Findings also revealed that almost 70% of farms reported financial budgets either on an annual basis or when they were planning to make major changes in operations. Importantly, Gloy and LaDue uncovered a strong positive relationship between a farm's usage of investment analysis and its profitability.

The most powerful of the existing crop insurance and risk management literature is underpinned by the assumption that producers accurately understand and rationally respond to the risks they face. Sherrick (2001) asserts that subjective probability beliefs about important weather variables are systematically miscalibrated to the true distributions. In his study, Sherrick examines the assumption that producers possess accurate probability beliefs when evaluating risk variables which affect their financial well-being. He concludes that significant errors in producers' risk assessments and insurance valuations arise simply because producers possess systematically inaccurate probability beliefs, especially about the weather.

Differences in yield model specifications can significantly impact quantitative assessments of revenue risk, insurance values, and other components of farmers' risk management decisions. In a related study, Zunit et al. (2000) evaluate parametric yield specifications and assess their implications for valuations of average production history and crop revenue insurance products. The authors conclude that having yield specifications as an unexamined premise may lead to incorrect conclusions in other important areas of insurance research, such as policy rating and quantitative assessment of expected losses from different types of policies.
Leverage

Gloy and Baker (2005) argue that risk aversion and financial leverage are important when making risk-management strategy selections. The authors also show that the stochastic dominance approach with risk-free asset criteria reduces the number of risk management strategies a manager must consider without making strong assumptions about risk preferences. Adding leverage was found to be a more efficient way to increase returns than reverting to a strategy with a greater mean and business risk.

Using data from U.S.-based food processors, Spordeker and Moss (2001) found leverage was negatively related to the amount of intangible assets, profitability, and investment autonomy. Their results suggest food processors view equity and debt not so much as alternative financing instruments and/or strategies, but an alternative governance structure, with equity providing greater decision-making discretion than debt. Spordeker and Moss report that managers prefer equity capital financing over debt.

Decisions about financial leverage can have major impacts on the long-run survival of agricultural firms. Given the level of business risk, the owner will choose a capital structure or a level of financial leverage which makes expected utility of returns to equity, subject to personal risk preferences. Risk balancing measures are influenced by leverage and are well documented in the literature (Gabriel and Baker, 1986; Barry and Baker, 1984; Cojan, 1983). Using panel data from Kansas over the period 1973-1988, and assuming maximization of the expected utility of returns to equity, Jensen and Langenmier (1996) investigate optimal leverage and the factors affecting leverage. Based on their findings, leverage is affected theoretically and empirically by tax policy, risk, farm productivity, and growth rate in the value of assets.

The relationships among business risk (Gabriel and Baker, 1986), profitability (Collins, 1986), price support (Featherstone et al., 1986), farm (Moss, Ford, and Ruggles, 1983), and financial risk constitute risk balancing dimensions of agricultural policy. Risk balancing refers to the adjustments in the components of total risk (i.e., business risk and financial risk) resulting from an exogenous shock to the existing balance (Gabriel and Baker, 1986).

Ahrendt, Collumner, and Dimm (1994) extended the basic model of Collins and Barry (1986) and added to the dimensions of risk balancing through relationships among depreciation, investment tax credits, and financial risk. The authors concluded that policies such as depreciation and investment tax credit deductions which increase farmers' profits or decrease farmers' business risk may, in fact, reduce farmers without constrained credit to increase financial risk through capital structure adjustments. However, as the authors point out, the adjustment process is likely to be slow.

The tax treatment of capital gains is a potentially important factor affecting investment in agriculture. Moss, Ford, and Ruggles (1983) consider the theoretical model explaining the effect of the elimination of capital gains deduction on investment decisions in U.S. agriculture. Using aggregate U.S. data, their analysis shows that elimination of the capital gains exclusion raises optimal leverage levels and the probability of a negative rate of return to equity for all levels of risk aversion.

Equilibrium analysis under risk evaluates a firm's possible responses to changes in the risk characteristics of its environment. Barry and Robison (1984) employ equilibrium analysis under risk to analyze financial structure at the firm level. In particular, using the portfolio theory framework, concepts of business risk, financial risk, and risk balancing, they assess the possible responses in financial
structure to changes in a firm’s operating environment and in the investor’s risk attitudes. Their results show important linkages between theory and practice in financial responses to risk and provide general guidelines for implementing portfolio adjustments.

Liquidity and Financial Reserves

A study by Burghardt and Robertson (1984) explains the application of a computer simulation model built to facilitate the examination of alternative risk-management strategies on agricultural farms’ liquidity, financial stress, and investment management under uncertainty. Their model was designed to aggregate financial strategies with production, marketing, and risk-management strategies of typical Midwest cash grain farms.

Chikhara (1988) developed a model based on the expected-utilitarian paradigm to explain an agricultural farm’s demand for cash and credit reserves (i.e., unused credit or borrowing power) as a response to risk. In general, he confirmed empirical support for the model when he tested it using data from Illinois farms. Chikhara found that liquidity value curves decline monotonically with debt levels, implying credit reserves quickly lost their liquidity value for financially stressed farms. Based on this result, credit reserves were of little use to distressed farms as a risk-management tool.

Finance theory suggests that increases in financial leverage raise the expected level and variability of returns on a farm’s equity capital, provided the returns on assets exceed the cost of borrowing. Because risk attitudes (and expectations) may differ among farmers, it is plausible to expect a wide range of optimal financial structures. Ghosh, Barry, and Ellinger (1982) offered risk-efficient growth plans and financial structures for representative cash grain farms under a broad set of sources of risk and various levels of risk aversion. Farm size, asset structure, and debt level are shown to change significantly with risk-aversion levels and are consistent with empirical observations. Farmers with low levels of risk aversion, or even risk neutrality, will prefer higher debt-to-asset ratios and achieve larger operations, faster financial growth, and larger expected incomes.

Other “Within-Firm” Risk-Management Strategies

Singer (1998) discusses reasons why managers may “smooth” income, i.e., engage in activities to reduce the fluctuation of their firm’s reported net income. An important potential reason is that income-smoothing may improve the perception of the firm’s risk by providers of external capital (e.g., equity investors and lenders). Singer analyzes a special mechanism for smoothing income available to commercial banks—namely, the provision for loan losses. The provision for loan losses is the amount banks charge against current earnings to build reserves aimed at absorbing future loan losses. He found significant evidence that rural as well as urban banks used the provision for loan losses to smooth income. This finding is important from a regulatory standpoint because using the provision to smooth income is at odds with the regulatory guidelines for commercial banks.

Risk-Sharing Management Strategies

Insurance

The Federal Insurance Act of 1990 authorized an expansion of the insurance program to become the primary form of disaster protection for farmers. Insurance may protect farmers from yield shortfalls and thereby stabilize income and provide liquidity when crop losses occur.

Leatham, Richardson, and McCall (1985) evaluated a producer’s choice of crop insurance and investigated the implications of this choice on the lender’s performance.
The authors found crop insurance forces producers with higher levels of yield variability. The choice of crop insurance by producers depends principally on their expected insurance loss ratio and risk aversion.

Federal subsidies to crop insurance products have increased, thereby lowering premiums paid by farmers for insurance products. These changes were made with the goal of improving the attractiveness of crop insurance to farmers. Little direct evidence exists concerning the effects of crop insurance use on crop revenue risk, and still less work examines the relative performance across alternative insurance products (e.g., types and coverage levels) and across different yield risk conditions.

Schmitz, Shero, and Irwin (2002) investigate the risk implications of a wide range of crop insurance products in actual farm contexts. Risk implications are analyzed by computing gross revenue distributions without crop insurance to gross revenue distributions resulting from the inclusion of different crop insurance products. Findings indicate that the group-policies often result in average payments exceeding their premium costs. Individual revenue products reduce risk in the tails more than group policies, but result in greater reductions in mean revenues. Findings based on certainty equivalent returns and low frequency Valhalla (share-of-risk guarantee) lower revenue products.

As expected, crop insurance is associated with greater relative risk reduction in locations with greater underlying yield variability.

The costs and benefits from using crop insurance may differ based on the design of the instrument chosen by the producer. Wang et al. (1997) study the relative performance of individual-yield and area-yield crop insurance programs. Performance is measured by farmers' participation rates and farmer welfare in an expected utility framework. Using a portfolio setting, producers have a variety of risk-management instruments including options, futures, government payments, and crop insurance. Wang et al. found that an insurance contract based on an area yield index is less expensive to implement and may have more attractive premiums than a contract based on an individual farm yield index.

An important aspect of insurance is the ability of insurance companies to manage the risk of a large portfolio of policies. The authors found that, at least from the lender's viewpoint, the use of crop insurance by a farm could reduce its business risk enough to allow higher financial risk arising from the greater amount of credit made available to borrowers.

Pfluger and Barry (2003) analyzed the relationship between farmers' use of crop insurance and the cost and availability of credit from their major non-agricultural lenders. Based on survey data and on the results from a simulation model, the authors found that, at least from the lender's viewpoint, the use of crop insurance by a farm could reduce its financial risk enough to allow higher financial risk arising from the greater amount of credit made available to borrowers.

Pfluger and Barry conclude that crop insurance may have considerable merit when combined with other management or policy actions that reduce default risk or increase revenues for highly leveraged, low-equity crop farms. More recently, Seo, Laehm, and Mitchell (2003) used a principal agent model to determine the optimal contract design between the investor and farmers with crop insurance and external financing.

Hedging with Contracts Traded in Derivatives Markets

Because of the farm crises that took place in the United States in the early to mid-1980s, much of the attention at the
time focused on the financial situation of farmers and the lending sector. Government, researchers, and policy makers were interested in finding ways to reduce the burden of debt owed by farmers and bankers. Financial management became a very important issue, and along with it, the tools to manage financial risk. The September 1984 meeting of Committee N-161 was dedicated to financial futures and options and their potential use in agriculture. Law (1984) reported a rise in financial risk, through more borrowed funds and microeconomic factors, during the early 1980s. The author outlined various policy instruments affecting interest rate variability and parties who were affected by increased interest rate variability. Law proposed interest rate futures and options as an effective mechanism for lenders and borrowers to offset that interest rate risk.

Solverson and Her (1984) presented a development of futures markets and explained the basic terminology used by traders—especially by those trading financial futures. Helton and Lee (1984) outlined hedging strategies for Farm Credit System lenders. The authors described and analyzed the debt management program and then compared two hedging strategies. Solverson and Her found interest rate hedging would allow the Farm Credit System banks and associations to broaden their range of services beyond the dominant variable rate loan. By hedging a portion of the debt portfolio, the Farm Credit System could often borrow at rates as low as 1% at least some specified time period.

Drabstroff and McInery (1984) discussed the issues surrounding the use of financial futures by agricultural banks in the early 1980s. They also reported data on the use of financial futures by agricultural banks obtained from a survey. The authors pointed out that agricultural banks were slower to incorporate futures into their risk management strategies than urban lenders. Financial futures were found to be most effective when incorporated into a well planned asset/liability management strategy. Based on their survey results, not many agricultural banks were using financial futures, but financial futures were effective tools to deal with interest rate risk. The survey also revealed that large banks were more likely to use financial futures, and small banks lacked expertise to become involved in financial futures.

Commercial banks have always encountered risks in their normal course of business. However, when interest rates are volatile (as they were in the early 1980s), there is an increased risk of mismatching interest-sensitive assets and liabilities. Drabstroff and McInery (1984) employed an econometric model of a rural bank to demonstrate the importance of hedging in bank performance. Results showed that hedging the cost of borrowing when rates are rising enables banks to increase overall portfolio size and significantly raise earnings.

The use of derivatives by financial institutions was the focus of a study by Yang and Leatham (1980). They reviewed the use of interest rate derivatives by many lenders to agriculture, more specifically commercial banks, thrift institutions, and life insurance companies. They also discussed the benefits and risks of using financial derivatives by such institutions.

Hedging in financial futures markets can offset the dollar loss on the bond. Additional interest cost due to rising zero bonds will be gained in the futures market. Leach and Leatham (1984) examined the use of hedging grain elevators on variable rate debt and concluded grain elevator managers could reduce interest rate risk and the cost of debt by hedging borrowed debt in the financial futures market. However, the authors found that hedging costs were usually greater for private grain elevators than for cooperative elevators because the cost of debt for the former was reflected by the prime rate and was more variable than for cooperatives.
Financial futures are useful for hedging positions in situations in which there is symmetry of gains and losses. In the case of asymmetrical gains and losses, a conventional futures market hedge may only reverse the asymmetry. Thus, risk would not be reduced efficiently, if at all. A potentially useful risk-management tool applicable to these cases is an option.

Leatham and Fakher (1984) discussed methods of using (managing) options by providing background information about options on financial futures and then illustrating a hypothetical hedging situation. The authors suggested that call options would serve banks and lenders better for fixed-rate loans.

Farmers' use of futures and options to hedge growing and stored crops can reduce price risk and decrease the variance on the returns to equity. Turner and Fakher (1985) argued that data from Ontario farms do not support the expected behavior of risk-averse farmers, as only 11% of farms used hedging. The authors examined alternative motivations, especially the liquidity motive, to farmers' use of hedging strategies. They found a direct correlation between relative risk aversion and hedging, and an inverse relationship between credit reserves and hedging. Results of their study supported their hypothesis that liquidity may be a motivation for farmers' use of futures and hedging.

Turner and Nguyen (1997) explored the relationship between hedging with futures and farm capital structure. They estimated a simultaneous hedging model of price, yield, and foreign exchange. In particular, they investigated the impact of the hedging decisions of a Canadian farm using U.S. Index price and yield futures on farm business, financial, and total risks. The authors developed a risk-minimizing hedge ratio for the joint hedging decision, and concluded that jointly hedging price and yield can reduce revenue risk more than hedging only with price futures. Turner and Nguyen envisioned the possibility that revenue insurance/insurance programs provided by the government or crop insurance companies will not crop and revenue insurance to producers.

Mason, Haugen, and Luong (2001) estimated the total risk absorbed by the U.S. crop insurance industry and separated it into possible and systemic components. They found that risk pricing, pricing, or value of the insurance premium provided by the federal government when it absorbs this systemic risk. The authors also estimated the possibility of specifying market risks in prices and yields to hedge the systemic risk accepted by the government. They concluded that risk reduction achievable by hedging is appreciable, but use of derivative contracts alone is clearly no panacea.

Production and Marketing Contracts

A study by Dodds (1998) focused on the potential implications of production confronting farmers for risk management. He concluded that the risk-return tradeoff for the commodity in question is likely to be a major determinant of the use of contracts by farmers. For commodities like processed fruits, vegetables, and some specialty crops, Dodds argued that producers engaged in contract output may not only be able to reduce their risks but also increase their profit margins. In contrast, for other farms such as those...
engaged in hot production, contracts may only provide a means to reduce risk. Dorrin's conclusions were based on his finding that crop farms with contracts were larger, had more equity, and enjoyed higher returns than crop farms without contracts; whereas poultry and hog farms with contracts had less equity, higher debt levels, and exhibited more financial stress than poultry and hog farms without contracts.

**Leasing Inputs**

The effects of interest rate volatility and tax regulations on the choice between lease and ownership of farm machinery were investigated by Pederson (1984) by means of a simulation model. Purchasing was found to weakly dominate leasing for tractor owners in many scenarios, and leasing was the most risk-efficient choice for risk-prefering farmers. However, Pederson cautioned that results were quite sensitive to the future dynamics of interest rates.

In times of financial crises in agriculture, greater emphasis has been placed on measuring farm financial performance. In much of the literature, the debt-to-asset ratio is used as an indicator of financial stress. Ellinger and Barry (1987) point out that this ratio has significant implications for performance. Tenure is important because a considerable amount of land is operated by farmers under various types of leasing arrangements. The authors evaluated the effects of farmers' tenure position on key performance measures—profitability and solvency. Their findings reveal that higher land ownership is associated with lower accounting rates of return and lower leverage positions. As tenancy increases, rates of return on assets and leverage positions are considerably higher. Further, as tenure increases, farm size as measured by acres also increases.

Leasing land for agricultural production is another way to reduce risk (Berry, Escalante, and Moss, 2000). The long-standing practice of share leasing farmland is increasingly giving way to cash leasing and to combinations of cash and share leasing (Reise, 1984). The differences in change generally involve risk, income, managed control, and land values issues facing farmers, landowners, and professional farm managers who represent landowners (Betsinger, Ellinger, and Barry, 2000).

Berry, Escalante, and Moss (2000) conceptualized the risk-averse valuation of cash versus share leases for farmers and landowners, and tested their model using farm-level data from Illinois. In particular, the authors empirically determined how rental agreements between cash and share leases are related to risk and other farm characteristics. They concluded that non-risk factors are likely to be the primary determinants of the magnitude and sign of the rental spread, and point out that high cash rents may be a bidding strategy to control additional leased acreage and thus expand farm size.

**External Equity**

Advantages and disadvantages of investing in external equity are a means to reduce risk and/or increasing capital were addressed by Lowenberg-DeBoer et al. (1987). Overall, they argued that external equity was not likely to be an economically viable strategy because of its relatively high transaction costs and the potential elimination of management incentives. However, they stressed that their conclusions were limited by the small amount of research available regarding using external equity by farmers, and by proprietary firm in general. Their study concluded with a long list of topics of relevance for future research in the area.

**Off-Farm Income and Investments**

Deregulation of financial markets in the late 1980s provided farmers with new opportunities to diversify their investments into off-farm financial assets, survey data on South Dakota farmers, collected and analyzed by Gustason and
Chomko (1992) in the early 1980s, created a new crop of financial institutions such as hedge funds and private equity funds to take advantage of new investment opportunities. Most of the respondents had diversified their investments into real estate, stocks, and mutual funds.

Shy and Lachman (1990) also focused on the role of off-farm investments in the financial planning process. They found that off-farm investments played a crucial role in the financial planning process. The results of their study indicated that off-farm investments were an important component of the financial planning process.

The results of the study conducted by Shy and Lachman (1990) were consistent with the findings reported by Li, Kowalski, and Hoffman (1991). These workers noted that off-farm investments were crucial in achieving financial goals and maintaining a stable income stream.

Mishra and Morehart (2000) found that farmers who had diversified their investments into off-farm assets were more likely to achieve financial goals. They also found that diversification was an important component of the financial planning process.

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Risk Management Tools and Financial Performance

The 1985 federal Agriculture Improvement and Reform Act shifted the dairy industry toward a more market-oriented pricing structure, with more input and output risk transferred back to dairy producers. Barfield, Skees, and Wesner (1990) investigated the use of Multiple Farm Credit Insurance (MFCI), Income Protection (IP), and Group Risk Plan (GRP) insurance risk management strategies on the financial performance of dairy farms in Pennsylvania. Results of the study indicated risk management tools to significantly lower some measures of financial performance for dairy farmers. This was especially true for production hedging, largely due to the more frequent resetting of hedges.

Agricultural Lenders and Risk Management

According to Collins and Barry (1988), fees sharing among Farm Credit System districts creates a free-rider problem. They provided a framework to argue that a central entity could evaluate the riskiness of each district and adjust the cost of funds to each district so as to reflect its corresponding external costs. In this manner, costs of funds would be internalized and the free-rider problem would be eliminated. Collins and Barry also explored ways to determine risk premia. They suggested that the calculation of the cost of funds which internalizes the external costs of risk management for each district and creates

as essentially neutral "insurance" and hedged on the probability density function (pdf) of the rates of return on assets. Collins and Barry pointed out that implementation of their instrument required the elimination of the delta and challenged future researchers to undertake this task.

In the mid-1980s, deregulation of interest rates, inflation and deflation, and agricultural recession combined to destabilize the earnings of commodity banks. In response to this volatile economic environment, banks employed various portfolio-adjustment and assets and liability management strategies to reduce risk exposures and stabilize profits. The net interest margin (NIM) is a gross interest income less gross interest expense. Converse information on the bank management's effectiveness in allocating funds and controlling expenses.

Pederson, Takacs, and Croun (1988) examined the variability of bank interest income and how it related to bank management and portfolio characteristics. Banks with higher expected net interest margins were also found to exhibit greater systematic net interest income variability. Ras, Pederson, and Echelle (1991) constructed an econometric model of bank investment and funding and used it to simulate optimal asset liability management decisions by means of a stochastic control program. When comparing the historical asset and liability decisions made by the Farm Credit Banks with the optimal decisions calculated from their model, the authors found that the former led to faster growth of assets and liabilities than the latter.

Withins and Gilbert (1988) used data from agricultural banks for 1984-1988 to assess whether banks that failed over this period did so because of their risk management strategies. They concluded lending banks were exposed to more risks than surviving banks, supporting the hypothesis that vulnerability, to failure, reflected management portfolio decisions.
Issues for Future Research

As demonstrated by the preceding review, the Regional Research Committee for
Agricultural Finance (RMA) has devoted significant efforts toward analyzing risk-management strategies in
agriculture, and valuable insights have been obtained as a result. However, this area of inquiry is quite rich and there are
important issues yet to be investigated.

Our knowledge of risk management in agriculture has the potential to be greatly enhanced by future research in the
following areas of inquiry, among others:

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  **Contract Production.** Production under contract has emerged as the dominant production arrangement in the hog
sector. There is little knowledge regarding the implications of contract production on risk management by both
  contractors and producers. Future research should explore the implications of contracting for lenders as well.

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  **Recent Risk-Management Tools.** For example, farmers now have available a large menu of novel insurance products
designed by the Risk Management Agency (RMA), e.g., GIP, revenue insurance, income protection, whole-
  farm insurance. Efforts are needed to assess the impact of these risk-management tools on the financial
  performance of farms, and on the risk-management strategies of lenders.

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  **Investment Risks Associated with Contract Production.** Investment in new farm infrastructure (e.g., new buildings
and equipment) has been spurred by production contracts. Future studies should analyze the extent of the risks
associated with such investments on the face of changes in contract terms.

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  **Forward Contracting of Inputs.** Forward contracting of factors of production in a growing activity between the suppliers of
inputs and the farmers who use them. Forward contracting of inputs could aid planning and allow farmers to diversify
purchases over time. Forward contracting of inputs also guarantees participating farmers an assured supply of
inputs at a specified price. Studies should be conducted to evaluate the effects of this practice on the financial
performance of farm businesses.

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  **Reactions to Government Support.** Future farm bills are likely to include provisions to reduce government
  support of the farm sector, thereby significantly altering the risk-management environment faced by
  farmers. Studies assessing the impact of payment limitations on farm performance, asset values (and values in
  particular), and economic well-being of farms and farm households should prove to be valuable contributions.

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  **Risk-Management Tools for Livestock Farms.** In recent years, the RMA has developed risk-management tools
  specifically designed to manage risks of livestock farms. For example, in 2003, the RMA introduced Livestock Price
  Insurance (LPI). Studies evaluating the use of LPI and its impact on the financial performance of livestock farms
  are warranted.

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  **New Hazards.** Mad-cow disease, bovine spongiform encephalopathy, and avian flu are prominent examples of risks faced by
  agricultural producers which were unheard of just a few years ago. A thorough examination of the tools available to
  manage such risks and their impact on the financial performance of agricultural and livestock farms is
  necessary.

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  **Enhanced Production Flexibility.** The 1986 FARM Act gave farmers greater flexibility to choose among crops to be
  produced. Studies are needed to investigate how this legislation has affected risk-management decisions at the
  farm level.
New Technologies: New technologies may have an important impact on risk management. For example, cross-pollination of non-genetically modified (non-GM) crops with GM crops may greatly reduce the value of the former. Studies should be conducted to investigate whether recently introduced technologies have affected existing risk-management practices, and whether new risk-management tools need to be developed to cope with the new risks involved.

Off-Farm Income and Investment: Off-farm income and investment have exhibited a positive trend over time. However, the amount of research devoted to them has not been commensurate with their relative importance. Studies focusing on the development of a greater understanding of off-farm income and investment patterns and opportunities should prove valuable.

Production Practices and Risk-Management Tools: Some production practices (e.g., integrated pest management) may provide effective ways to manage risks, whereas other practices may require a careful choice of risk-management tools to be attractive. Competition versus complementarities in the use of production practices and financial instruments to manage risks clearly is an area worthy of research efforts in the future.

In summary, risk is a critical characteristic of production agriculture, and farmers, agribusinesses, and lenders are all substantially exposed to various types of risks. Consequently, it is not surprising that substantial resources have been devoted to research regarding risk-management issues. The present study reviews the significant body of research on the topic generated by the Regional Research Committee for Financing Agriculture in a Changing Environment: Macro, Market, Policy, and Management Issues, and its predecessors.

For this purpose, risk-management strategies are classified into two main categories—"within-firm" strategies and "risk-sharing" strategies. Given the literature examined here and the recent developments that have occurred in the U.S. agricultural sector, the present study identifies a number of research topics worthy of attention for future research in the field. The hope is that such research endeavors will be as productive as the previous efforts reported here have proven to be.

References


