THE NEW RISK ENVIRONMENT IN AGRICULTURE

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Economic and natural factors have both contributed to the evolution of a new risk environment in which western agricultural producers must operate. A "credit crunch" has developed in agriculture. As a result, there is potential for significant changes in resource allocation in the west as the agribusiness sector adjusts its approach to risk management. These potential adjustments have wide-ranging economic and social policy implications for the west.

In the past, risk management tools have been under-utilized in the west because they did not meet the perceived needs of the region's agribusiness people. Given a moderate climate, irrigation control of water, and broad options for diversification, California agribusiness peoples' concern for production risk has been relatively low. But recent events are beginning to challenge those attitudes.

For example, a freeze, a five-year drought, and farm lenders' new attitudes toward these risks have combined to make production risk exposure a renewed concern of agribusiness people in California. At the end of 1990, a record-breaking freeze significantly damaged a number of crops in many regions of the state. Also, for the first time in the history of the state's water project, all water deliveries to agriculture were suspended. And on average, the federal Central Valley Project made just 25 percent of deliveries to agriculture. These events have already caused agricultural lenders to weigh production risk more heavily in their lending decisions. Many are now including a water supply questionnaire in their loan application process, and borrowers who have been creditworthy in the past may be turned down if they do not have a secure water supply.

IMPLICATIONS OF THE PROBLEM

The credit crunch, as a symptom of the new risk environment, is having a significant effect on many agricultural producers in the west. Some people have not been able to borrow the amounts they had hoped to, and interest rates have gotten relatively higher for some borrowers in agriculture, compared to urban borrowers, due to the perceived risk differences between the sectors. Many lenders have reassessed the risks involved in agriculture.

Although no lenders have completely withdrawn from the rural sector, large commercial lenders have tightened loan requirements causing some borrowers to be dropped as customers. In particular, some lenders have raised the minimum size of loans, to $750,000 in one case. This means that small scale agricultural producers will have to look elsewhere for operating capital. This, in turn, means that those people (which large lenders consider to be risky) will have to seek other sources of capital with their best prospects being small, rural lenders. This situation creates the danger that over time rural lenders will accumulate much riskier loan portfolios than large lenders, making the rural banks more likely to fail (Sundell). To avoid such risk, rural lenders may have to turn people away, leaving some agricultural producers without sufficient capital to operate effectively.

OBJECTIVES AND PROCEDURES

The general objectives of this paper are to identify changes in attitudes and operating procedures concerning risk management in western agribusiness, and to outline the resulting policy implications. A secondary objective of the study is to evaluate the usefulness of portfolio theory in analysis of agricultural production and investment decisions by comparing expectations derived from the theory with empirical results from survey data.

Specific objectives to be addressed include:

1. Determine why risk management tools are under-utilized in California.
2. Identify changes in attitudes towards risk management methods in California.
3. Determine how risk management tools could be tailored to better fit the needs of California growers.

Hypotheses regarding the effects of the increase in perceived risk in agriculture in the western U.S. are tested with data collected through surveys. The hypotheses are derived first using standard portfolio theory.

To collect empirical data to test the hypotheses, a broad-based mail survey was used to elicit information from farmers, ranchers and other agribusiness firms in California. Personal interviews with producers and lenders were used also to supplement the mail survey. The interview sample of producers was selected from the mail sample group to generate a representative cross section of the state's commodities and geographical regions.

A PORTFOLIO MODEL OF PRODUCERS' ENTERPRISE SELECTION

A person deciding whether to produce agricultural enterprises in a particular market must first identify the opportunities available in that market. Those opportunities can be plotted on an expected return-variance (EV) graph to facilitate analysis. This is done for a hypothetical market in Figure 1. The curved line labeled EV_1 represents the opportunity set available to agricultural producers within some geographic market (before an increase in perceived risk levels). Each point on EV_1 is an enterprise or portfolio of enterprises which is efficient in terms of its return/risk relationship. The location and shape of EV_1 is determined by the data used to calculate expected returns for all portfolios.

If no leasing of land is possible, for whatever reason, only land owners can produce crops. Each person would choose to produce the portfolio represented by the

point on EV_1 which is tangent to one of their indifference curves. This leads to different enterprise portfolios being produced by owners with different risk attitudes.

If a risk-free investment exists in the form of cash leases of land, borrowing and lending can occur and the opportunity set available to growers is altered. In this study, a risk-free return (R_f) to land is defined as the return from cash leasing it to others (as suggested by Collins and Barry). During the period covered by a cash lease, the land owner is guaranteed a specific return which will not vary. Such a risk-free return is available only if an active market exists for cash leases on land (Robison and Barry). Lending occurs when land is leased out to others, borrowing occurs when land is leased in from others. Lending land is analogous to investing in a risk-free asset, which has a return of R_f, and is plotted as a point on the vertical axis of an EV graph (initially at R_{f1}). Borrowing land implies that a producer chooses to invest more than 100 percent of the amount of land owned in some agricultural enterprise portfolio *i* which is expected to generate returns exceeding the leasing rate. For a borrower, $E(R_i)-R_f > 0$.

Land Owner Production Opportunities

When leasing is possible, all land owners which have the same returns expectations will produce the same enterprises, although the composition of their selected portfolios will still vary with their risk attitudes. Using the risk-free return, a single optimal risky portfolio and a land owner's production opportunities line (POL) can be identified. The POL represents the opportunity set available to land owners in a market (given some returns expectations). It is plotted as a straight line which passes through the point representing the risk-free return and is tangent to the EV. The point of tangency represents the market's "optimal" portfolio, which has expected returns of $E(R_m)$. The portfolio selected by each owner is found at the point of tangency between this linear POL and an indifference curve for that person. The selected portfolio has expected returns of $E(R_i)$.

For example, in Figure 1 the initial POL existing for land owners when leasing rates are the value R_{f1} is the line labeled "1", which is tangent to EV_1 at point *A* (which is the same point as R_{i1}). If an owner's indifference curve is tangent to line 1 at point *A* (as is the case in Figure 1), all of that person's land should be "invested" in the enterprises comprising the optimal portfolio represented by that point. If the indifference curve is tangent at some point to the left of *A*, the person will invest some land in producing portfolio *A* and the remaining land in the risk-free asset (by leasing that land out). Points on the POL to the right of *A* require an investment in portfolio *A* involving all of an owner's land and some land leased in. Thus, all land used for crop production by owners sharing the expectations represented by EV_1 will be planted to the same portfolio of enterprises in the same relative proportions. The only difference in composition of portfolios between owners will be the relative proportions of land each chooses to lease in or out.

A landowner's profit function for holding his selected portfolio over some future period can be specified as

$$E_o(R_i) = E_o(GR_m)X_m + R_fX_f - K \qquad (1)$$

where:

R_i = net profit (returns) from selected crop portfolio *i*,

E_o = the owner's expectations operator,

GR_m = gross returns from the market's optimal enterprise portfolio,

R_f = risk-free returns from cash leasing out land,

X_m = the proportion (or total number of units) of land planted in the market portfolio,

X_f = the proportion (or total number of units) of land leased out (or leased in if negative), and

K = total fixed costs incurred in owning a parcel of land (including mortgage, property taxes, insurance, investments in improvements, etc.), expressed in per acre (or total dollar) terms.

If X_m and X_f are expressed in terms of proportions (acres), they must sum to one (the total acres owned). The variance of returns for a portfolio held by a landowner is

$$\sigma^2_i = X_m^2[\sigma^2_m] \qquad (2)$$

where σ^2_i and σ^2_m are the variance in expected returns of the selected and optimal portfolios, respectively. The variance of the profit model is the variance of expected returns to the optimal portfolio component only because all other factors are known with certainty and, therefore, have zero variance.

In portfolio theory, utility maximization is assumed to be the objective. Therefore, the focus of decision making is the certainty equivalent of $E(R_i)$, which Freund shows is

$$E(U_i) = E(R_i) - (\gamma/2)(\sigma^2_i) \qquad (3)$$

where U is utility and γ is a risk-aversion parameter (equalling the slope of the indifference curve at the tangency point) which is positive for risk-averse hedgers. The first-order conditions for equation 3 gives the utility-maximizing portfolio composition,

$$X_m = \frac{E_o(GR_m)-R_f}{\gamma\sigma^2_m}, \qquad (4)$$

remembering that the proportion of land leased out or in (X_f in equation 1) is $1-X_m$.

Tenant Production Opportunities

Differences in the land holding status of owners and tenants alter the POL available to tenants and, therefore, the resulting enterprise decisions. Tenants have no land to lend, therefore they can only borrow land. This means that the POL available to tenants is a combination of the linear POL for owners and the curved EV. In Figure 1,

for example, if line 1 is the POL for owners, the POL for tenants would be the segment of line 1 from point *A* to the right, plus the segment of EV_1 to the left of point *A*.[1]

A tenant would select an enterprise portfolio in the same manner as owners: the point of tangency between the POL and a person's indifference curve identifies the portfolio to be produced, if the prospective tenant chooses to undertake a lease. If the tangency point is at point *A* or to the right on line 1, the tenant will produce the same enterprises as an owner with similar risk preferences: the optimal portfolio for that market. On the other hand, if a tenant's indifference curve is tangent to the POL somewhere to the left of point *A*, they will be on EV_1, which is less risk efficient than points on line 1 to the left (i.e. line 1 offers the same returns at lower levels of risk than available on the EV_1 curve). Also, portfolios on EV_1 to the left of *A* are unique combinations of enterprises, not combinations of portfolio *A* and land leased out as is the case for points to the left of *A* on line 1. This means that tenants and owners selecting portfolios to the left of *A* will be producing different enterprises.

A tenant's profit function for holding his selected portfolio over some future period can be specified as

$$E_t(R_i) = E_t(GR_i)X_i \; + \; (-X_i R_f) \qquad (5)$$

where $E_t(GR_i)$ is the tenant's expected gross return from selected portfolio *i* and X_i is the amount of land in that portfolio. For tenants, whether the two X_i's are expressed in terms of portfolio proportions or acres, they must sum to zero[2] because no land is owned. The variance of returns for a portfolio held by a tenant is $X_i^2[\sigma^2_i]$.

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1 The portfolios making up the EV are available to tenants as long as sufficient land is available to lease in. Portfolios on line 1 to the right of point *A* are also available only if land requirements can be met. Note that points on line 1 to the right of *A* represent the same combination of enterprises as in portfolio *A*, except that increasing total amounts of land are used as a grower moves further to the right on the line. This means portfolios on the EV require less land than portfolios on line 1 to the right of *A*.

2 When expressed as proportions, the weightings X_i and $-X_i$ must be 1 and -1, since all land used is leased in and invested in the single crop portfolio R_i.

The focus of decision making by a utility-maximizing tenant is the certainty equivalent of $E_t(R_i)$, which is expressed like equation 3. This means that tenants face the same first-order conditions as owners and have a utility-maximizing portfolio composition,

$$X_i = \frac{E_t(GR_i)-R_f}{\gamma\sigma^2_i}, \qquad (6)$$

that is similar to that in equation 4 for owners (except that the optimal market portfolio is no longer the focus).

EFFECTS OF INCREASED RISK ON PRODUCERS' ENTERPRISE SELECTION

An increase in production risk[3] shifts the EV for all producers to the right, meaning that a higher level of risk must be accepted for each level of returns. In Figure 1 this is illustrated by a shift from EV_1 to EV_2. This new EV triggers a three-stage reaction. First, it creates a new POL with a lower slope encouraging land owners to lease out more land, rather than producing on it themselves. Second, the lower profitability of this POL is not high enough to attract tenants in sufficient numbers to enable owners to lease out all the land they wish, thus leasing rates fall until a new equilibrium rate is found (at R_{f2} in Figure 1), which establishes a new POL. Finally, the new POL has a higher slope which may cause land owners to lease in more land to use in the production of a less risky portfolio of enterprises.

In the sections below, the affects of increased risk on production decisions are discussed in more detail for land owners and tenants. To illustrate the affects of land holding status, as well, the remaining discussion will take the case of an owner and a tenant with exactly the same expectations concerning gross returns and with identical

3 Production risk is one source of what finance specialists call "business risk". Business risk and financial risk are the two components of a firm's "total risk" (Van Horne).

risk attitudes. It is hypothesized that increased risk affects production decisions both directly and indirectly through other factors, as described below.

Direct Affects of an Increase in Perceived Risk

The first question to be addressed is what direct affects do increases in risk levels have on production decisions of owners and tenants? To begin it is assumed that a land owner and tenant each face a leasing rate of R_{f1}, making line 1 the relevant POL in Figure 1. The indifference curve I_1 reflects the risk attitudes of both people. Since I_1 is tangent to line 1 at point *A*, the land owner and tenant would both select the same portfolio. Portfolio *A* requires that the land owner use all of his land for production of the enterprises in that portfolio (which is the optimal portfolio). The tenant would also produce the enterprises in portfolio *A*. (For now it is assumed that the tenant would be able to lease in the amount of acreage necessary to achieve the returns at point *A*.)

If the perceived level of risk increases, represented by a rightward shift in the EV to EV_2 in Figure 1, production decisions of the owner change significantly. Line 2 in Figure 1 becomes the relevant POL for owners and it is tangent to EV_2 at point R_{i2}. The owner's utility is decreased, as indicated by the move from indifference curve I_1 to I_2. The new selected portfolio for the owner is at point *B*. Portfolio *B* requires that the land owner use only part of his land for production of the enterprises in the portfolio at point R_{i2} (the new optimal portfolio), with the remaining acreage being leased out. The composition of portfolio R_{i2} is clearly more risky than that of portfolio *A*. Hence, owners respond to increases in risk by producing more risky crops, but they produce on fewer acres. As plotted, the difference between portfolios *A* and *B* is a reduction in both expected returns and risk levels, resulting in a decrease in the certainty equivalent (plotted at the intersection of the relevant indifference curve and the vertical axis).

The tenant will also change his cropping plans when risk levels increase. The tenant's POL becomes the combination of Line 2 in Figure 1 from point R_{i2} to the right

and the section of EV_2 to the left of R_{i2}. The tenant's utility is decreased, as indicated by the move to a lower indifference curve (which would be tangent to EV_2 at some point to the left of R_{i2}). The new selected portfolio for the tenant is at that point. The composition of that portfolio may be as risky as that of portfolio *A* although more risky than portfolio *B*. As plotted, the difference between the two selected portfolios is a reduction in expected returns with about the same risk level, resulting in a decrease in the certainty equivalent.

Another difference between the new selected portfolios of the land owner and tenant is in their degrees of risk efficiency. Since the two decision makers are assumed here to have identical risk preferences, the tenant would also choose portfolio *B* if he could, but he is unable to do so because it requires leasing out land which he does not have. Due to differences in their ownership control over land, production efforts of the two people generate different portfolios: the owner produces crops in the optimal (risk efficient) portfolio and the tenant produces his second best alternative which is the less efficient portfolio on EV_2. In this sense, the difference between the certainty equivalents of the relevant indifference curves represents an opportunity cost (benefit) to tenants (owners).

In response to the reduced profitability offered by POL_2, tenants' demand for land would decline, causing cash leasing rates to decline which, in turn, would cause changes in production plans. If leasing rates decrease to R_{f2}, production decisions of the owner change again. Line 3 in Figure 1 becomes the relevant POL for owners and it is tangent to EV_2 at point R_{i3}. The owner's utility is decreased further, as indicated by the move from indifference curve I_2 to I_3. The new selected portfolio for the owner is at point *C*. Portfolio *C* requires that the owner produce on all of his land and lease in additional land. The composition of the optimal portfolio, R_{i3}, is less risky than that of portfolio R_{i2} and, considering the owner's risk preferences, R_{i3} offers too little return given current leasing rates, hence portfolio *C* is selected. As plotted, the difference

between selected portfolios *B* and *C* is a relatively slight decrease in expected returns and an increase in risk levels, resulting in another decrease in the owner's certainty equivalent.

The tenant in this example will also choose to produce portfolio C with leasing rates at this level, however little land will be available. Increased demand for land by owners would leave little land for tenants unless cash lease rates were bid up. If leasing rates are R_{f2}, the tenant's POL becomes the combination of Line 3 in Figure 1 from point R_{i3} to the right and EV_2 to the left of R_{i3}.

Credit Limit Affects

An increase in the perceived level of production risk leads directly to a reduction in the amount of financial risk (measured as debt levels) which a firm can take on without raising its total risk exposure (Van Horne). Therefore, higher production risk will either cause interest rates charged to the firm to rise or the amount of credit extended to the firm to decrease.

Credit limits tightened by an increase in risk levels can have a significant affect on portfolio choice and its risk efficiency. This point can be illustrated using the case of an owner and tenant facing a POL like line 1 in Figure 1. Each producer would choose portfolio *A* if possible. If the owner needs to borrow additional funds to lease in land and expand production, he has the equity in his land to serve as collateral. The tenant, however, faces a much greater chance of being unable to borrow the full amount needed because he needs more funds (a tenant is leasing in *all* the land to be used in production, not just part of it like the owner) and has no equity in land to serve as collateral, hence, he may represent a more risky loan to the lender. If the tenant cannot borrow all the funds needed to produce the desired portfolio, he would find his new selected portfolio by moving to the left along his POL until the credit constraint was no longer binding. All opportunities on the POL to the right of the highest returning

portfolio which can be funded are not available to the decision maker. This means that for all producers credit constraints will, at some point, truncate the POL. For tenants, the lower their credit limits, the more likely they will be forced to select a portfolio on the less efficient EV portion of their POL. Also, it is important to note that *any* movement to the left on the POL due to credit limits reduces both expected and certainty equivalent returns. Such a reduction can be viewed as another opportunity cost (benefit) of lacking (possessing) land wealth.

The Decision to Produce Crops

The discussion of credit limits above raises the question: At what point do owners and tenants decide to *not* produce? For owners this refers to the point at which they prefer to lease out all of their land. For tenants, deciding not to produce is equivalent to deciding not to lease in any land. Despite this difference in perspective, the answer to the question is the same for owners and tenants. Any potential grower will decide to not produce when the certainty equivalent of expected returns from the selected portfolio is less than or equal to the sum of all opportunity costs faced, as explained below.

As inferred in equation 4, owners are concerned about the gross profits from leasing, therefore it is the certainty equivalent of expected gross returns which is relevant to their production decision. The opportunity costs incurred by owners involve both their land and labor assets. For a land owner, the foregone opportunity of investing land in crop production is the chance to collect cash lease payments, valued at R_f per acre. If a grower invests his own labor in crop production, he foregoes the opportunity to invest it off the farm where it would be valued at the equivalent of L (some number of dollars) per acre. Since both leasing out land and working for a wage off the farm are considered to be riskless investments, it is clear why a necessary condition for crop production on the part of a land owner is

$$E_o(U_i) \geq R_f + L \qquad (7)$$

where $E_o(U_i)$ is the certainty equivalent of expected gross returns to selected portfolio *i* and the factors on the right side are the opportunity costs.

Tenants are concerned about the net profits from leasing, therefore it is the certainty equivalent of expected net returns which is relevant to their production decision. The opportunity costs incurred by tenants involve only their labor assets since they have no land. If a potential tenant invests his labor in crop production, he foregoes the opportunity to invest it off the farm at a return of *L* per acre. Therefore, a necessary condition for crop production on the part of a tenant is

$$E_t(U_i) \geq L$$

where $E_t(U_i)$ is the tenant's certainty equivalent of expected net returns to selected portfolio *i* and the single opportunity cost is on the right side. This condition can be rearranged to be expressed as gross returns giving

$$E_t(U_i) \geq R_f + L$$

which is identical to equation 7. This means that a person facing a particular production opportunity would reach the same conclusion about whether or not to produce if they were an owner or tenant.

EMPIRICAL RESULTS AND POLICY IMPLICATIONS

In this section the survey results are summarized and their policy implications are discussed. First, the results are presented for each of the specific objectives listed earlier. Then, interpretation of those results is provided regarding six topic areas with a policy focus.

Objective 1

To determine why risk management tools are under-utilized in California, the answers to three questions proved to be useful: (1) What risk management tools do California producers use? (2) Which of these tools are preferred? (3) How do

producers rate available risk management tools relative to one another? The responses of producers to these questions are summarized in Table 1.

Question 1 produced the responses in the first column of Table 1. Diversification is the risk management tool used by more producers than any other tool available in California. This is not surprising in a state where 250 commodities are produced. It does support the hypothesis that producers have enterprise portfolios which can be adjusted in response to perceived changes in risk (Blank; Weimar and Hallam), as suggested by the portfolio theory outlined earlier. Forward contracting was also used by a majority of producers. The three other tools listed, hedging with futures or options, crop insurance, and government programs, were each used by a small minority of producers. The reason most often given for not using these risk management tools was their lack of availability for the specific enterprises under production.

The responses to question 2, summarized in the second column of Table 1, provide additional insight regarding the level of usage for the risk management tools. Forward contracting was the preferred method for dealing with risk because it guaranteed a reduction in price risk. Interestingly, 73% of producers responding indicated that they would use forward contracting first as a risk tool, yet only 61% are currently contracting. This indicates that many producers would like to contract, but do not have the opportunity in their particular markets. Diversification was a distant second in popularity with only 26% of respondents preferring it as a risk management tool. The reasons given indicate that diversification is viewed as "less of a sure thing" regarding its ability to reduce risk. Even so, most producers are diversified, meaning that they believe some risk reduction is worthwhile although not precisely forecastable. Hedging was the preferred risk management tool of only one percent of respondents. Those people were typically undiversified producers who had misgivings about the flexibility of forward contracting. The fact that crop insurance and participation in

government programs was not the preferred risk tool of any respondents is explained largely by their limited availability and the popularity of forward contracting.

The remainder of Table 1 presents the rankings given by producers in response to question 3. In general, forward contracting, diversification, and hedging were the highest ranked tools for managing risk (in that order). Clearly, crop insurance and government programs are not judged to be as useful in managing risk as are the other three tools. One reason given regarding crop insurance's limited usefulness was that its cost was considered "too high" relative to the expected benefits. A number of those people not using crop insurance did indicate that they would possibly use it if costs were lower; they were interested in its ability to insure against yield variability. Government program participation was judged to be too restricted in its coverage of various risks and "time consuming" for participants.

Objective 2

To identify changes in producer attitudes toward risk management methods in California, the following questions were asked: (1) Is risk included in management decisions? (2) Do risk variables enter into plans and decisions about enterprise selection and/or resource use and management? (3) Were producers able to plan contingencies for the drought and/or freeze using existing risk management strategies? If not, what did they do? (4a) Did the freeze and/or drought alter producers' attitudes toward or estimates of risk? (4b) If so, how will their risk management efforts be affected in the short-run? In the long-run? (5) Has the credit crunch affected any operating decisions of producers? The results are summarized in Table 2.

As a whole, the responses reported in Table 2 indicate that producers are now very aware of risk, yet over half were unprepared, to some degree, for the shocks of the drought, freeze, and credit crunch. Ninety-three percent of respondents indicated that they are currently considering risk in their decision making. Yet, many producers are apparently uncertain as to *how* to incorporate risk into their management plans. For

example, the most obvious place risk should be considered is in enterprise selection, yet only 62% are doing so. Those respondents not considering it when selecting enterprises often explained that they produced perennial crops, so they were "not selecting enterprises each year". Another indication of weak risk planning is the response to question 3 to which only 37% of producers claimed to have active contingency plans for major risks such as the drought or freeze. Question 4 results show that 53% of respondents now have a better appreciation for the need to consider risk in management planning than they did before the drought began. Yet, only 25% have developed new risk plans since that time. This result may show some confusion on the part of respondents because 31% replied positively to question 5, meaning that nearly one-third are reacting to the new credit environment. The most often cited example is a shift in enterprises to reduce credit needs by considering the timing of cash flows from particular enterprises in their "portfolio".

Objective 3

The survey asked producers to list and rank their specific criticisms of existing risk management tools, and to describe how these criticisms might be addressed. A wide range of responses were received, but a few criticisms were much more common than others and, therefore, are discussed below.

The most common complaint about relying on diversification as a means of managing risk was that it required investment in multiple sets of equipment and/or skills. This was considered a weakness because it complicated the production efforts and made them more costly. No solution for this problem was offered by respondents.

Forward contracting was criticized for causing sellers to be locked into delivering a fixed quantity of a product. Survey respondents mentioning this attribute of contracting were concerned about yield variability, saying that it prevented them from contracting more than 50-75% of their expected output, thus still being faced with

significant price risk as well. Their solution was to establish pricing contracts with no quantity specifications.

Hedging with futures or options was criticized for requiring "too much time and money". This response indicates that many producers still do not understand hedging. Due to that lack of familiarity, no solutions were offered by survey respondents.

The two most common complaints about crop insurance were that it was not available for a particular enterprise and that it "costs too much". The obvious solutions were listed. Some responses indicated unfamiliarity with crop insurance by suggesting that it be subsidized by the government (which it always has been) to lower rates.

The most common complaint about government program participation was that "the benefits did not always justify the paperwork". Surprisingly, not many solutions were suggested. In fact, many respondents suggested that government programs ought to be dropped or overhauled completely.

Policy Implications

Responses to many open-ended questions on the survey provide insight on how producers will react to perceived increases in risk and what the economic and policy implications of those factors might be. A brief discussion of the issues of concern in this new risk environment and their policy implications follows.

Drought. The long drought will cause natural resource use to change. Many farmers have decided to manage water risk by putting in more wells. As a result, increased state government involvement in both surface and ground water management may be required.

Farm size/productivity. Effective farm sizes have decreased with water shortages. Producers facing shortages fallow marginal land because focusing inputs on fewer acres is usually more profitable than spreading those inputs too thinly across more acres. As agricultural production is eliminated on plots of land tax revenues to

the state and local governments are reduced because in California taxes are based in part on the value of products produced on that land.

Land prices. Prices will decline due to the lower profits which are generated when producers must operate under water limitations. Lower land values lead to (1) lower property tax revenues to the state and (2) lower borrowing capacity of producers. For producers with significant debt levels, the loss of equity for use as collateral needed to borrow capital could force reductions in production, at the least, and possibly bankruptcy. The reduction in output would be due to reduced credit limits based on the lower equity level on a firm's balance sheet. Liquidation might be caused if the lower level of credit will not support sufficient production to generate cash flows meeting expense levels.

Supply stability. Questions about the availability of agricultural inputs may deter business development in the food processing and distribution sectors, thus hindering job creation. Despite California's growing population, investors may be slowed in the agricultural sector due to the overall reduction in profit levels brought about by the increased level of perceived risk.

Restructuring. Both reduced profitability and technological change in agricultural production mean that (1) there is more incentive to develop land into non-agricultural uses and (2) that fewer, larger firms are needed, possibly reducing labor needs further.

More firms at risk. The lower level of income in the agricultural sector expected as a result of the perceived increase in risk means that there will be increased financial stress among producers. This will lead to increased demand for education and guidance on the part of those producers. Even firms able to absorb increased financial risk will experience adjustments due to the necessary shifts in enterprise portfolios. Also, the entire agricultural sector will be adjusting its portfolio in the sense that enterprise acreages will be redistributed across the state and western region.

SUMMARY AND CONCLUSIONS

This paper has evaluated the effects of a perceived increase in the risk environment of agricultural production in California and found that significant economic and policy implications are anticipated. Using a portfolio model, hypotheses were derived concerning the reaction of individual producers to the shift in risk. Empirical data was collected by survey and interviews to test whether the hypothesized reactions were, in fact, beginning to occur. From the preliminary results reported here it does appear that agricultural producers are reacting in the rational manner hypothesized. This has significant implications for the economic well-being of California's agricultural sector. Among those are: (1) all producers will face lower incomes and/or higher levels of risk, (2) enterprise selections of individuals will be adjusted leading to acreage redistributions across the state, (3) lower income levels will increase the degree of financial stress in the agricultural sector, (4) lower incomes will cause land values to decline, thus reducing equity needed as collateral for loans, leading to the credit crunch already evident, and (5) less land will be in agricultural production, leading to reductions in tax revenues to state and local governments, and adding incentive to develop more land into non-agricultural uses. It is unclear at present how significant will be the final adjustments to the perceived risk increase because the degree of new business risk perceived to exist in the agricultural sector is not yet known; the adjustments are still ongoing. Yet, it is clear that the successive shocks of a prolonged drought and a severe freeze have altered attitudes about risk in the agricultural sector and have caused risk management to become a more integral part of producers' decision-making. This development, in turn, may lead to improved efficiency in resource use within the sector according to both theoretical and empirical observation. Unfortunately, the timing of this transition may be adding to the recessionary conditions within California's economy.

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Table 1. Producers' View of Risk Management Tools

	Used?	Preferred?	Rank (%)				
	(%)	(%)	1st	2nd	3rd	4th	5th
Diversification	86	26	26	57	8	6	3
Forward contract	61	73	73	26	1	0	0
Hedging	14	1	1	17	63	17	2
Crop insurance	9	0	0	0	22	15	63
Gov program	7	0	0	0	6	62	32

Table 2. Producers' Attitudes Toward Risk

	Yes (%)
Risk used in decision-making?	93
Risk used in enterprise selection?	62
Risk contingency plans?	37
Drought/freeze altered risk attitudes?	53
New risk plans developed?	25
Credit crunch influenced operations?	31

Figure 1. The Effects of Increased Risk on Producers' Enterprise Selection