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FARM PORTFOLIO ADJUSTMENTS TO THE ELIMINATION OF U.S. TARGET AND SUPPORT PRICE PROVISIONS

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FARM PORTFOLIO ADJUSTMENTS TO THE ELIMINATION OF U.S. TARGET AND SUPPORT PRICE PROVISIONS

Allen Featherstone and Timothy G. Baker[1]

One of the major recurring farm policy issues facing Federal policymakers is that of choosing the appropriate form of farm commodity programs. One dimension of the current problem is the cost of agricultural programs at a time of high Federal budget deficits. With efforts to reduce the deficit aimed at cutting expenditures, money spent on price and income stabilization will come under increased scrutiny.

A second dimension of the policy problem is that farm commodity programs are often subject to great criticism. They have been said to: return a negative social rate of return, have benefits that accrue largely to big producers who do not need the support to survive, provide benefits that in large increase rent and thus land prices, and have detrimental effects on U.S. agricultural trade (Gardner; Lin, Johnson, and Calvin; Rasmussan; U.S. Senate).

Juxtaposed to the criticisms of commodity programs is the argument that programs, such as the loan rates and target price programs for grains are needed to reduce the price and income stability problem--the propensity for farm prices and incomes to swing up and down, widely and sharply, in an unpredictable fashion. Stability arguments are based partially on economic rationale but are also motivated by the humanitarian desire to reduce the pain and suffering associated with farm bankruptcies.

Although it does not look like the U.S. is going to completely eliminate all price and income supports in the immediate future, information is needed on the possible farm level effects of such a step for future farm policy debates. The purpose of this paper is to report results from a study of likely farm level effects of alternative price and income support programs including complete elimination of loan rates and target prices. A representative Midwestern corn-soybean-hog farm model is used to determine the effects of alternative programs on 1) farm income variability, use of debt, probability of survival, and growth; 2) farm income and wealth; 3) diversification of corn-soybean-hog farms into other farm enterprises and into non-farm employment and investment; and 4) determine how effects

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of alternative programs vary across farmers with different levels of initial leverage. The primary contribution of this study over previous examinations of farm policy effects is the estimation of optimal farm debt and investment adjustments due to the differing risks of alternative policies.

The remainder of this paper is organized in the following manner. The theory is briefly discussed in the next section. The procedures are then outlined followed by the results. Finally, the paper concludes with a brief summary of the results and a discussion of the policy implications of this study.

Theory

Theoretical evidence indicates that the effects of such policies are intertwined with the debt financing and investment decisions of farmers as well as with rent, asset values, and farm wealth (Barry and Baker). It is generally taken for granted that programs which reduce price variability will reduce income variability and improve the financial stability of farmers. This view, which may be true in the short run, is flawed. When a farmer's choice of the amount of money to borrow is viewed as an economic optimizing decision, the effects of price stability programs may actually increase the probability of farm bankruptcies (Featherstone, Moss, and Baker).

The major difference between this study and previous farm level analysis of similar policies (e.g., O'Brien and Fulton; Ryan, et al.; and Boehlje and Griffin) is that the debt financing is treated as an optimizing decision. Previous approaches have been largely simulation analysis and have not incorporated optimal leverage adjustments. Thus, they may tend to exaggerate the actual effects of increased risk, since they do not allow the simulated farm to optimally choose a lower level of leverage or make other liquidity management adjustments.

Procedures

Discrete stochastic programming was chosen as the quantitative technique to model the farm decision making process. There have been few applications of discrete stochastic programming in the agricultural economics literature. Discrete stochastic programming was developed by Cocks in 1968. Rae modeled the problem of fresh vegetable storage. Another empirical application of discrete stochastic programming has been to model the optimal investment in grain dryers and grain storage facilities (Klemme). Leatham uses discrete stochastic programming to model the choice between fixed and variable rate loans.

Discrete stochastic programming can be thought of as a mathematical programming formulation of a decision tree. Discrete stochastic programming has tremendous intuitive appeal as the decision maker's knowledge of outcomes of future events can change over time. Also, once the optimal plans are provided,

recommendations for modifying the initial optimal plan as uncertainty is unraveled through time are also provided.

The main disadvantages of discrete stochastic programming are the need for detailed probability information and "the curse of dimensionality." Every state on the decision tree needs full information on prices, yields, and interest rates. Thus, a large number of assumptions must be made to simplify the continuous probability model into a small number of discrete outcomes. Also, the model gets very large as the number of years and number of probabilistic outcomes increases. The size of the model grows exponentially as the number of stages (years) increases.

An expected utility maximizing model of an Indiana farmers' production, investment, and financing decisions was developed. The model consists of 900 nonlinear variables, 4,262 constraints, and 6,225 activities, which are used to model a four year planning horizon.

In this study, three alternative programs were examined: (1) loan rates and target prices at the 1984-85 level, (2) loan rates and target prices at 1986 levels, and (3) the elimination of loan rates and target prices. The three alternative policies will be referred to as the 1981 programs, the 1985 programs, and the Free Market respectively.

Broadly defined the remaining procedures needed to set up the Indiana representative farm model were threefold: (1) specify the economic environment under alternative farm programs in a probability distribution sense, (2) develop a firm level representative farm model that includes investment and debt financing as optimally chosen variables, and (3) examine the effects of alternative policies.

The Probability Model

An Indiana crop-hog farmer faces many uncertain variables. These include prices, yields, and interest rates. If the model is to approach reality, these uncertain outcomes must be modeled in a manner such that interrelationships between the uncertain variables must approach those that the decision maker subjectively perceives.

PC WHEATSIM and FEEDSIM (Holland and Sharples; Chattin, Hillberg, and Holland) were used to stochastically simulate corn, soybean, and wheat prices under the alternative policies. These models were chosen because of their stochastic nature. Other policy simulation models were considered but were not used because they did not allow stochastic simulations. Results of the corn, soybean, and wheat price simulations under each policy scenario are found in Table 1.

For this study, it is assumed that the decision maker perceives corn, soybean and wheat prices to follow a random walk

stochastic process. The price of hogs is assumed to follow a slightly different process based on the work of Brandt and Bessler. They suggest that hogs prices are affected by hog prices three quarters previous and corn prices two quarters previous. They also found other variables to be significant but these variables are outside our probability model and will be included in the error term. The corn, soybean, wheat, and hog prices are assumed to have the following stochastic processes:

$$(1)\quad P_{Ct} = P_{Ct-1} + \bar{P}_{Ct} + e_{Ct}$$

$$(2)\quad P_{St} = P_{St-1} + \bar{P}_{St} + e_{St}$$

$$(3)\quad P_{Wt} = P_{Wt-1} + \bar{P}_{Wt} + e_{Wt}$$

$$(4)\quad P_{Ht} = \underset{(1.69)}{19.61} + \underset{(1.79)}{.39} P_{Ht-1} + \underset{(1.24)}{4.52} P_{Ct-1} + \bar{P}_{Ht} + e_{Ht}$$

where P_{Ct}, P_{St}, P_{Wt}, P_{Ht} represent the price of corn, soybeans, wheat and hogs n period t respectively; P_{Ct}, P_{St}, P_{Wt}, P_{Ht} represent the mean change in price in year t; and e_{Ct}, e_{St}, e_{Wt}, e_{Ht} represent the random shocks to prices in year t. The error terms are assumed to be distributed multivariate normal with mean zero and variance-covariance matrix of Σ.

The real interest rate is assumed to follow a random walk stochastic process that is independent of prices. That is:

$$(5)\quad r_t = r_{t-1} + \bar{r}_t + e_t$$

where r_t is the real interest rate for period t, $\bar{r}_t$ is the mean change in real interest rate-assumed to be zero for this study, e_t is distributed as normal with mean zero and standard deviation equal to .02.

Gallagher provides evidence that U.S. corn yields are negatively skewed with an upper limit on output and a good chance of occasional low yields. Based on Gallagher's work, we assume that corn yield has a negatively skewed distribution. We also assume that soybean and wheat yields also are negatively skewed. The stochastic nature of yields are modeled in the following manner:

$$(6)\quad Y_{Ct} = M_C + b_1 t - e_{Ct}$$

$$(7)\quad Y_{St} = M_S + b_2 t - e_{St}$$

$$(8)\quad Y_{Wt} = M_W + b_3 t - e_{Wt}$$

where Y_{Ct}, Y_{St}, and Y_{Wt} are the yield for corn, soybeans, and wheat, respectively in time t; M_C, M_S, and M_W are the maximum potential yield for corn, soybeans and wheat; b_1, b_2, and b_3 are the estimated time trend in yields; and e_{Ct}, e_{St}, and e_{Wt} are a random shock in yields. The error term is distributed multivariate lognormal with mean u and variance Σ.

Direct production costs of corn, soybeans, wheat, and hogs; tax rates, rent, land price, wages, consumption, machinery prices and hog facilities prices are assumed to be nonstochastic for this study. The previous probability model discussion serves as the base for choosing the discrete outcomes needed for the mathematical model.

The Representative Farm Model

This section describes the modeling of an 800 acre representative Indiana crop-hog farm. Because of the curse of dimensionality, there is an inherent trade-off between the number of states and the number of time periods modeled. One way to possibly ease the curse of dimensionality would be to supply the model with richer probability information in the short term and less detailed information in the longer term. A decision maker is more likely to be able to formulate and describe detailed probability information in the near term than the long term. A four year horizon was chosen for this study with 9 states in the first year, 5 states for the second and third years, and 4 states for the final period. Eliminating the less important constraints and activities also helps reduce the curse of dimensionality

The farm operator operates in a competitive environment. This implies that all prices for inputs and outputs are viewed as parameters. The farmer is operating under constant returns to scale as farm size increases or decreases.

For this study, it is assumed that the farmer is an expected utility maximizer. The individual is assumed to have a negative exponential utility function. This implies that the farmer has a constant absolute aversion to risk. It is also assumed that the individual withdraws a constant amount of money from the farm business for family living expenses each year; whether the farmer had a profitable or unprofitable year. Thus the farmer can maximize discounted terminal net worth instead of maximizing income from each year. It is also assumed that in real terms that a dollar of income earned today provides the same utility as a dollar of income earned in the future, thus the discount factor is assumed to be one.

The farm operator maximizes the expected utility from ending equity subject to certain constraints. These constraints include financial constraints, technical constraints, and accounting constraints. The activities that are available to the farmer include purchasing and selling land, cash or share renting land, purchasing hog facilities, hiring labor, raising corn and soybeans

(rotation), wheat, and hogs, borrowing money, investing off the farm in a "safe" asset, and working off the farm.

The adjustment of land price and rent to alternative agricultural policies must be modeled to effectively evaluate alternative policies. A rent and land adjustment equation is estimated based on a set of historical nominal returns to Indiana land. It is assumed that the pricing of rent and land will follow the same underlying process under alternative policies. The estimated rent adjustment equation is:

$$(9) \quad R_t = \underset{(.681)}{3.7848} + \underset{(3.084)}{.0812} I_t + \underset{(13.882)}{.8652} R_{t-1}$$

where R_t is the real cash rent in period t, I_t is the real returns to a corn and soybean rotation. The t-ratios are below the estimates in parentheses. The estimated R-squared for this equation is .913. In the short-run, a one dollar change in the real returns to rotation corn and soybeans will raise cash rent by 8.1 cents. In the long-run, a one dollar change in returns will increase cash rent by 60.3 cents.

The land price adjustment equation is based upon the familiar capitalization formula. Land price is a function of rent and lagged land prices:

$$(10) \quad L_t = \underset{(.446)}{-36.652} + \underset{(3.321)}{5.936} R_t + \underset{(5.038)}{1.097} L_{t-1} - \underset{(2.549)}{.438} L_{t-2}$$

where L_t is the real land price in period t and R_t is the real cash rent in period t. The R-squared for this estimated equation is .959. The estimated land equation exhibits cyclical behavior similar to that documented by Burt. In the short-run, a one dollar increase in cash rent is capitalized at the real rate of 16.8 percent. In the long run, a one dollar increase in rent is capitalized at the real rate of 5.7 percent.

Financial Modeling

One of the primary objectives of this study was to examine desired debt use under alternative programs. Therefore, it was necessary to add features to the representative farm model to incorporate ideas such as credit reserve risk and liquidity risk. Agriculture is inherently a risky business, hence there is a need for liquidity in the normal course of a farm's operation because of the variability in farm income. Many times, however, a reduction in liquidity occurs precisely at the time when a firm needs the extra cash to meet it's obligations. This is known as liquidity risk. The farmer's ability to meet it's cash obligations is in greatest jeopardy when a sequence of bad years occur if he has not carried sufficient liquidity reserves, because productive assets may have to be sold off at values far below "fair" market value to meet cash obligations.

To capture the concept of liquidity risk in the representative farm model, an additional two percent transactions cost was charged for selling land for each year that land price declined. The normal transactions cost for selling land was assumed to be ten percent. If land price declined one year the transactions cost for selling land was twelve percent. If land price declined for two years in a row, the transactions cost for selling land was assumed to be 14 percent etc. Modeling the transactions cost for land in this manner places the farmer in greatest jeopardy when land has declined for several years in a row and captures some of the essence of liquidity risk.

Credit reserve risk (Barry, Baker and Sanint) is incorporated into the model through the external credit rationing constraint. The maximum amount of credit is equal to either last period's debt or this year's beginning equity depending on whether land price increased or decreased. If land price increased, the market value of equity was likely to grow, therefore the lender will allow a credit equal to the current market value of equity. If land price decreased, equity was likely to fall. If equity fell, the credit limit is equal to last period's debt. Credit reserves are extremely risky when modeled in this manner because if land prices fall, the entire credit reserve is lost.

Off-farm investment was included as an activity to help combat the loss of credit reserves. A farmer can invest a dollar of assets off the farm and earn a rate two percentage points below what the farmer pays for borrowing. If a farmer simultaneously is holding off-farm investments and debt, then the off-farm investment may be used to insure a credit reserve. The farmer is paying a premium of two percent so that the ability to borrow after land price declines is maintained.

The probability model specified in the previous section of this paper is continuous. Discrete outcomes are necessary for the mathematical model. Several methods of selecting the alternative states of nature were considered. These ranged from a purely random sampling technique to a stratified sampling technique. The method used for this study was a combination of stratified and random sampling. For further information on this technique along with further information on the mathematical or probability model see Featherstone.

The Results

The farm level effects of alternative agricultural policies are examined on a representative Indiana corn-soybean-hog farm under three initial leverage positions. First, a farm with forty percent initial leverage is discussed. Next, a representative Indiana farmer with initial leverage of seventy percent debt is discussed. Finally, a farmer with no initial debt is discussed. For each initial debt position, the effect of a farmer's aversion to risk is also examined. Five levels of risk aversion are studied ranging from moderate risk aversion (Arrow-Pratt measure

of absolute risk aversion of .005) to being nearly risk neutral (.00005). Wilson and Eidman found that attempts to empirically measure the Arrow-Pratt absolute risk aversion coefficient produced a range of -.0002 to .0012.

40 percent debt

Based on expected utility, either the 1981 or 1985 programs are preferred over the Free Market by the farm operator at any level of risk aversion. The level of utility is greater with government programs than without programs as can be seen with the expected value and variance (EV) curve in Figure 1. Every point on the Free Market curve lies below and to the right of either the 1981 or 1985 programs curve. The expected value and variance of terminal wealth do not change much under either the 1981 or 1985 programs as the risk aversion coefficient is varied. Under the 1985 programs, the farm operator is able to obtain higher utility than under the 1981 programs at all risk aversion coefficients but .005. Because of the twenty percent setaside requirement, corn prices tend to be more variable under the 1985 programs (Table 1), hence there is more positive deviation that the farm operator under the 1985 programs can take advantage of. However, the target prices are virtually the same under either program, therefore the negative deviation is about the same as under the 1981 programs.

The expected terminal net worth is greatest under the 1985 programs, followed by the 1981 programs, followed by the Free Market scenario (Table 2). The expected ending net worth under the 1985 programs is about three percent higher than the expected ending wealth under the 1981 programs. The expected ending wealth under the Free Market scenario is between 16 and 22 percent less than the terminal wealth under the 1981 programs depending on the level of risk aversion. The expected wealth under either the 1981 or 1985 programs does not vary much as the risk aversion coefficient is varied. Under all three policy scenarios, the expected terminal wealth is expected to increase, from the initial level of equity of $750,000.

The expected terminal net worth is riskier under the Free Market than under either the 1981 or 1985 programs. Riskiness is measured using the coefficient of variation of terminal net worth and is found in Table 2. The 1985 programs terminal net worth is about twenty percent riskier than the terminal net worth under the 1981 programs.

An estimate of the minimum terminal wealth needed to be guaranteed to the farm operator to induce this farm operator to leave farming is found in column 5 of Table 2. The farmer operating under the 1981 programs would need to be guaranteed a real annual return of 10.3 to 12.6 percent depending on his level of risk aversion to leave farming. The farmer operating under the 1985 programs would need a return of between 10.1 and 13.4 percent

to exit from farming. The Free Market operator would need an annual real return of between 2.9 and 7.7 percent to exit farming.

The amount of debt, credit reserves, and off-farm investment under alternative farm programs for various risk aversion levels are listed in Table 3. Results indicate that for all practical purposes, the farmer does not deviate from the initial 40 percent debt to asset ratio under the 1981 programs. The farmer holds the same level of debt in the second year, if the most likely outcome occurs, as in the first year. There is no need for off-farm investment to be used as a liquidity reserve under the 1981 programs. The farmer operating under the 1985 programs increases his borrowing to almost fifty percent if he is nearly risk neutral (.00005). However, the extra money borrowed during the first year is invested off the farm and held for investment after the first year. If the most likely outcome occurs, land price decreases, hence the individual would not be able to expand his borrowing capacity beyond what he had the previous year. Because of this, the farmer borrows when the credit is available and invests the money at a cost of two percent to maintain the credit reserve for the following year.

If a farmer is more risk averse and operating under the 1985 programs, the amount of debt held is about the same as that held under the 1981 programs. The Free Market farmer that is nearly risk neutral (.00005 and .0001) holds slightly more debt than the 1981 farmer. An extra $9,000 are borrowed and used as a liquidity reserve in case land price declines. As the Free Market farmer becomes more risk averse, debt use declines. The results of the optimal amount of debt conform to Collins' results for the first year if the risk aversion coefficient is .005 through .0005. Collins' results show that as more government programs are used, the amount of debt held by the utility maximizing farmer increases. If a farmer is more risk neutral, the results do not hold. One possible explanation for the results not holding as the more risk neutral levels is that the model here is a transitional model, whereas Collins' results come from an equilibrium model. Hence, the farmer that is nearly risk neutral may be able to avoid making painful leverage adjustments for a short period of time, while the more risk averse individual makes the adjustments.

The first year's portfolio of hogs, rotation acreage, and wheat are identical for the 1981 and 1985 farmers at every level of risk aversion examined (Table 4). The Free Market farmer grows a larger proportion of wheat than either the 1981 or 1985 farmers during the first year. The second year, under the most likely outcome, the Free Market farmer does not grow any wheat under any risk aversion coefficient. The farmers operating under either of the government programs grow wheat if they are fairly risk averse. The Free Market farmer raises more hogs than he would if he was operating under either of the government program scenarios if he is more risk averse than .0001. Also, if the Free Market farmer is more risk averse than .0001, the farmer raises less than 800

acres of crops. At a risk aversion coefficient of .005, the Free Market farmer raises 86 acres of share rented corn and soybeans.

Shadow prices and penalty costs of the contribution of an extra unit of crops or hogs in period one to the certainty equivalent are presented in Table 5. These shadow prices listed may or may not be unique, but they are exact for the particular solution. The method for determining these shadow prices can be found in Preckel et al. Another acre of land available for use at no cost to the operator would return the most under the 1985 programs. Another acre of land available for use under the 1981 programs and the Free Market scenario would return at the margin about the same in certainty equivalents. The shadow price on the acre of owned land can be interpreted as the rent that the farm operator would be able to pay in terms of certainty equivalents to obtain another acre of land. The shadow price on another acre of owned land is very similar to the shadow price on the acre of cash rent, except that the shadow price on cash rent assumes the crop grown is corn and soybeans, while the shadow price on the owned land allows the crop to be chosen in an optimal manner. Another acre of wheat base is more profitable under the 1981 programs than under the 1985 programs. As a farmer becomes more risk averse, another acre of wheat base becomes more valuable under both the 1981 and 1985 programs. Another dollar of hog facilities return about the same certainty equivalent under any of the policy scenarios.

Off-farm labor use is about equal under either the 1981 or 1985 farm policy scenarios. Labor supplied off the farm increases under the Free Market scenario. As the farmer is more risk averse, he is more involved in off-farm employment. If the farmer is nearly risk neutral (.00005) twelve percent more labor is supplied, however if the farmer is more risk averse, about fifty percent more labor is supplied off the farm under the Free Market scenario.

The incentives for growth in farm size are much greater under the 1981 or 1985 programs than under the Free Market scenario (Table 6). Under average outcomes, after three years, the farm under the 1981 programs is slightly larger than the farm under the 1985 programs; while being much larger than the farm under the Free Market Scenario. The level of risk aversion does not affect the growth in farm size under the 1981 programs. If a farmer operating under the 1985 farm programs is more risk averse, then the farm after three years of "average" outcomes will be smaller than if he was less risk averse. The Free Market farmer has no intentions to increase farm size from the initial size of 800 acres under "average" outcomes. In fact, if a farmer is more risk averse, then he will even sell off a portion of the farm.

A farmer operating under either the 1981 or 1985 farm programs,is willing to pay about the same for another acre of land (Table 6, column 5). If the farmer is more risk neutral, another acre of land is worth slightly more under the 1985 programs,

however, if the farmer is more risk averse, then another acre of land is slightly more valuable under the 1981 farm programs. Under both the 1981 or 1985 programs, if a farmer is more risk averse, he is willing to offer less to get another acre of land. The marginal value of another acre of land in terms of certainty equivalents is negative for the farmer operating under the Free Market scenario. If a farmer is more risk averse, the marginal value of additional land becomes more negative.

A farmer operating under the 1985 programs is willing to pay the most for an additional dollar of beginning equity (Table 6, columns 6 and 7). A farmer that is nearly risk neutral (.00005) is earning a certain annual return to initial equity of 10.3, 9.7, and 9.0 percent at the margin under the 1985 programs, the 1981 programs, and the Free Market scenarios, respectively. A farmer that is more risk averse (.005) is earning 6.8, 7.2, and 5.5 percent at the margin under the 1985 programs, the 1981 programs, and the Free Market scenarios, respectively.

70 percent debt

As was the case with the farm with 40 percent initial debt, based on expected utility, the 1981 and the 1985 programs are preferred over the Free Market scenario, by the farm operator at any level of risk aversion. The level of utility is greater with government programs than without government programs as can be seems using the EV curves in Figure 2. The expected value and variance of terminal wealth does not change very much under either the 1981 or 1985 programs as the risk aversion coefficient is varied as was the case with the 40 percent debt farm. The farmer operating under the 1985 programs is able to obtain more utility under the 1985 programs than under the 1981 programs at all but one level of risk aversion (.005).

The terminal net worth is greatest under the 1985 programs, followed by the 1981 programs, followed by the Free Market scenario as was the case under 40 percent initial debt (Table 7). The expected ending net worth under the 1985 programs is between six and seven percent higher than under the 1981 programs. The expected ending wealth under the Free Market scenario is between 25 and 37 percent less than the terminal wealth under the 1981 programs. In absolute dollars these differences among policies are about the same as the differences under the farm with 40 percent initial debt. Under all three policy scenarios, the expected terminal wealth is expected to increase over the initial equity level of 375,000.

As was the case with the farm with 40 percent initial debt, the expected terminal net worth is riskier under the Free Market than under either the 1981 or 1985 programs. The 1985 programs terminal wealth is about 30 percent more risky than the 1981 programs terminal wealth. The coefficient of variations on terminal wealth are about double what they were on the farm with 40 percent initial debt.

The farmer operating under the 1981 programs would need to be guaranteed a real annal return of between 14.6 and 20.3 percent depending on his level of risk aversion to leave farming. The farmer operating under the 1985 programs would need a return of between 14.6 and 22.0 percent to leave farming. The Free Market operator would need an annual real return of between .6 and 11.4 percent to exit farming. Under the 1981 and 1985 programs, the return needed to exit farming is larger on the farm with 70 percent initial debt than the required return on the farm with forty percent debt for all levels of risk aversion. Also, there is no probability of bankruptcy on the farms with initial debt of 40 or 70 percent under the 1981 or 1985 programs. Under the Free Market scenario, the required return to exit from farming, is higher for the more risk neutral farm operator while being lower for the farmer who is more risk averse. Under the Free Market scenario on a farm with 40 percent initial debt there is no probability of anticipated bankruptcy as the farmer plans to be able to exit from farming while maintaining a positive equity even when prices and incomes are extremely low. However, under the Free Market scenario, when the farmer has an initial debt of 70 percent, there is a positive probability of bankruptcy at every risk aversion level except .005. These results are different than those of the theoretical model of Featherstone, Moss, and Baker (FMB). One reason for the difference is that the FMB results are comparative statics, that is they compare results from two equilibrium positions. This model is a transition model, which may account for the differences.

The amount of debt, credit reserves, and off-farm investment under alternative farm programs for various risk aversion levels for the farm with initial debt of 70 percent are found in Table 8. For all practical purposes, the farmer does not deviate from the initial 70 percent debt to asset ratio under the 1981 programs. The farmer holds the same amount of debt during the second year under the most likely outcome as in the first year. There is no need for the farmer to invest off the farm as was the case for the 40 percent debt farmer under the 1981 programs. The farmer operating under the 1985 programs increases borrowing nearly up to his credit limit during the first year if he is more risk neutral (.0001 or .00005). As was the case on the 40 percent debt farm, this extra initial borrowing during the first year is to maintain the credit reserve for the second period. The farmer operating under the Free Market scenario, uses off-farm investment to maintain liquidity for a risk aversion level of .00005. As the farmer becomes more risk averse, the Free Market farmer begins to decrease the amount of debt use. For the risk aversion levels of .005 through .0005, the results suggest that Collins' results hold. However for the more risk neutral individuals, the results do not hold for the reasons explained above in the forty percent debt case.

The first year's portfolio of hogs, rotation acreage, and wheat are identical for the farmers operating under the 1981 and the 1985 programs for every level of risk aversion studied (Table

9). In fact, these portfolios are identical to those on the farms with initial debt of 40 percent. The Free Market farmer's portfolio is also the same as it is on the farm with 40 percent initial debt at the same risk aversion levels for all but one case. If the farmer has a risk aversion coefficient of .005, then less wheat and less hogs are raised on the farm with 70 percent initial debt than on the farm with 40 percent initial debt. The Free Market farmer with a risk aversion coefficient of .005 grows 101 acres of rotation on share rented land. During the second year on the farm with 70 percent initial debt, less acres of rotation are grown under all three policy scenarios than on the farm with initial debt of 40 percent.

At the margin, another acre of owned land is more valuable on the farm with 70 percent initial debt than on the farm with 40 percent initial debt for all three policy scenarios (Table 10). The penalty cost for another acre of land cash rented is greater on the farm with 70 percent debt than on the farm with 40 percent debt for most levels of risk aversion. Wheat remains more profitable on the farm under the 1981 programs than on the farm operating under the 1985 programs. If the farmer is more risk averse, the value of another acre of wheat base is larger than if the farmer was less risk averse. The value of hogs in terms of certainty equivalent increases if the farm has an initial debt level of 70 percent instead of 40 percent under all three policy scenarios. Incentives exist for the farm to be more diversified if the initial debt position is 70 percent instead of 40 percent under all three policy scenarios.

The same amount of off-farm labor is supplied at every level of risk aversion under any policy alternative on the farms with 40 percent debt as on the farms with 70 percent debt. More off-farm labor is supplied under the Free Market scenario than under the 1981 or 1985 programs.

Land is more valuable per acre on the farm with 70 percent initial debt than on the farm with 40 percent initial debt for farms operating under the 1981 or 1985 farm programs (Table 11). One reason for this may be that under the 1981 and 1985 farm programs the return on land is very certain, at least on the low end of the distribution. Therefore, under conditions of higher leverage, being able to obtain a resource that has a lower bound on return is worth more to the farm operator in terms of certainty equivalent. Conversely, under the Free Market scenario the value of an extra acre of land is less negative on the farm with 40 percent initial debt than on the farm with 70 percent initial debt. As would be expected given the shadow prices, the size of the farms under the 1981 and 1985 programs are larger if the farm has initial debt of 70 percent instead of 40 percent. If a farm begins with 70 percent initial debt, the 1981 farm owns the most land followed by the 1985 farm followed by the Free Market farm after three years of average occurrences.

A farmer operating under the 1985 programs is willing to pay more for an extra dollar of beginning equity at all but one level of risk aversion (Table 11). The marginal value of an extra dollar of equity is more valuable in terms of certainty equivalents on the farm with 70 percent debt than on the farm with 40 percent initial debt. At the margin, if a farm operator has a risk aversion coefficient of .00005 then a marginal dollar of equity earns a 13.3, 14.8, and 13.9 percent certain return per year under the 1981 programs, the 1985 programs, and the Free Market. An extra dollar of equity earns more at the margin for this farmer under the Free Market scenario than under the 1981 programs, unlike the situation for the farm with 40 percent initial debt. At a risk aversion coefficient of .005 on the farm with 70 percent initial debt, an extra dollar of equity earns 7.7, 7.3, and 7.4 percent under the 1981 programs, the 1985 programs, and the Free Market scenarios respectively. Equity on the Free Market is relatively more valuable than on the 40 percent debt farm.

No initial debt

Based on expected utility, the 1981 and 1985 programs are preferred over the Free Market scenario by farmers with any risk aversion coefficient examined. The expected value and variance of terminal wealth does not change much under either the 1981 or 1985 programs as was the case using the other initial debt levels (Figure 3). The farmer operating under the 1981 programs is able to obtain more utility at a risk aversion level of .005 than the 1985 farmer, otherwise the 1985 programs are preferred over the 1981 farm programs by the less risk averse farmers.

The terminal wealth is greatest under the 1985 programs followed by the 1981 programs followed by the Free Market scenario as was the case on the other two farms examined (40 and 70 percent initial debt). The expected ending wealth under the 1985 programs is between two and three percent higher than under the 1981 programs (Table 12). The expected ending terminal wealth is between ten and fifteen percent lower than under the Free Market. Under all three policy scenarios, the expected terminal wealth is expected to increase from the initial wealth position of $1,250,000.

The expected terminal net worth is riskier under the Free Market than under the 1981 or 1985 programs. It is interesting to note that the terminal wealth on the Free Market farm with no initial debt is less risky than the terminal wealth on a farm operating under the 1981 and 1985 programs with initial debt of 70 percent. The coefficients of variation on the farms with no initial debt are not much different than those on the farms with 40 percent initial debt.

The farmer operating under the 1981 programs would need to be guaranteed a real annual return to equity of between 8.8 and 10.9 percent depending on the risk aversion coefficient to exit

farming. The farmer operating under the 1985 programs would need a return of between 8.5 and 11.6 percent to exit from farming. The Free Market farmer would need a guaranteed annual real return of between 3.7 and 7.8 to leave farming. The Free Market farmer needs a higher return to leave farming if he has no initial debt than if he has an initial debt level of 40 percent on a farm with otherwise the same initial characteristics. Whereas, the farmers operating under the 1981 or 1985 programs need a higher return on equity on the forty percent debt farm than they do on the farm with no initial debt. Bankruptcy problems do not occur under any scenario as was the case with 40 percent initial debt. The farmers are able to sell out and still have positive equity if conditions turn unfavorable.

The amount of debt, credit reserves, and off-farm investment under alternative farm programs for various risk aversion levels for the farm with no initial debt are found in Table 13. The farmer holds the same amount of debt under the 1981 programs for any risk aversion level. Off-farm investment is again used widely to insure credit reserves as was the case on the other farms with different initial debt positions. Off-farm investment is used widely on the Free Market farm to maintain liquidity. During years where the outcomes are unfavorable the Free Market farm does not have to make as many painful disinvestment decisions hence this accounts for a higher guaranteed return to exit from farming with no initial debt than with 40 percent initial debt.

The first year's portfolio of hogs, rotation acreage, and wheat are identical for the farmers operating under the 1981 and the 1985 programs for every level of risk aversion studied (Table 14). In fact, these portfolios are identical to those on the farms with 40 and 70 percent initial debt. The Free Market portfolio for the first year are similar to the portfolios on the farm with 40 percent initial debt. The Free Market operator tends to farm more acres of wheat and raise more hogs than the farmers under the 1981 or 1985 programs. However, after the first year, the Free Market farmer does not plan to grow any wheat. Unlike the farms with 40 or 70 percent initial debt, the Free Market farmer does not farm any share rented land if he has a risk aversion level of .005.

With no initial debt, the value of another acre of owned land on a farm operating under the 1981 programs is almost equal to the value of another acre of owned land on a farm operating under the 1985 programs. The penalty cost for another acre of land cash rented to grow soybeans on has increased on the farm operating under the 1985 farm programs. A possible reason for the change from the farms with initial debt of 40 or 70 percent is that the farm under the 1985 programs is able to obtain enough credit capacity to reach a more optimal size. The value of another acre of land is more valuable as initial debt decreases under the 1981 programs and less valuable as initial debt decreases under the Free Market. An acre of wheat base is less valuable at the margin as the amount of initial debt decreases under both the 1981 and

1985 programs. The need for the farm to decrease it's business risk decreases as the farm's financial risk decreases as would be expected. Also hogs are less valuable at the margin, as the amount of initial debt decreases under all three policy scenarios.

As was the case on the farms with 40 and 70 percent initial debt, an additional acre of owned land has a positive value under the 1981 and 1985 programs while having a negative shadow value under the Free Market scenario (Table 16). The shadow value of another acre of owned land decreases in terms of certainty equivalents as the farm has less initial debt under both the 1981 and 1985 programs. However, another acre of owned land is less undesirable if a farm has less initial debt under the Free Market. The Free Market farm has less financial risk therefore it can accept more business risk. The farm size does not vary much with risk aversion under the 1981 programs. However under either the 1985 programs or Free Market scenarios, farm size does vary with the level of risk aversion.

A farmer operating under the 1985 programs is willing to pay the most for an initial amount of equity under all but one level of risk aversion (Table 16). As would be expected, an additional dollar of equity is worth less on the farms with no initial debt than on farms with some initial debt. A marginal dollar of equity is worth an annual guaranteed return of 7.4, 8.0, and 7.3 percent under the 1981 programs, the 1985 programs, and the Free Market scenarios, respectively, if the farm operator has a risk aversion coefficient of .00005. At a risk aversion coefficient of .005, the marginal annual return is less for an additional dollar of equity; 5.8, 5.2, and 4.1 percent under the 1981 programs, the 1985 programs, and the Free Market scenarios, respectively.

Policy Implications and Conclusions

One of the overriding policy implications of this study is the wealth effect. With the elimination of price and income supports, a farmer can expect an average ending terminal wealth up to 37 percent less than he would expect under the 1981 programs. With the elimination of price and income supports, the riskiness of terminal wealth is much greater, that is the farmer can expect to get outcomes farther from the expected value more often under a Free Market scenario. Under the Free market scenario, a much smaller guaranteed income is needed to induce that farmer to exit from farming than would be needed with the continuation of current programs. However, the difference between the payment needed to get the Free Market farmer to quit farming and the payment needed to get a farmer to leave farming under either the 1981 or 1985 programs is smaller as the level of debt decreases. Results suggest that under the Free Market, farmers with small debt to asset ratios have a good chance to survive through a transition period, although some painful disinvestment decisions may have to be made.

The Free Market farm tends to be a smaller, more diversified operation. More investment in livestock will occur under the Free Market than under either of the program scenarios, especially if the farmer has a lower level of debt when or if a switching of policies occurs. More crop share agreements may come into use especially for the more risk averse farmers. The marginal value of an additional acre of land is negative under the Free Market scenario while being positive under either of the program scenarios. As the debt load increases, a Free Market farmer is more likely to sell land while the farmer operating under government programs is more likely to buy land at the margin. Land could be considered a safe asset under the government programs while being a risky asset under the Free Market. Some farmers may want to reduce the amount of land operated if policies change to a Free Market scenario. This provides opportunities for individuals wanting to enter farming. However, large amounts of equity will be needed in order for these entering farmers to survive.

The availability of off-farm employment opportunities is an important consideration to be considered before a decision is made to move to a Free Market scenario. Up to fifty percent more labor would be supplied for off-farm employment by the farmer under the Free Market scenario than is supplied under the current programs. If employment is not available in the rural areas, many of the more risk averse farmers may be displaced to metropolitan areas to find employment.

Debt use tends to be smaller under the Free Market than under the 1981 or 1985 programs especially for those farmers who are more risk averse. Along with a smaller level of debt use, off-farm investment may be a more common instrument to maintain liquidity and credit reserves. Methods other than holding off farm investment will be in demand in order to help farmers manage increased credit and liquidity risk.

The tendency of farms to be one size would be eliminated with the elimination of price and income supports. Farm sizes may vary considerably and still be optimal under the Free Market scenario. A larger number of smaller more diversified farms would exist under the Free Market scenario than currently exist. In conclusion, although the transition period to the Free Market would involve many painful adjustments, many of the more profitable farms with fairly low debt levels have a good chance of surviving the transition.

Figure 1. Expected Mean And Variance for Alternative Risk Aversion Levels for a Farm Operator with 40 Percent Initial Debt.

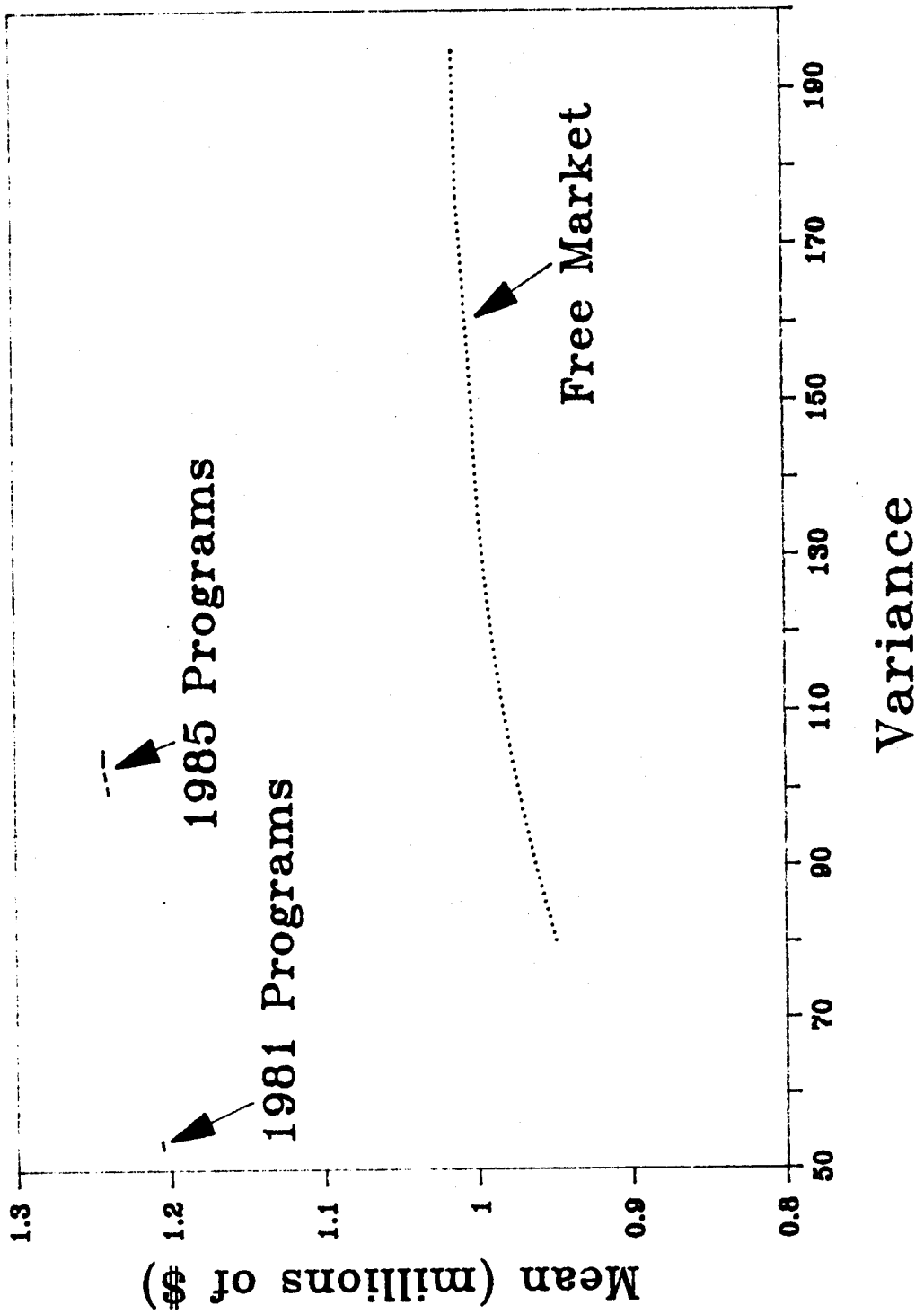

Figure 2. Expected Mean and Variance for Alternative Risk Aversion Levels for a Farm Operator with 70 Percent Initial Debt.

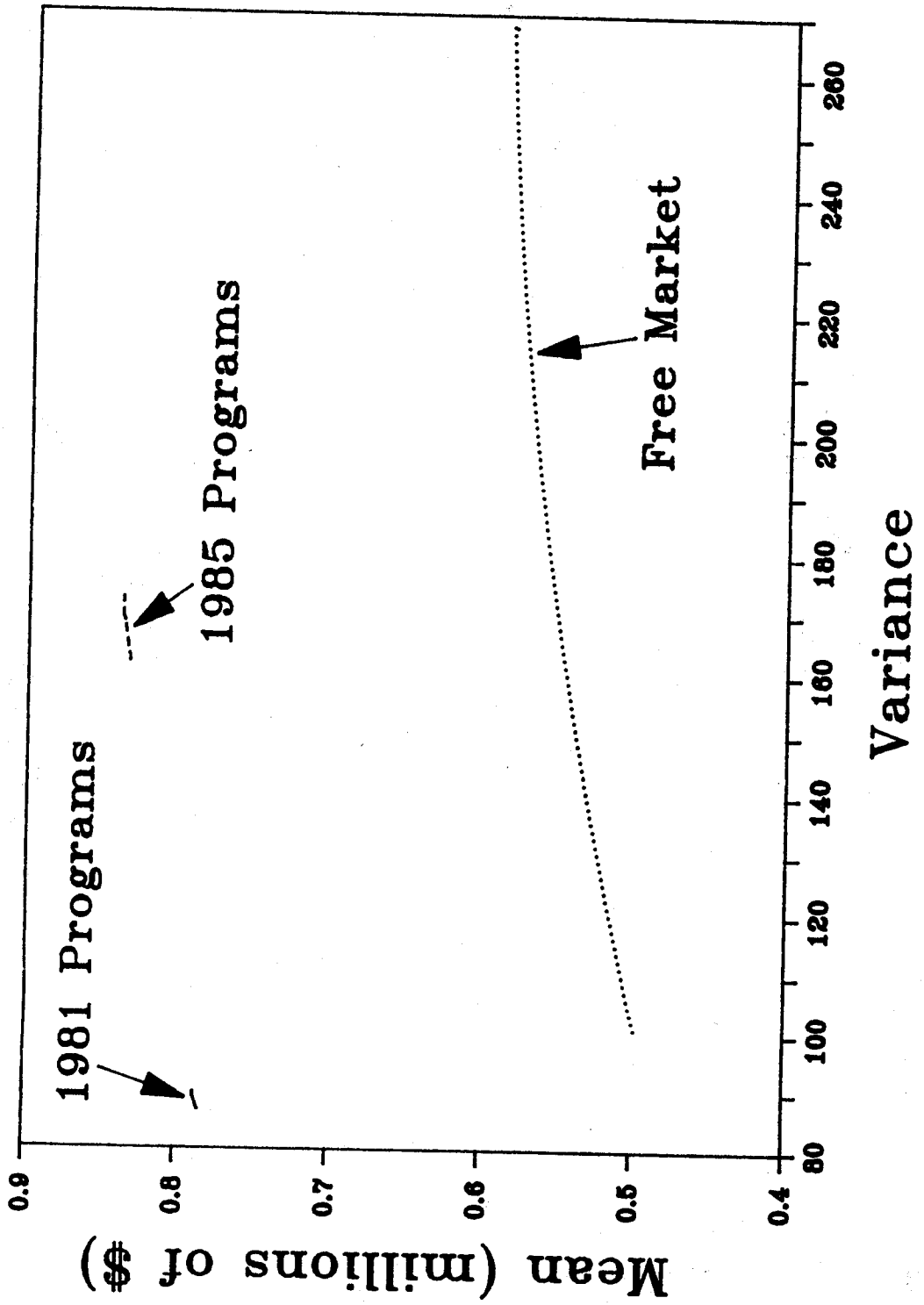

Figure 3. Expected Mean and Variance for Alternative Risk Aversion Levels for a Farm Operator with No Initial Debt.

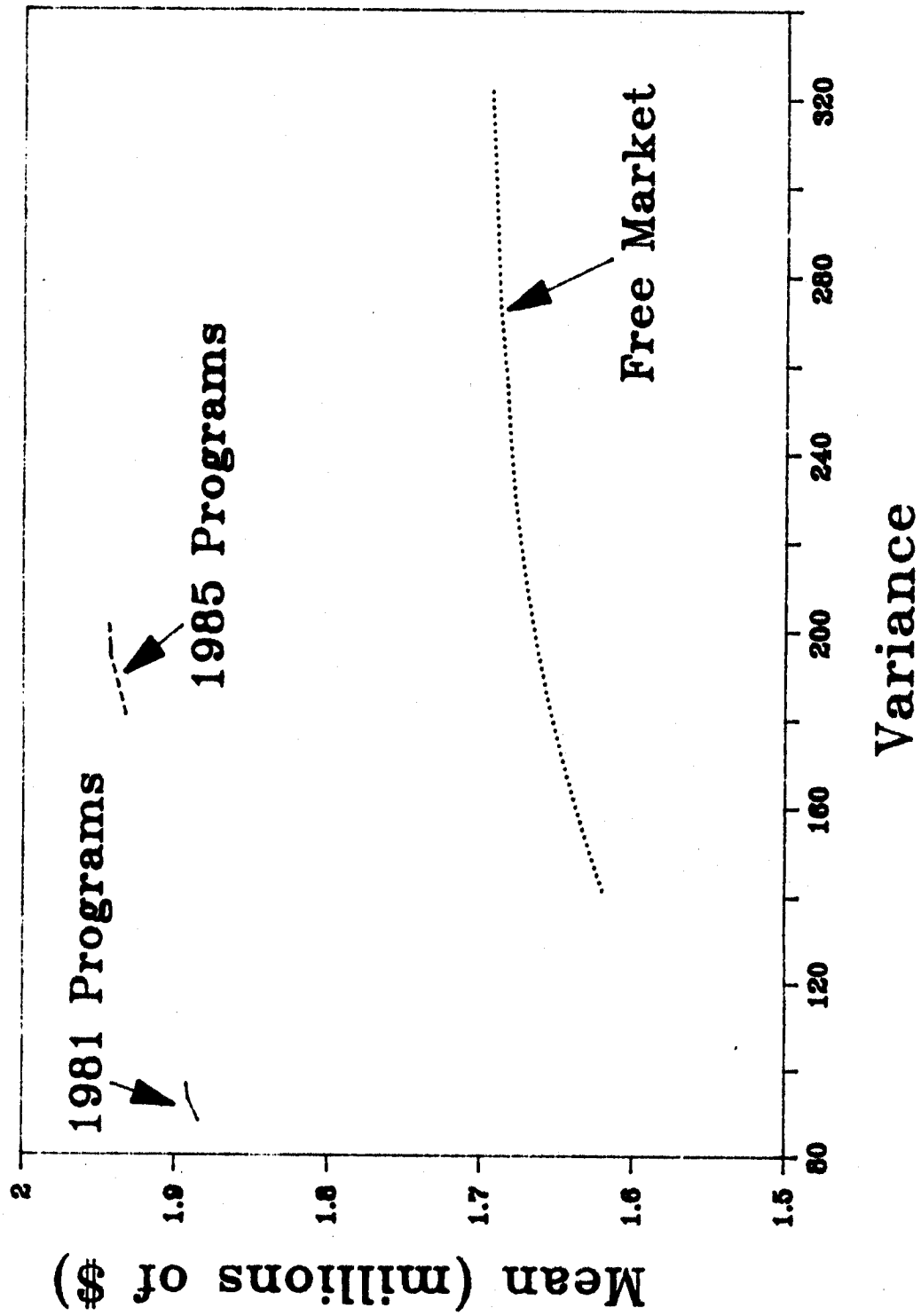

Table 1. Corn, Soybean and Wheat Average Prices under Alternative Commodity Programs for 1986 through 1989.

Year	1981 Programs	1985 Programs	Free Market
	----------1985 dollars per bushel----------		
		Corn Price	
1986	2.52	2.37	1.79
	(.25)[a]	(.56)	(.52)
1987	2.55	2.54	2.43
	(.28)	(.57)	(.62)
1988	2.54	2.64	2.19
	(.28)	(.52)	(.61)
1989	2.52	2.69	2.43
	(.27)	(.54)	(.60)
		Soybean Price	
1986	4.99	4.96	4.87
	(.56)	(.59)	(.56)
1987	5.84	5.82	5.50
	(.79)	(.77)	(.77)
1988	6.05	6.08	5.91
	(.78)	(.87)	(.85)
1989	6.16	6.20	5.99
	(.77)	(.80)	(.79)
		Wheat Price	
1986	3.09	2.93	2.53
	(.52)	(.50)	(.53)
1987	2.87	2.81	2.24
	(.43)	(.38)	(.43)
1988	2.99	2.79	2.25
	(.40)	(.41)	(.52)
1989	3.01	2.87	2.40
	(.36)	(.43)	(.57)

[a]Standard deviation

Table 2. The Average Ending Wealth and the Variability of Ending Wealth on an Indiana Corn-Soybean Farm with 40% Initial Debt under Alternative Commodity Programs.

Absolute Risk Aversion(θ)	Ending Wealth			
	Mean	Standard Deviation	Coefficient of Variation	Certainty Equivalent
	thousands of dollars	thousands of dollars	percent	thousands of dollars
		1981 Programs		
.00005	1206	232	19.2	1205
.0001	1206	232	19.2	1204
.0005	1206	232	19.2	1193
.001	1206	231	19.2	1181
.005	1205	230	19.1	1111
		1985 Programs		
.00005	1242	325	26.2	1240
.0001	1242	323	26.0	1237
.0005	1242	322	26.0	1218
.001	1242	321	25.9	1198
.005	1239	316	25.5	1103
		Free Market		
.00005	1013	441	43.6	1008
.0001	1013	441	43.6	1004
.0005	1011	420	41.5	971
.001	1002	387	38.6	939
.005	950	282	29.7	842

Table 3. Debt, Credit Reserves, and Off-Farm Investment on an Indiana Corn-Soybean Farm with 40% Initial Debt under Alternative Commodity Programs.

θ	Year 1			Year 2[a]		
	Debt	Credit Reserves	Off-Farm Investment	Debt	Credit Reserves	Off-Farm Investment
	thousands of dollars					
			1981 Programs			
.00005	513	237	0	513	0	0
.0001	513	237	0	513	0	0
.0005	513	237	0	513	0	0
.001	513	237	0	513	0	0
.005	513	237	0	513	0	0
			1985 Programs			
.00005	721	29	211	721	0	0
.0001	570	180	60	570	0	0
.0005	510	240	0	510	0	0
.001	510	240	0	510	0	0
.005	510	240	0	510	0	0
			Free Market			
.00005	524	226	9	524	0	0
.0001	524	226	9	524	0	0
.0005	476	263	71	392	85	0
.001	386	335	158	348	38	0
.005	0	670	248	0	0	0

[a]The second years outcome in this table is the most likely outcome to occur. It has a 1 in 3 chance of occurring.

Table 4. Crop and Hog Diversification on an Indiana Corn-Soybean Farm with 70% Initial Debt under Alternative Commodity Programs.

θ	Year 1 Acres Rotation	Year 1 Acres Wheat	Year 1 Sows	Year 2[a] Acres Rotation	Year 2[a] Acres Wheat	Year 2[a] Sows
			1981 Programs			
.00005	700	100	51	820	0	46
.0001	700	100	51	820	0	46
.0005	700	100	51	820	0	46
.001	700	100	51	723	100	46
.005	700	100	51	723	100	46
			1985 Programs			
.00005	700	100	51	958	0	46
.0001	700	100	51	858	0	46
.0005	700	100	51	818	0	46
.001	700	100	51	818	0	46
.005	700	100	51	721	100	46
			Free Market			
.00005	638	162	51	800	0	46
.0001	638	162	51	800	0	46
.0005	565	131	51	696	0	50
.001	447	80	51	527	0	86
.005	0	48	58	48	0	133

[a]The second years outcome in this table is the most likely outcome to occur. It has a 1 in 3 chance of occurring.

Table 5. Marginal Contribution of Crops and Hogs to Certainty Equivalents for an Indiana Corn-Soybean Farm with 40% Initial Debt under Alternative Commodity Programs.

θ	Owned[a] Land	Cash[a] Rent	Share[a] Rent	Wheat[a] Base	Hogs[b]
			1981 Programs		
.00005	40.73	-52.55	-50.47	32.09	.187
.0001	40.40	-52.73	-50.55	32.24	.187
.0005	37.83	-54.18	-51.23	33.38	.185
.001	34.87	-55.88	-52.04	34.73	.182
.005	16.86	-67.83	-59.00	43.47	.170
			1985 Programs		
.00005	73.28	-22.12	- 16.21	27.99	.195
.0001	73.69	-21.45	- 15.42	28.23	.195
.0005	76.63	-16.38	- 9.42	29.83	.194
.001	80.23	-10.66	- 2.70	31.53	.192
.005	71.17	-12.35	---	38.98	.181
			Free Market		
.00005	40.28	-50.77	-12.83	0	.187
.0001	39.26	-51.39	-13.07	0	.186
.0005	32.68	-55.33	-14.58	0	.185
.001	27.21	-58.76	-15.89	0	.183
.005	40.81	-46.88	0[c]	0	.199

[a]dollars of certainty equivalents per acre.
[b]dollars of certainty equivalents per dollar of hog facilities.
[c]86 acres of rotation are share rented.

Table 6. Average Growth and the Marginal Value of an Extra Acre of Land or Initial Dollar of Equity on the Indiana Corn-Soybean Farm with 40% Initial Debt under Alternative Commodity Programs.

θ	Year 1 Land	Year 2[a] Land	Year 3[a] Land	Shadow Value of Land	Shadow Value of Equity	Marginal Growth of Equity
	----------acres----------			$CE/acre	$CE/acre	percent
			1981 Programs			
.00005	800	820	1080	202.38	1.449	9.7
.0001	800	820	1080	201.36	1.447	9.7
.0005	800	820	1080	193.49	1.430	9.4
.001	800	823	1082	184.41	1.411	9.0
.005	800	823	1082	128.23	1.320	7.2
			1985 Programs			
.00005	800	958	1064	205.70	1.480	10.3
.0001	800	858	1064	203.95	1.476	10.2
.0005	800	818	1064	191.52	1.443	9.6
.001	800	818	930	178.31	1.411	9.0
.005	800	821	821	117.76	1.301	6.8
			Free Market			
.00005	800	800	800	-20.06	1.413	9.0
.0001	800	800	800	-25.51	1.407	8.9
.0005	696	696	696	-55.30	1.366	8.1
.001	527	527	527	-78.37	1.334	7.5
.005	48	48	65	-105.39	1.241	5.5

[a]The second and third years outcome in this table is the most likely outcome to occur. The second years outcome has a 1 in 3 chance of occurring. The third years outcome has a 1 in 6 chance of occurring.

Table 7. The Average Ending Wealth and the Variability of Ending Wealth on an Indiana Corn-Soybean Farm with 70% Initial Debt under Alternative Commodity Programs.

θ	Ending Wealth: Mean	Standard Deviation	Coefficient of Variation	Certainty Equivalent
	thousands of dollars	thousands of dollars	percent	thousands of dollars
		1981 Programs		
.00005	787	299	38.0	785
.0001	787	299	38.0	783
.0005	787	299	38.0	766
.001	787	298	37.9	747
.005	784	294	37.5	647
		1985 Programs		
.00005	837	415	49.6	833
.0001	837	415	49.6	828
.0005	837	411	49.1	799
.001	836	410	49.1	769
.005	832	402	48.3	646
		Free Market		
.00005	585	518	88.5	578
.0001	585	518	88.5	572
.0005	582	493	84.6	529
.001	570	450	78.9	490
.005	498	311	62.5	384

Table 8. Debt, Credit Reserves, and Off-Farm Investment on an Indiana Corn-Soybean Farm with 70% Initial Debt under Alternative Commodity Programs.

θ	Year 1 Debt	Year 1 Credit Reserves	Year 1 Off-Farm Investment	Year 2[a] Debt	Year 2[a] Credit Reserves	Year 2[a] Off-Farm Investment
	thousands of dollars					
			1981 Programs			
.00005	888	237	0	888	0	0
.0001	888	237	0	888	0	0
.0005	888	237	0	888	0	0
.001	888	237	0	888	0	0
.005	888	237	0	888	0	0
			1985 Programs			
.00005	1109	16	224	1109	0	0
.0001	1109	16	224	1109	0	0
.0005	918	207	33	918	0	0
.001	885	240	0	885	0	0
.005	885	240	0	885	0	0
			Free Market			
.00005	891	234	2	891	0	0
.0001	889	236	0	889	0	0
.0005	780	312	0	768	12	0
.001	650	389	46	650	0	0
.005	250	624	188	208	42	0

[a]The second years outcome in this table is the most likely outcome to occur. It has a 1 in 3 chance of occurring.

Table 9. Crop and Hog Diversification on an Indiana Corn-Soybean Farm with 70% Initial Debt under Alternative Commodity Programs.

θ	Year 1 Acres Rotation	Year 1 Acres Wheat	Year 1 Sows	Year 2[a] Acres Rotation	Year 2[a] Acres Wheat	Year 2[a] Sows
			1981 Programs			
.00005	700	100	51	807	0	46
.0001	700	100	51	807	0	46
.0005	700	100	51	807	0	46
.001	700	100	51	710	100	46
.005	700	100	51	710	100	46
			1985 Programs			
.00005	700	100	51	953	0	46
.0001	700	100	51	953	0	46
.0005	700	100	51	828	0	46
.001	700	100	51	806	0	46
.005	700	100	51	709	100	46
			Free Market			
.00005	638	162	51	741	0	46
.0001	638	162	51	737	0	46
.0005	565	131	51	696	0	46
.001	448	80	51	528	0	60
.005	0	9	51	9	0	91

[a]The second years outcome in this table is the most likely outcome to occur. It has a 1 in 3 chance of occurring.

Table 10. Marginal Contribution of Crops and Hogs to Certainty Equivalents for an Indiana Corn-Soybean Farm with 70% Initial Debt under Alternative Commodity Programs.

θ	Owned[a] Land	Cash[a] Rent	Share[a] Rent	Wheat[a] Base	Hogs[b]
			1981 Programs		
.00005	48.92	-57.00	-55.71	34.78	.210
.0001	48.31	-57.18	-55.74	34.94	.210
.0005	43.76	-58.67	-56.07	36.14	.204
.001	38.85	-60.42	-56.56	37.55	.198
.005	13.65	-72.75	-62.95	46.23	.170
			1985 Programs		
.00005	79.42	-32.42	-27.01	29.79	.223
.0001	79.43	-31.49	-25.89	30.01	.222
.0005	80.82	-23.94	-17.05	31.84	.216
.001	84.26	-15.13	- 6.89	33.63	.209
.005	72.16	-12.91	---	40.04	.181
			Free Market		
.00005	51.53	-56.91	-14.10	0	.219
.0001	49.55	-57.76	-14.46	0	.217
.0005	37.45	-62.44	-16.50	0	.201
.001	31.22	-64.09	-17.21	0	.204
.005	44.14	-48.76	0[c]	0	.210

[a]dollars of certainty equivalents per acre.
[b]dollars of certainty equivalents per dollar of hog facilities.
[c]101 acres of rotation are share rented.

Table 11. Average Growth and the Marginal Value of an Extra Acre of Land or Initial Dollar of Equity on the Indiana Corn-Soybean Farm with 70% Initial Debt under Alternative Commodity Programs.

θ	Year 1 Land	Year 2[a] Land	Year 3[a] Land	Shadow Value of Land	Shadow Value of Equity	Marginal Growth of Equity
	----------acres----------			$CE/acre	$CE/acre	percent
			1981 Programs			
.00005	800	807	1137	219.63	1.645	13.3
.0001	800	807	1137	217.92	1.639	13.1
.0005	800	810	1137	205.09	1.592	12.3
.001	800	810	1140	191.39	1.542	11.5
.005	800	810	1130	116.57	1.348	7.7
			1985 Programs			
.00005	800	953	1069	229.97	1.735	14.8
.0001	800	953	1069	227.14	1.721	14.5
.0005	800	828	1019	206.68	1.625	12.9
.001	800	806	970	186.74	1.543	11.5
.005	800	809	809	112.65	1.326	7.3
			Free Market			
.00005	800	800	800	- 30.91	1.682	13.9
.0001	800	800	800	- 37.55	1.665	13.6
.0005	696	696	696	- 73.93	1.553	11.6
.001	528	528	528	- 95.23	1.479	10.3
.005	9	9	9	-117.66	1.330	7.4

[a]The second and third years outcome in this table is the most likely outcome to occur. The second years outcome has a 1 in 3 chance of occurring. The third years outcome has a 1 in 6 chance of occurring.

Table 14. Crop and Hog Diversification on an Indiana Corn-Soybean Farm with No Initial Debt under Alternative Commodity Programs.

θ	Year 1 Acres Rotation	Year 1 Acres Wheat	Year 1 Sows	Year 2[a] Acres Rotation	Year 2[a] Acres Wheat	Year 2[a] Sows
			1981 Programs			
.00005	700	100	51	837	0	46
.0001	700	100	51	837	0	46
.0005	700	100	51	837	0	46
.001	700	100	51	740	100	46
.005	700	100	51	740	100	46
			1985 Programs			
.00005	700	100	51	1062	0	46
.0001	700	100	51	1062	0	46
.0005	700	100	51	921	0	46
.001	700	100	51	876	0	46
.005	700	100	51	738	100	46
			Free Market			
.00005	638	162	51	800	0	46
.0001	638	162	51	800	0	46
.0005	502	104	51	606	0	142
.001	439	77	51	515	0	173
.005	0	37	78	37	0	158

[a]The second years outcome in this table is the most likely outcome to occur. It has a 1 in 3 chance of occurring.

Table 15. Marginal Contribution of Crops and Hogs to Certainty Equivalents for an Indiana Corn-Soybean Farm with No Initial Debt under Alternative Commodity Programs.

θ	Owned[a] Land	Cash[a] Rent	Share[a] Rent	Wheat[a] Base	Hogs[b]
			1981 Programs		
.00005	55.58	-30.39	-28.45	29.59	.173
.0001	55.76	-29.87	-27.81	29.78	.173
.0005	58.59	-26.02	-23.05	31.19	.172
.001	61.89	-21.75	-17.78	32.86	.171
.005	71.55	- 8.81	---	41.74	.166
			1985 Programs		
.00005	58.34	-29.49	-23.86	26.06	.180
.0001	58.52	-28.95	-23.18	26.32	.180
.0005	60.43	-24.88	-18.06	28.31	.180
.001	61.99	-21.46	-13.62	30.31	.180
.005	67.03	-11.70	---	38.02	.180
			Free Market		
.00005	36.16	-49.24	-12.63	0	.177
.0001	35.10	-49.92	-12.88	0	.177
.0005	28.51	-54.24	-14.50	0	.176
.001	29.14	-51.95	- 9.71	0	.184
.005	38.08	-45.62	---	0	.182

[a]dollars of certainty equivalents per acre.
[b]dollars of certainty equivalents per dollar of hog facilities.

Table 12. The Average Ending Wealth and the Variability of Ending Wealth on an Indiana Corn-Soybean Farm with No Initial Debt under Alternative Commodity Programs.

θ	Ending Wealth: Mean	Standard Deviation	Coefficient of Variation	Certainty Equivalent
	thousands of dollars	thousands of dollars	percent	thousands of dollars
		1981 Programs		
.00005	1892	310	16.4	1890
.0001	1892	310	16.4	1888
.0005	1892	310	16.4	1870
.001	1891	305	16.1	1850
.005	1884	297	15.8	1750
		1985 Programs		
.00005	1944	449	23.1	1939
.0001	1944	449	23.1	1934
.0005	1943	443	22.8	1900
.001	1943	441	22.7	1865
.005	1933	425	22.0	1730
		Free Market		
.00005	1694	567	33.5	1686
.0001	1694	567	33.5	1678
.0005	1688	523	30.9	1628
.001	1682	505	30.0	1582
.005	1616	375	23.2	1443

Table 13. Debt, Credit Reserves, and Off-Farm Investment on an Indiana Corn-Soybean Farm with No Initial Debt under Alternative Commodity Programs.

θ	Year 1: Debt	Year 1: Credit Reserves	Year 1: Off-Farm Investment	Year 2[a]: Debt	Year 2[a]: Credit Reserves	Year 2[a]: Off-Farm Investment
	thousands of dollars			thousands of dollars		
			1981 Programs			
.00005	13	1237	0	13	0	0
.0001	13	1237	0	13	0	0
.0005	13	1237	0	13	0	0
.001	13	1237	0	13	0	0
.005	13	1237	0	13	0	0
			1985 Programs			
.00005	352	898	343	352	0	0
.0001	352	898	343	352	0	0
.0005	140	1109	130	140	0	0
.001	71	1179	61	71	0	0
.005	10	1240	0	10	0	0
			Free Market			
.00005	598	652	584	8	590	0
.0001	598	652	584	8	590	0
.0005	419	810	609	118	301	0
.001	207	1013	491	126	81	0
.005	0	1169	686	0	0	437

[a]The second years outcome in this table is the most likely outcome to occur. It has a 1 in 3 chance of occurring.

Table 16. Average Growth and the Marginal Value of an Extra Acre of Land or Initial Dollar of Equity on the Indiana Corn-Soybean Farm with No Initial Debt under Alternative Commodity Programs.

θ	Year 1 Land	Year 2[a] Land	Year 3[a] Land	Shadow Value of Land	Shadow Value of Equity	Marginal Growth of Equity
	----------acres----------			$CE/acre	$CE/acre	percent
			1981 Programs			
.00005	800	837	1335	188.13	1.332	7.4
.0001	800	837	1335	187.22	1.330	7.4
.0005	800	837	1335	180.37	1.315	7.1
.001	800	840	1335	173.09	1.300	6.8
.005	800	840	1335	135.67	1.252	5.8
			1985 Programs			
.00005	800	1062	1335	189.17	1.363	8.0
.0001	800	1062	1335	187.50	1.357	7.9
.0005	800	921	1294	175.81	1.324	7.3
.001	800	876	985	165.42	1.295	6.7
.005	800	838	872	131.74	1.223	5.2
			Free Market			
.00005	800	800	800	- 27.39	1.325	7.3
.0001	800	800	800	- 32.84	1.319	7.2
.0005	606	606	606	- 64.30	1.284	6.5
.001	515	515	515	- 83.54	1.258	5.9
.005	37	37	101	- 99.62	1.176	4.1

[a]The second and third years outcome in this table is the most likely outcome to occur. The second years outcome has a 1 in 3 chance of occurring. The third years outcome has a 1 in 6 chance of occurring.

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