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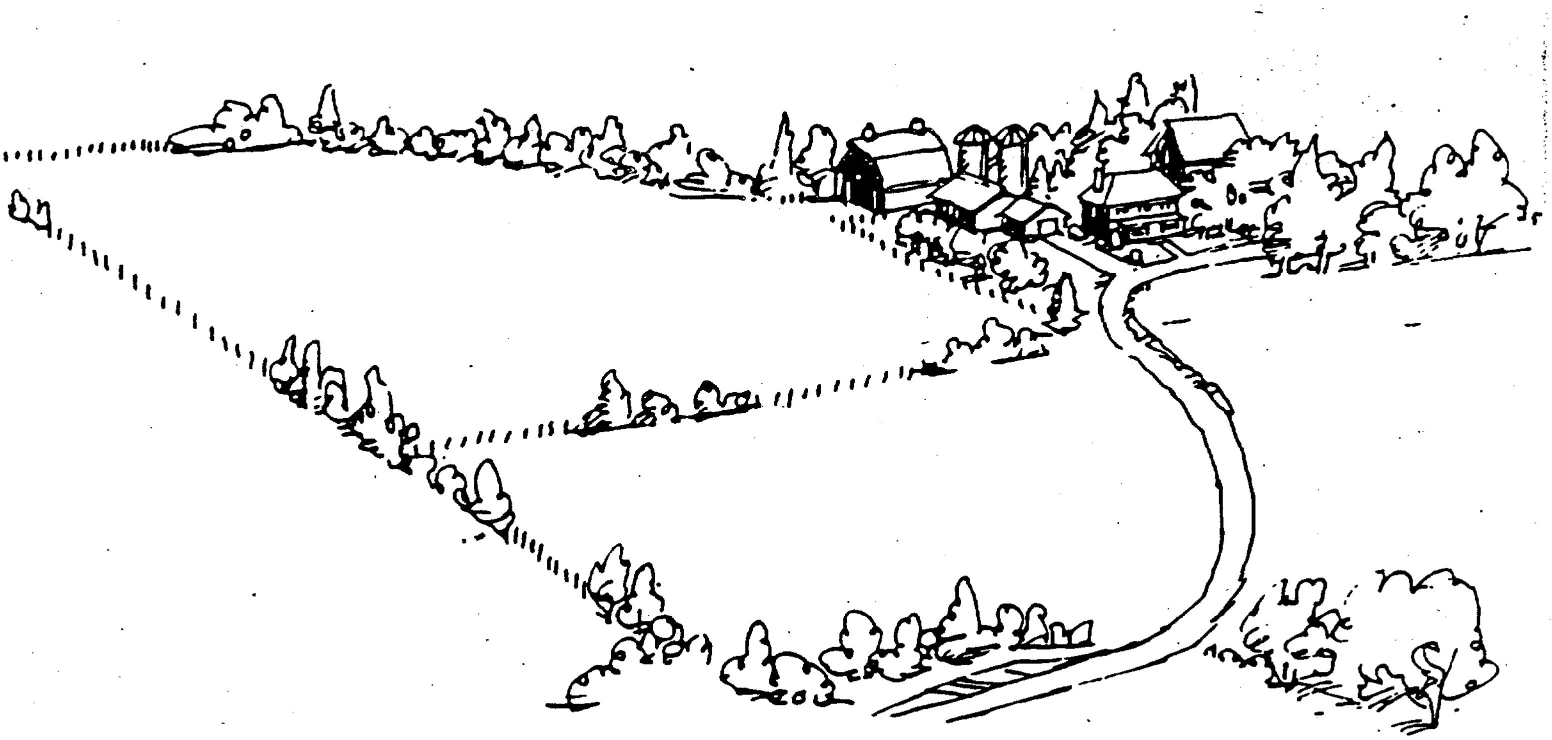
The Agricultural Sector Study

Impacts of Environmental Regulations on Agriculture



THE AGRICULTURE SECTOR STUDY:

IMPACTS OF ENVIRONMENTAL REGULATIONS ON AGRICULTURE

by

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Agricultural Sector Study

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ACKNOWLEDGEMENTS

We would like to thank the U.S. Environmental Protection Agency Program Offices for their help in supplying the data necessary for this analysis. We are particularly grateful to the Economic Analysis Branch of the Office of Pesticide Programs for the extensive amount of time and effort that they contributed to this study. We would also like to thank the members of the Economic Research Service at the U.S. Department of Agriculture who aided in determining the impact of EPA actions on livestock and major field crop producers. Finally, we appreciate the help of the members of EPA's Office of Policy Planning and Evaluation who helped in the preparation of this report.

EXECUTIVE SUMMARY

Environmental regulations affect U.S. farms in many ways. Traditionally, the most important of these regulations have been those that restrict, and in some cases prohibit, the use of certain pesticides. Pesticides will continue to be the subject of the most important environmental regulations for agriculture, not only of the traditional registration and use regulations, but also of new regulations requiring health and safety precautions for farmworkers using pesticides, controls on the use of pesticides in areas with vulnerable groundwater or near targeted estuaries, and restrictions on the use of pesticides that threaten endangered species. In addition, other proposed and forthcoming environmental programs affect agriculture. These include the banning of lead in the gasoline used in farm vehicles, the control of stormwater and other runoff from agricultural lands, restrictions on agricultural burning, standards for the operation and repair of underground storage tanks containing petroleum and chemicals, and the reporting of toxic chemical use.

This study examined the cumulative impact of recent and proposed future environmental regulations on the financial condition of farms in the United States. The regulations included in the analysis are those that have been undertaken since 1982 or are anticipated to occur by 1992, and have a direct impact on agriculture. The primary goal of the study is not to determine the aggregate total cost of EPA actions on agriculture, but to examine the impact of these actions on the profitability of U.S. farms and their ability to survive. Because of the complexity of the agricultural sector and the many uncertainties that still accompany the new environmental programs this study has had to limit its focus to a few "representative" farm types and has had to make many assumptions about future environmental requirements. Accordingly, the study cannot be considered to cover all potential agricultural impacts or to present the final word on future environmental programs. It does, however, describe the kinds of impacts that may occur and estimates the range of potential impacts upon a group of farms that are likely to experience relatively large environmental costs.

For livestock-and major field crops, three specific farm types were examined: (1) an Illinois corn soybean farm, (2) a Mississippi cotton soybean farm, and (3) a Kansas cattle wheat farm. For specialty crops, six crops were selected; apples, tomatoes, potatoes, peas, caneberries (e.g., raspberries, blackberries, etc.), and peanuts. There proved to be insufficient information to complete the analysis for caneberries and peanuts, however, so that results are available only for apples, tomatoes, peas, and potatoes. The difficulty in obtaining information about producers of specialty crops was itself a significant finding of the study.

Three regulatory scenarios of future EPA actions. were considered in the agriculture sector study, ranging from a conservative (low cost) scenario to an expansive (high cost) scenario. In addition, two alternative levels of effects were considered for each of the farms that were examined. In an average impact case it was assumed that the farm would incur the average environmental costs of all farms of that type and in a maximum impact case it was assumed that the farm would incur all of the environmental costs that a farm of that type might face. The maximum impact cases represent very unlikely worst cases, but provide an upper bound on the potential losses under each regulatory scenario.

For the three types of major field crops and livestock farms examined in this study, the effects of EPA actions on farms in different financial conditions were considered. The loss in income incurred by farms in average financial condition under the average impact case (average environmental costs) was 3 percent or less under each of the regulatory scenarios considered. Losses of this magnitude resulted in only very small changes in these farms' debt to asset ratios (less than 1 percent). Under the unlikely maximum impact cases, farms in average financial condition experienced substantial losses in income, but were not forced out of business as a result of EPA actions.

The major field crop and livestock farms in vulnerable condition were more sensitive to increased environmental costs than their counterparts in average financial condition. Although the absolute reduction in income was similar for farms in vulnerable and average financial condition under each scenario, these losses resulted in much larger changes in the vulnerable farms' debt to asset ratios. Even though the vulnerable farms' financial conditions were found to deteriorate more than the farms in average financial condition, only one of the vulnerable farms was predicted to go out of business during the forecast period (1987-1996). The Kansas wheat cattle farm in vulnerable financial condition was predicted to go out of business even without any environmental costs and was predicted to go out of business one year earlier than it otherwise would have under one of the regulatory scenarios considered.

Because of limited data availability, the study did not forecast losses in income or changes in debt to asset ratios for specialty crop farms. Instead, it examined changes in net returns per acre (which reflect returns to land and farmer provided labor). Under the least costly regulatory scenario, the changes were generally less than 1 percent for farms experiencing average environmental costs and less than 8 percent for even the maximally affected farm. Under the most costly regulatory scenario, however, losses of the average impacted producers increased substantially, particularly for apple producers in New York and Michigan, where predicted losses were 60 percent and 84 percent respectively. These dramatic decreases in net returns may bring about substantial structural changes in the production and market for the crops affected. Large differences in the impact of EPA regulations on crops grown in different regions occurred because some of the proposed restrictions involve pesticides that are used in some regions and not in others. Even though the results of this study must be considered preliminary, these figures show that EPA actions could create economic problems for some specialty crop farms and suggest that the Agency exercise caution in this area.

The agriculture sector study illustrates the advantages of examining the impacts of environmental regulations at the farm level as well as at the aggregate national level. While national analyses provide useful information concerning the total losses incurred by different aggregate types of farmers (e.g., corn farmers as a whole), the impact of environmental regulations on farms' financial conditions depends on the distribution of those losses among farmers and on the initial financial conditions of the affected farms. In order to determine the effect of EPA regulations on the ability of farms to survive, both aggregate and farm level analyses are necessary.

This study highlights the data and analytical requirements necessary to determine the impacts of EPA actions on agriculture. Such requirements include accurate pesticide usage and efficacy data, improved national commodity price-quantity models, and better information on the financial and production conditions of farmers. Limitations in data modeling capability are currently much more severe for specialty crops than for livestock and major field crops and EPA is seeking improvements in this area. The importance of improving data and modeling. capabilities is likely to increase in the future as EPA tries to cost-effectively reduce environmental risks associated with agriculture.

AGRICULTURAL SECTOR STUDY

Environmental regulations affect farms in the United States in many ways. Traditionally, the most important of these regulations have been those that restrict, and in some cases prohibit, the use of certain pesticides. Pesticides will continue to be the subject of the most important environmental regulations for agriculture, not only of the traditional registration and use regulations, but also of new regulations requiring health and safety precautions for farm workers using pesticides, controls on the use of pesticides in areas with vulnerable groundwater or near targeted estuaries, and restrictions on the use of pesticides that threaten endangered species. In addition, other proposed and forthcoming environmental programs affect agriculture. These include the banning of lead in the gasoline used in farm vehicles, the control of storm water and other runoff from agricultural lands, restrictions on agricultural burning, standards for the operation and repair of underground storage tanks containing petroleum and chemicals, and the reporting of toxic chemical use.

This study examined the cumulative impact of recent and proposed future environmental regulations, on the financial condition of farms in the United States. The regulations included in the analysis are those that have been undertaken. since 1982 or are anticipated to occur by 1992, and have a direct impact on agriculture. The primary goal of the study is not to determine the aggregate total cost of U.S. Environmental Protection Agency's (EPA) actions on agriculture, but to examine the impact of these actions on the profitability of U.S. farms and their ability to survive. Because of the complexity of the agricultural sector and the many uncertainties that still accompany the new environmental programs, this study has had to limit its focus to a few "representative" farm types and has had to make many assumptions about future environmental requirements and other factors that may affect the financial conditions of farms, such as farm support programs under the Food Security Act. Accordingly, the study cannot be considered to cover all potential agricultural impacts or to present the final word on future environmental programs. It does, however, describe the kinds of impacts that may occur and estimates the range of potential effects upon a group of farms that are likely to experience relatively large environmental costs.

AGRICULTURE AND ENVIRONMENTAL REGULATIONS

There are a number of environmental and health hazards that may be associated with agricultural production. These include:

1. Surface Water Pollution
   Water running off farm lands may carry soil particles, pesticides, and animal wastes into the surface waters.

2. Groundwater Pollution
Pesticides and sewage sludge applied to fields and crops, as well as petroleum and chemicals from leaking underground storage tanks, may seep into the groundwater.

3. Air Pollution
Air pollution problems may result from agricultural burning practices and from the use of leaded gasoline powered trucks, tractors and combines.

4. Worker Exposure
Farm workers who handle pesticides may be exposed to the harmful effects of these chemicals.

5. Endangered Species
Endangered species may be exposed to the harmful effects of pesticides applied to fields and crops in their habitat. Another threat is a reduction in their habitat caused by agricultural expansion.

6. Dietary Risk
Pesticide residues may remain on agricultural products that reach the consumer.

Pesticides play a role in most of these hazard pathways and are a critical focus of the environmental regulations that affect agriculture. Every pesticide must be registered with EPA's Office of Pesticide Programs (OPP). OPP reviews the health, safety, and environmental effects of these pesticides and, from time to time, issues regulations that restrict or prohibit the use of certain pesticides that are judged to present an unreasonable adverse affect. EPA also issues regulations controlling the operation and repair of underground storage tanks, and many other agricultural activities that may present environmental hazards.

These regulations affect both large and small farms in the U.S. Restrictions on the use of certain pesticides may require the substitution of more expensive pesticides and/or may reduce crop yields. Other environmental regulations may impose extra operating costs or may require additional investments in land preparation or farm equipment.

The ability of farms to comply with these environmental regulations will depend not only on the 'costs of each regulation and the effects of the required activities on agricultural yields, but also on the financial condition of each farm, the market conditions at the time the regulations become effective, and the number of farms that are covered. While some environmental regulations apply to all farms, most apply to only a portion of all farms, such as those that use a certain pesticide or have underground storage tanks.
Although the average net farm income in 1984 was identical to that in 1971 -- $12,000 in constant 1986 dollars -- the financial condition of U.S. farms has fluctuated dramatically over the past

two decades. Higher prices, expanding exports, and low real interest rates combined in the early 1970s to produce not only record farm incomes ($25,300 average in 1973), but also a rapid expansion in agricultural production. Unfortunately, these trends all reversed in the early 1980s. Prices declined, exports decreased, and interest rates rose at an unprecedented rate. Average net farm income fell to a low of $10,200 in 1981 and did not surpass the $12,000 level until 1985. Declining incomes led to declining farmland values and increasing debt-asset ratios. Recently, this trend has begun to change. Decreased production expenses, increased government payments, and lower interest rates have allowed net incomes to rise to an average of $14,000 and have slowed the decline in farmland values. The average debt-asset level in 1987 is expected to show a decline from 1986.

Trends for the average farm may belie significant differences within farm size categories and types. During the 1982-1985 period, farms specializing in vegetables, melons, and other specialty crops enjoyed average incomes of $60,000 per year. These farms, however, account for only a small portion of all farms. Farms producing cash grain, tobacco, cattle-sheep-and-hogs, general livestock, and animal specialties all had average incomes of less than $10,000 per year. These farms account for 70% of all farms and nearly 50% of farm marketings.

The financial condition of a farm, and hence its ability to comply with environmental regulations, may vary dramatically even within size categories and types of farms. For example, a study of the financial characteristics of U.S. farms in 1985-1986 showed 55% of all commercial farms were in a favorable financial situation, while 39% were in a marginal situation, and 3% were financially vulnerable.

STUDY METHOD AND LIMITATIONS

This study consists of an in-depth examination of the cumulative impact of environmental regulations on selected livestock, major field crop, and specialty crop producers. The approach of examining only a limited set of producers was chosen because the primary goal of determining the cumulative impact of EPA actions on the financial condition of producers requires an extensive amount of data collection and analysis. The approach followed in this study is summarized as follows:

1. Define alternative scenarios of EPA policies.
2. Select a subset of livestock, major field crop, and specialty crop producers for analysis.
3. Obtain cost and yield change information from EPA Program Offices.
4. Estimate price changes resulting from EPA actions (under each scenario) for each of the selected crops and livestock.
5. Define "impacts“ for selected producers.

6. Examine the change in the financial condition of selected producers under each scenario.

Definition of Policy Scenarios

Because it is difficult to predict future EPA decisions for many regulations, the study examined three alternative scenarios corresponding to a range of potential policies. The scenarios can be summarized as follows:

SCENARIO 1: Past and current EPA actions plus a conservative (low cost) set of assumptions about future actions.

SCENARIO 2: Past and current EPA actions plus an intermediate (mid cost) set of assumptions about future actions.

SCENARIO 3: Past and current EPA actions plus an expansive (high cost) set of assumptions about future actions.

Past and current EPA actions that were included in each scenario are:

EDB - cancellation,
Toxaphene - cancellation,
Dinoseb - cancellation,
SARA Title III,
Leaking Underground Storage Tanks,
Farm Worker Protection Standards,
Chlorodimeform - cancellation of yield enhancement,
Alachlor - restricted use.

The scenarios also include alternative assumptions (high, mid, and low cost) about. EPA actions in the following areas:

Fungicides
Corn Rootworm Insecticides
Broad Spectrum Organophosphates
Grain Fumigants
Pesticides in Groundwater Strategy
Lead in Gasoline Phaseout

Detailed information concerning the assumptions about future policies made under each scenario are provided in Appendix A. The scenarios in this study include only direct impacts of federal EPA actions. Indirect impacts, such as effluent regulations on pesticide manufacturers, may result in increased costs to farmers, however, it was beyond the scope of this study to determine the extent to which higher production costs incurred by agricultural input industries would be passed on to farmers in the form of-higher input costs. Environmental protection actions which may be taken at the state level are also not considered in this study. Finally, this study does not account for voluntary actions taken by farmers (e.g., voluntarily ceasing to use a pesticide prior to cancellation).

Crop and Livestock Selection

A crucial step in this study was determining which producers to focus on. An effort was made to include those producers who were likely to experience relatively large impacts under the alternative policy scenarios considered. The cases that are examined, therefore, provide a variety of impact levels, but include worst case examples. The selection of livestock and major field crop producers was enhanced by the availability of an econometric simulation model, AGSIM, that indicated which crops and livestock were likely to be most affected. For livestock and major field crops, three specific producer categories were examined. Since the ability of any given type of producer to survive cost and yield affects associated with EPA actions is a function of his initial financial condition, two alternative financial conditions were examined for each of the livestock and major field crop producers considered:

* the average financial condition of all producers of the commodity and region considered, e.g., the average of all Illinois corn soybean farmers, and

* the average financial condition of all producers of the commodity and region considered that are in a "vulnerable" financial position. Vulnerable producers are defined as those that have debt to asset ratios greater than 0.4 and have a negative net cash income.

This resulted in the examination of six different representative livestock and major field crop farms:

* Illinois Corn Soybean Farm
    - in average financial condition
    - in vulnerable financial condition

*'Mississippi Cotton Soybean Farm
    - in average financial condition
    - in vulnerable financial condition

* Kansas Cattle Wheat Farm
    - in average financial condition
    - in vulnerable financial condition

The selection of specialty crops was more difficult than the selection of livestock and major field crop producers since specialty crop production is more diverse and information on pesticide usage is much more limited than for major field crops. In addition, no information was available on the initial financial condition of specialty crop producers. Through discussions with staff at EPA's Office of Pesticide Programs, the following set of specialty crops was selected:

* apples,
* tomatoes (fresh and processing treated separately),
* peas,
* potatoes,
* peanuts, and
* caneberries.

Analyses were not completed on peanuts and caneberries due to data. acquisition problems.

Obtaining Crop and Yield Effects

The EPA Program Offices provided information on the cost and yield effects (by crop and by region) that were expected to result from each individual action considered. In addition, they estimated the percent of farms of a particular type and region that were expected to incur each of the effects.

Estimation of Price Changes

EPA actions may increase fixed and variable costs, decrease yields, and affect production decisions. These impacts may in turn be translated into commodity price changes. Failure to account for these price changes would result in overestimation of the impact of EPA actions on farmers who bear the initial cost of EPA policies and would overlook the potential gain to producers who are not directly affected by EPA actions.

In order to estimate the price changes that might occur due to the impact of EPA actions on livestock and major field crop producers, a regional econometric-simulation model, AGSIM, was utilized. AGSIM includes eight major field crops and five types of livestock. The effects of EPA policies are entered into AGSIM as per-acre cost and yield changes for each crop in each of ten United States Department of Agriculture (USDA) production regions. A more detailed-description of AGSIM is provided in Appendix B of this report.

A national price-quantity model developed by Erik Lichtenberg, Douglas Parker and David Zilberman was utilized to estimate price changes due to the impact of EPA actions on specialty crop producers. This model is much more limited than AGSIM. It does not account for variation in impacts among different regions (only one national production cost change is used, which represents a weighted average of individual regional impacts). It also does not account for impacts on substitute crops that are not affected directly (e.g., a regulation that increases the price of broccoli may in turn increase the demand for, and price of, cauliflower). A more detailed description of the national price-quantity model used for specialty crops is provided in Appendix C.

Defining "Impacts" for Selected Producers

Since we are simultaneously examining the effect of several EPA policies, a fundamental issue to be determined was: how is an "impacted" farmer defined? For example, an Illinois corn soybean farmer may be affected by the cancellation of several different pesticides, may incur insurance costs if he has an underground storage tank that meets certain criteria, and may incur an expense to rebuild his leaded gasoline tractor engine if all lead is banned from gasoline. How many of these potential costs do we assume the "impacted" farmer incurs? For each producer, two alternative sets of financial impacts were examined:

* Maximum Impact Case: This case assumes that the producer is impacted by every regulation that may possibly affect a producer of that type.

* Average Impact Case: This case assumes that the producer experiences the average impact of producers of that type - e.g., if 10 percent of all producers of a given type (such as Illinois corn producers) experienced a cost of $1000, we would utilize a $100 cost ($1000 x 0.1) for the average impact case.

Estimation of Financial Effects on Selected Producers

In order to examine the effect of EPA policies on the selected producers of major field crops and livestock, a whole farm recursive programming simulation model of representative producers, REPFARM, was used (see Appendix D for a description of REPFARM). REPFARM model for each of the selected producers was developed by USDA. The REPFARM models were simulated over the 1987-1996 period, using the average and maximum cost and yield impacts for each policy scenario and the scenario specific prices derived from AGSIM. The effect of EPA policies on each of the representative farms' financial condition was determined by examining:

* the change in net cash farm income 1/, and
* the change in debt to asset ratio.

This examination provides information on the effect of EPA actions on the producers' income and ability to survive. It is assumed that a farm goes out of business when its debt to asset ratio reaches one -- i.e., its level of debt is equal to its assets.

1/ Net cash farm income is defined as cash farm income minus farm expenses. It includes both property tax payments and income from government programs. It does not include depreciation of machinery and buildings or off-farm income.

There is only limited information on the baseline financial conditions of specialty crop producers. Therefore, our ability to determine the impact of EPA actions on their financial condition is more limited than for livestock and major field crop producers. The impact of EPA actions on specialty crop producers was estimated by examining the change in net returns per acre for producers in different production regions. Net returns, for the purposes of this report, consist of all farm income minus all farm expenses, with the exception of non-hired labor and land, on a per acre basis. Net returns per acre, therefore, reflect the return to land and farmer provided labor.

Budget information was collected for each of the selected specialty crop producers in several different production regions to establish a baseline level of net returns. The specialty crop budgets for each region were then projected over the 1987-1996 period using the average and maximum impacts for each region under each policy scenario along with the scenario specific prices (determined by the national price-quantity model). This projection provides information on the change in net returns per acre for producers in different regions under each policy scenario (see Appendix E).

Study Limitations

The complexity of the agricultural sector, the uncertainty associated with many environmental regulations, and data and modeling limitations necessitated the use of many simplifying assumptions. Each of the study's major limitations is discussed in more detail below;

Examination of a Limited Number of Commodities

As discussed above, data and analytical requirements associated with the objectives of this study necessitated choosing a limited set of commodities to examine. Producers of crops not considered in this report will experience different levels of impacts; however, an effort was made to include producers that are expected to experience relatively large impacts.

Limited Information About Producer Baseline Conditions

In addition to EPA actions that will affect different crops to varying degrees, producers of the same crop will also be affected to varying degrees depending on their: (1) geographic location (e.g., different regions use different pesticides) and (2) baseline production and financial characteristics. Marginal producers may be forced out of production, while producers in more favorable financial condition will be able to withstand greater impacts. Information on the initial financial condition of the representative livestock and major field crop producers was available. However, numerous assumptions about future prices, government policies, interest rates, and cost and yield trends affect the baseline projections (predicted under the assumption of no EPA policy impacts) of net cash farm income and debt to asset ratios obtained from the REPFARM models. If these assumptions result in an overestimate of the financial strength of the representative farms in the baseline, then we will overestimate the ability of producers to survive in the face of EPA actions. Likewise, if these assumptions result in an underestimate of the financial strength of the farms, then we will underestimate the ability of producers to bear the costs of EPA actions. More information about the specific assumptions used in the REPFAFM model is supplied in Appendix D.

Sensitivity analysis reveals that assumptions about crop yields and future crop prices have a large effect on the REPFARM model results. For example, upper and lower sensitivity runs were made assuming that prices were 15% higher and lower respectively in the years 1991-1996. The resultant estimates of net cash farm income in the upper sensitivity runs were double those in the lower sensitivity runs. This analysis illustrates the sensitivity of the results of this study to critical assumptions, and helps to place the magnitude of the predicted effects in perspective relative to the other factors that influence farms' financial health.

Only limited information was available on the baseline financial conditions of specialty crop producers. Crop enterprise budgets for the selected specialty crops were collected from the Agricultural Extension Service in major producing states, which provided information necessary to calculate the net returns per acre for each crop/region examined. However, information on the debt to asset ratios of specialty crop farmers, or their total net farm income was unavailable. The limited information on baseline financial conditions makes it difficult to determine whether the EPA actions assumed in alternative scenarios would actually cause the specialty crop producers examined in this study to go out of business.

Uncertainty about Future EPA, and other Government Agency Actions

In order to complete this study, it was necessary to make assumptions about what actions EPA might take in the next five years. There is obviously a tremendous amount of uncertainty about which actions will be undertaken in the future. This study does not presume to accurately predict future actions of the Agency. Rather, it attempts to define a range of impacts that correspond to a plausible range of future policy scenarios.

In addition, this study does not account for possible indirect impacts on agricultural producers (through regulation of agricultural input industries) and does not account for actions taken at the state level. To the extent that state actions further increase production costs or decrease yields, failure to account for these actions results in an underestimate of the direct effects on farms due to environmental and health concerns. State actions may be especially significant for the livestock industry, which is a major source of nonpoint source (NPS) pollution. Under legislation passed in February, 1987, states were given grants to assess the magnitude of the NPS problem and to develop management plans, which are due at EPA by August 1988. State actions in the NPS area, however, are not accounted for in this analysis. This omission may be particularly significant for the KS wheat cattle farm.

Another potential bias created by not modeling state level actions occurs in the Pesticide in Groundwater Strategy. In this analysis, federal Pesticide in Groundwater Strategy actions were assumed. In reality, states may take action on their own, circumventing federal level action. If state actions are less severe than the federal level actions assumed in this analysis, then these results may tend to overestimate the magnitude of the Pesticides in Ground-water Strategy.

Finally, this study does not account for possible changes in USDA policies in response to income losses generated by EPA actions. Agricultural programs may tend to cushion the effects of EPA regulations. For example, crop insurance would protect farmers from the losses caused by removal of important pesticides during periods of infestation.

Uncertainty About the Incidence and Magnitude of EPA Impacts

Once a policy scenario is defined, predicting which producers will be impacted requires an extensive amount of information. For example, if a particular pesticide is to be canceled, detailed usage data is required to predict which producers will be affected. Pesticide usage data for major field crops are available at state and multi-state production region levels (based on statistically valid samples collected by USDA and other sources). However, these data are not reliable at a county level. This created problems in predicting the impacts of the Pesticides in Groundwater Strategy, since this program was assumed to result in county specific pesticide cancellations. Data provided by a contractor were used to determine the incidence of Pesticides in Groundwater actions. However, this data base is composed of information drawn from available reports and expert opinions of local Cooperative Extension Service personnel and is not baaed on a statistically valid sample.

Predicting the incidence of EPA actions on specialty crops is especially difficult because there is less information about pesticide usage on these crops than on major field crops. Much of the specialty crop pesticide usage data utilized in this analysis were derived from private data collection agencies (e.g., Doanes) that do not provide information on the sampling techniques utilized in collection. The lack of reliable pesticide usage information for specialty crops severely limits the reliability of conclusions drawn in this study. A more detailed discussion of the data and assumptions used in this analysis is provided in Appendix F.

In addition to knowing what types of producers are likely to be affected by each EPA action, it is important to determine the extent of the impact. For a pesticide cancellation, this requires knowing what alternative will be used in place of the cancelled pesticide and what cost and/or yield variations the user will experience with this alternative. These efficacy data are not always readily available, and are based primarily on expert judgement rather than on models of farmers' responses to regulations and the resulting crop and yield effects. The lack of reliable efficacy data increases the uncertainty associated with predicting impacts of EPA actions. Furthermore, there was not sufficient information to fully account for changes in quality (e.g., size, shape) brought about by restrictions of pesticides.

Finally, effects of pesticide cancellations were projected to dissipate evenly over a seven year period as users adjust their practices and new pest control products become available. The use of an arbitrary assumption of this type was necessitated by the lack of a reliable method to predict the development of substitute pest control products and the adjustment in agricultural practices over time. Clearly this assumption may overestimate the adjustment process for some cancellations and underestimate it for others. Some commodities, such as apples and oranges, are less' able to adjust to pesticide cancellations through the use of more pest resistant species due to the long term structure adjustment problem associated with tree removal and replacement.

Model Assumptions

In addition to assumptions about the incidence and magnitude of ‘impacts, the models themselves utilize assumptions that affect the results. For example, the assumptions about elasticities of supply and demand that are used in the national price-quantity models are crucial in determining the extent to which EPA impacts are passed on to consumers in the form of higher prices. Elasticities are often listed as a range of numbers and are for a wide category of crops rather for a specific crop.

RESULTS OF LIVESTOCK AND MAJOR FIELD CROP IMPACT ANALYSES

As previously discussed, the change in the financial condition of selected livestock and major field crop producers was examined using USDA's REPFARM model. Changes in financial condition are measured by changes in net cash farm income and changes in debt to asset ratios that are caused by EPA actions under each of the three scenarios. Assumptions about initial characteristics of the representative producers along with the cost and yield effects assumed for each EPA action are presented in Appendix D.

All of the different farm types and level of impacts that were considered in our analysis resulted in 36 sets of output; therefore, all the results are not presented in this report. Only the results of Scenarios 1 and 3 for the farms in average financial condition are presented here. These results provide a range a impacts that are predicted for the case study farms in average financial condition. A brief discussion is provided as to how the results for the farms in vulnerable financial condition differ from those in average financial condition. In viewing these results it should be recognized that many factors influence the financial condition of a farm. Accordingly, the actual impact that the EPA policies considered in this study would have on any particular farm may differ from the results presented here.

Illinois Corn Soybean Farm

There are 30,837 farms in Illinois that are classified as cash grain farms that produce corn and soybeans. Survey observations of these farms were used to develop the baseline characteristics of the Illinois corn soybean REPFARM in average financial condition (See Appendix D for a description of baseline characteristics of each REPFARM model). There are 112,489 farms in the five state Cornbelt region (Iowa, Illinois, Indiana, Missouri, Ohio) that fit the corn soybean farm definition.

Illinois Corn Soybean Farm in Average Financial Condition

SCENARIO 1

Figures l-a and l-b indicate the net cash farm income and debt to asset ratios, respectively, of the representative Illinois corn soybean farmer (average financial condition) under Scenario 1. The maximum impact case (which assumes the producer incurs all possible cost and yield impacts) results in a mean annual decrease in net cash farm income of $2,900. This represents an eight percent average annual decrease from the baseline. The mean decrease under the average impact case (which assumes the producer experiences the average costs and yield impacts of all similar producers), however, is significantly less at $270, or less than one percent of the baseline net cash farm income. The substantial gap between the average and maximum impact cases is due primarily to the underground storage tank regulation. The costs associated with this regulation are substantial, yet only a small percentage of farmers are affected. 2/

A reduction in net cash farm income due to EPA policies may result in increases in farmers' debt to asset ratios in two ways: (1) it decreases the return to land and, therefore, the value of land (which is the primary component of farm assets) and (2) it may cause farmers to borrow funds if they are put into a position of negative

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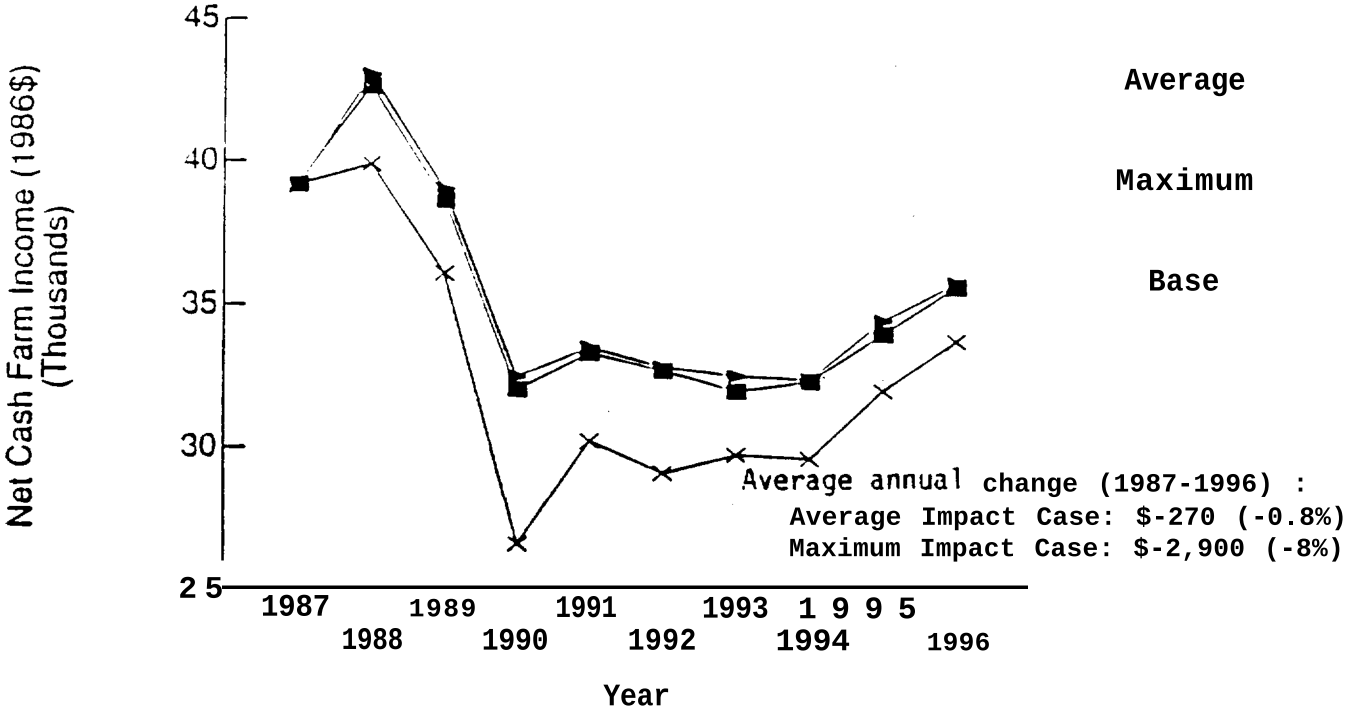
2/ Farmers having a petroleum underground storage tank (>llOO gallons) were assumed to incur $25OO/yr. insurance cost (1988-1996) and a $500 charge in 1991 and 1994 for a tank tightness test. No costs were included for remedial action and it was not assumed that any farmers would remove their USTs.

Illinois Corn Soybean Farm: Scenario 1

a.



b.

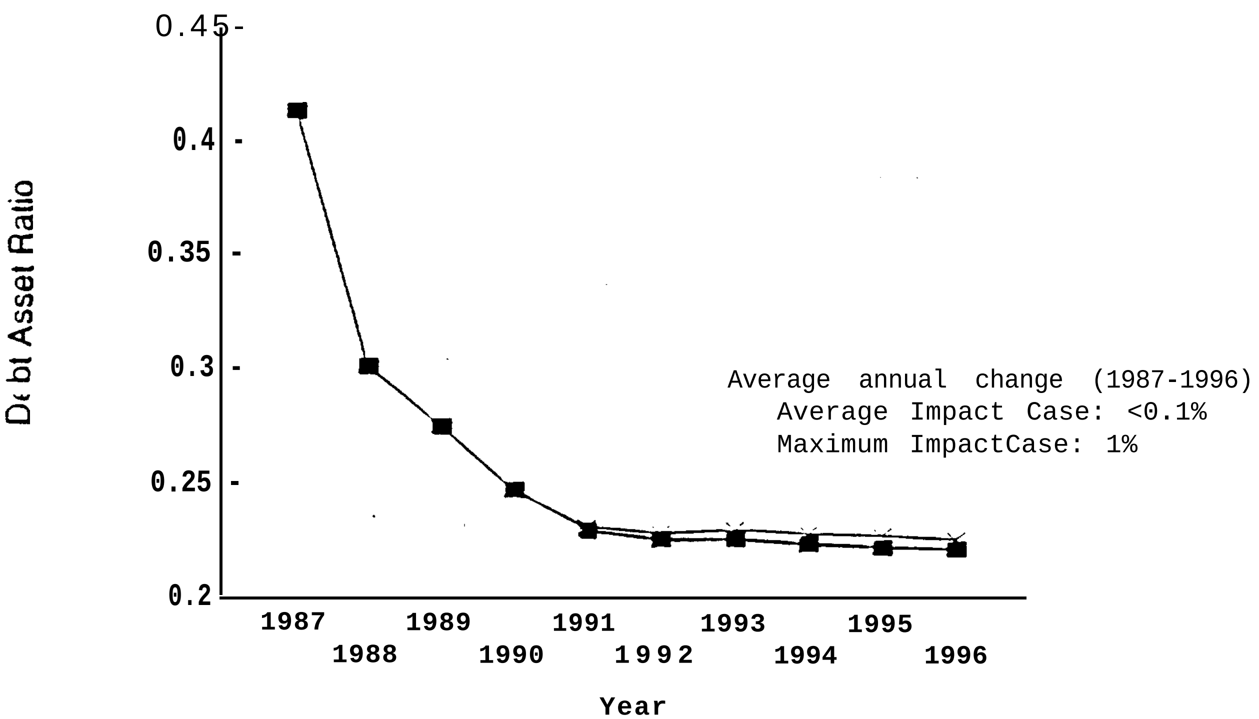


Figure 1. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in average financial condition: Scenario 1

cash flow. The debt to asset ratio in each REPFARM model may be viewed as an indicator of the producer's ability to survive. Producers are assumed to go out of business when their debt to asset ratio equals one.. As seen in Figure l-b, the maximum impact case results in a very slight increase in debt to asset ratios under Scenario 1 (one percent) while no significant change in the debt to asset ratios occurred for the average impact case.

SCENARIO 3

Under the expansive set of EPA actions (Scenario 3) the maximum impact case results in an average annual decrease in net cash farm income of $9,200 (Figure 2-a) and an average annual increase in debts to assets of two percent (Figure 2-b). These substantial impacts are due primarily to assumptions about restrictions on the use of alachlor, triazines and corn rootworm insecticides. The average impact case, however, results in an <u>increase</u> in average annual net cash farm income. This occurs because the larger cost and yield changes incurred by affected corn and soybean farmers under Scenario 3 reduced production levels and raised corn and soybean prices. These higher prices more than offset the cost and yield impacts assumed in the average impact case. The average annual increase in net cash farm income for the average impact case is $4,800 (14 percent increase from the baseline). This results in a slight improvement in the debt to asset ratio.

The large difference between the results in the average and maximum impact cases highlights the importance of understanding the distributional implications of EPA policies. Because initial price and yield impacts are not distributed evenly among farms, producers will experience different financial impacts. In cases where EPA actions result in commodity price increases, farmers who experience relatively small crop and yield effects may actually benefit from the policies. In order to provide more insight into the distribution of cost and yield impacts expected under alternative scenarios, a cumulative probability cost curve was generated for each of the representative producer in average financial condition under each scenario. These curves indicate the probability that each representative farm will incur a cost less than or equal to a given level. (See Appendix G for a complete description of these curves) . The discounted present value of the cost and yield impacts (1987-1996) incurred under the maximum impact case in Scenario 3 is over $60,000. However, Figure 3-b indicates that under Scenario 3 the representative Illinois corn soybean farm in average financial position has a .7 probability of incurring discounted present cost and yield impacts (1987-1996) that are less than $28,000; and a .5 probability of incurring impacts of less than $5,000. The cumulative probability cost curves illustrate that <u>the maximum impact cases described here represent a set of very unlikely worst cases.</u> The average impact cases presented in this section provide insights into the financial effects that each of the representative farms examined would have a significant chance of incurring. As indicated in Figure 3-b, under Scenario 3 the representative

Illinois Corn Soybean Farm: Scenario 3

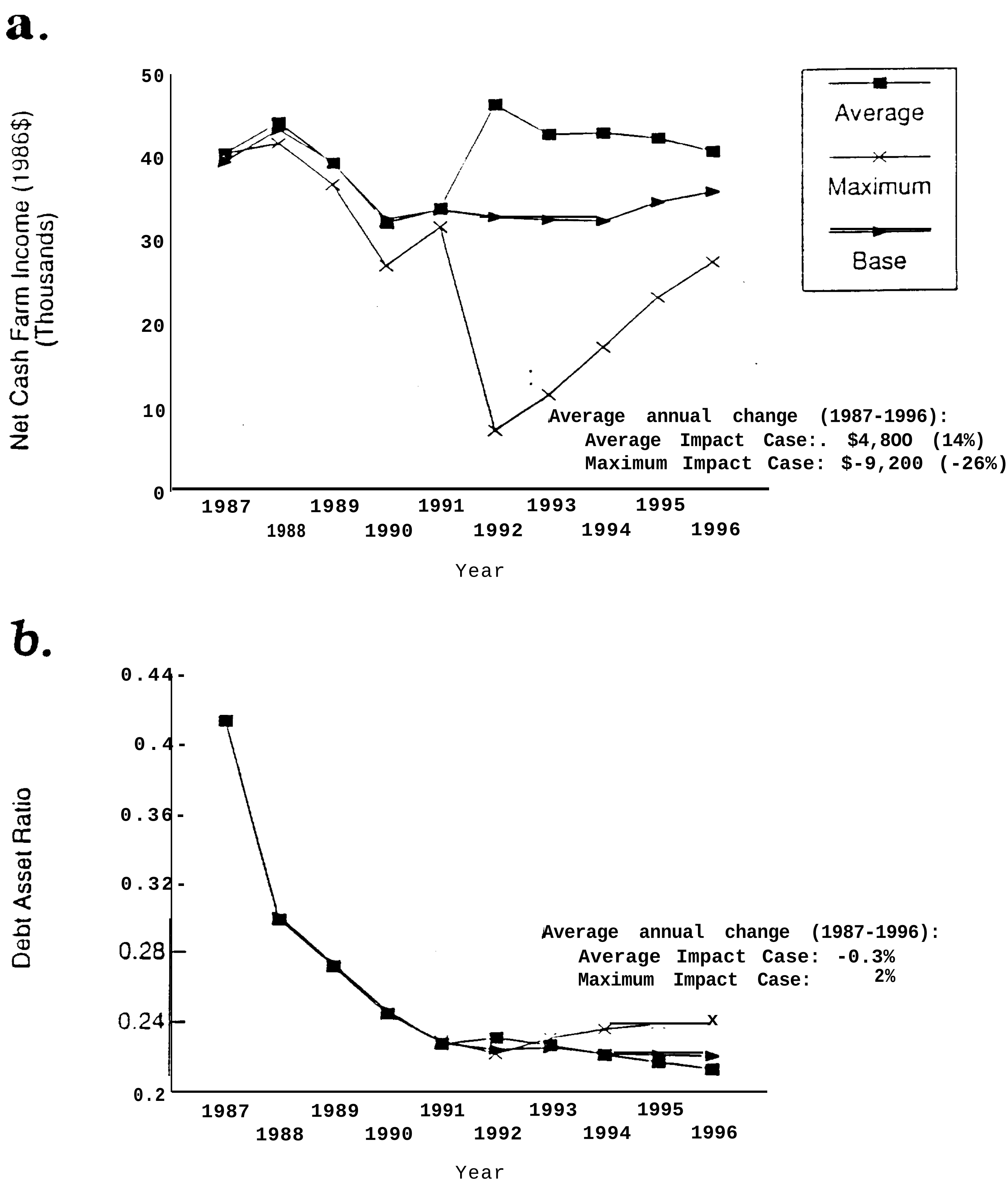


Figure 2. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in average financial condition: Scenario 3

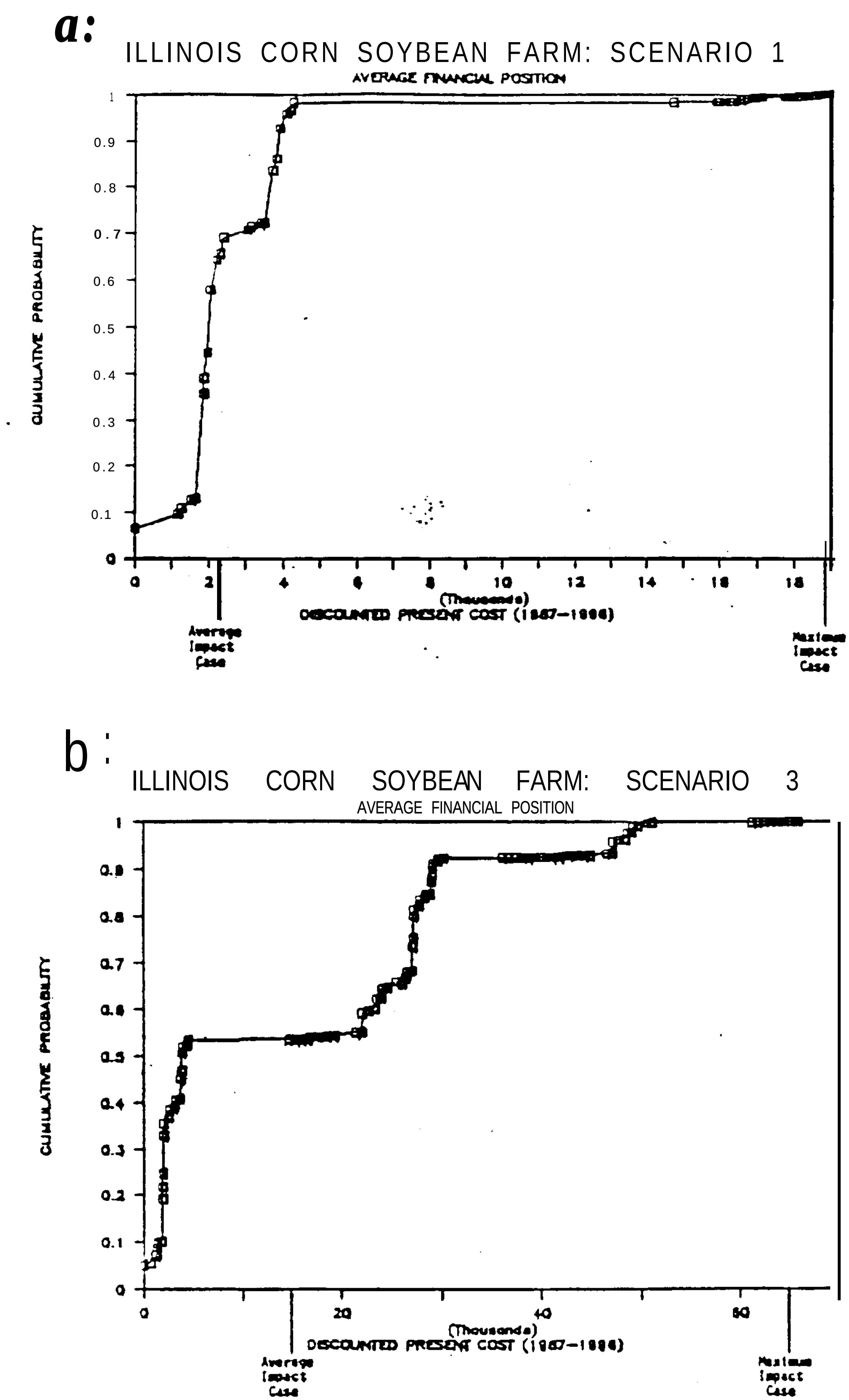


Figure 3. Cumulative probability cost curves for a representative Illinois corn soybean farm in average financial condition: Scenarios 1 and 3

Illinois corn soybean farmer has a .45 probability of incurring cost and yield impacts that are greater than those corresponding to the average impact case and a .55 probability of incurring cost and yield impact less than those in the average impact case.

Illinois Corn Soybean Farm in Vulnerable Financial Condition

Results for the Illinois corn soybean farm in vulnerable financial condition are presented in Appendix D and are only summarized briefly here. Of the 30,837 Illinois corn soybean farms, approximately ten percent were determined to be in vulnerable financial condition. Survey observations on this group of farms were used to develop the characteristics of the Illinois corn soybean farm in vulnerable financial condition.

The absolute decrease in net cash farm income for the vulnerable farm under each scenario is approximately the same as the decrease experienced by the farm in average financial condition, however, the percentage reduction is greater because the base income level of the vulnerable farm is much less than that of the average farm (an annual average of $550 as opposed to $35,000). Likewise, the change in net cash farm income experienced by the vulnerable farm has a greater impact on its debt to asset ratio (e.g., the changes in debt to asset ratios for the maximum impact case under Scenario 3 are two percent and 22 percent for the Illinois farms in average and vulnerable financial condition, respectively). This result occurs because the lower base income of the vulnerable farm makes it more sensitive to changes in cash flow than its counterpart in average financial condition.

The difference in results observed for the vulnerable and average farm highlights the importance of understanding the baseline financial condition of farms when predicting how EPA actions will affect their ability to survive. Although EPA actions result in much greater changes in debt to asset ratios for the vulnerable farm than for the farm in average financial condition, the vulnerable farm is not predicted to go out of business, even under the most expansive sets of EPA actions.

Mississippi Cotton Soybean Farm Results

There are 1,798 farms in Mississippi that are classified as field crop farms producing cotton and soybeans. Survey observations on these farms were used to develop the Mississippi cotton soybean REPFARM in average financial condition. There are 3,576 farms in the three state Delta region (Mississippi, Arkansas, Louisiana) that fit the cotton soybean farm definition.

Mississippi Cotton Soybean Farm in Average Financial Condition

SCENARIO 1

The maximum impact case for the Mississippi cotton soybean farm in average financial condition results in a mean annual decrease in net cash farm income of $10,700 under Scenario 1 (Figure 4-a). The mean decrease in net cash farm income under Scenario 1 for the average impact case, however, is significantly less at $1,700. The gap between the average and maximum impact cases occurs because underground storage tank regulations, and dinoseb and toxaphene cancellations cause significant costs to impacted producers, but only affect a small fraction of producers. 3/ For example, only 1.2 percent of the soybean acres in Mississippi are thought to be affected by the cancellation of toxaphene and less than two percent of the farms are expected to have underground storage tanks.

Both the maximum and average impacted producers experience increases in their debt to asset ratios under Scenario 1 (six percent and .6 percent increases, respectively), yet neither producer is forced out of business (Figure 4-b).

The discounted present value of the cost and yield impacts (1987-1996) incurred under the maximum impact case in Scenario 1 is over $80,000. However, the cumulative probability cost curve for the Mississippi cotton soybean farm in average financial condition (Figure 5-a) indicates that it has a 70 percent chance of incurring discounted present cost and yield impacts (1987-1996) that are less than $10,000. The maximum impact cases described here, therefore, should be viewed as a set of very unlikely worst cases. The average impact case for Scenario 1 corresponds to a level of discounted present costs and yield effects that the representative Mississippi cotton soybean farm has a 25 percent chance of exceeding, and a 75 percent chance of having lesser impacts.

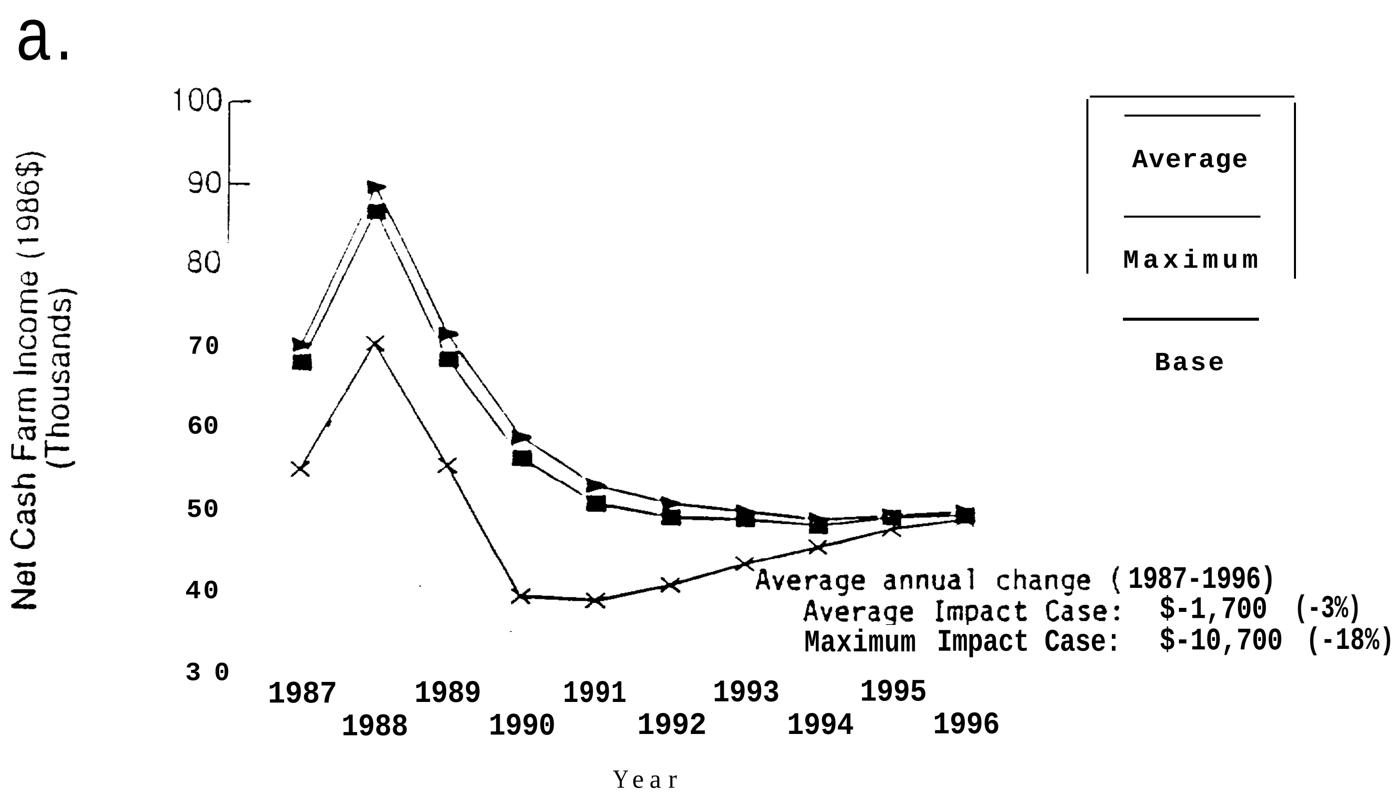
SCENARIO 3

Under Scenario 3, the maximum impact case results in an average annual decrease in net cash farm income of $14,200 (Figure 6-a) and an average annual increase in debts to assets of six percent (Figure 6-b). The loss in income is greater than that experienced under the maximum impact case for Scenario 1. The loss in income for the average impact case, however, is less under Scenario 3 than under Scenario 1 ($400 less, on average). This result occurs because the larger cost and yield changes incurred by cotton and soybean farmers as a whole under Scenario 3 reduce production and cause higher cotton and soybean prices. These higher prices cause the income of

3/ See Appendix D, Table D-6 for the cost and yield impacts and percent of acres treated assumed for the cancellation of dinoseb and toxaphene. Information about. UST assumptions may be found in both Appendix D and Footnote 1.

MS Cotton Soybean Farm: Scenario 1

a.



b.

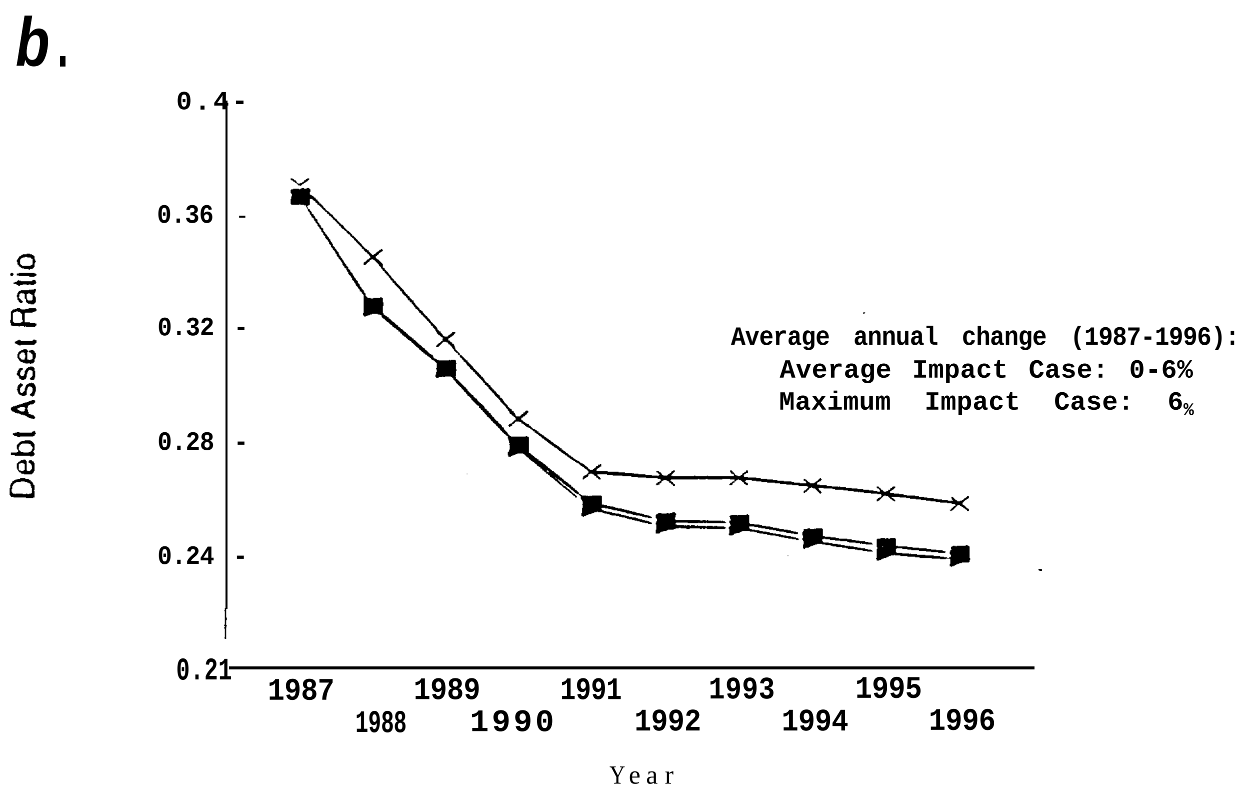
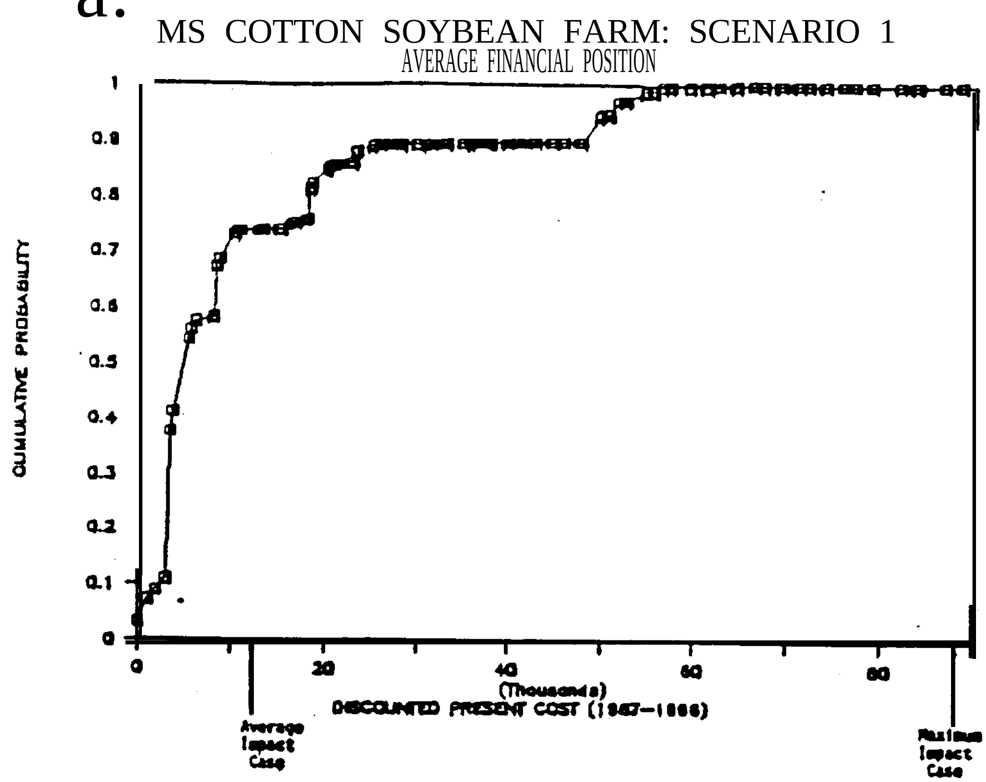


Figure 4. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in average financial condition: Scenario 1

a:



b:

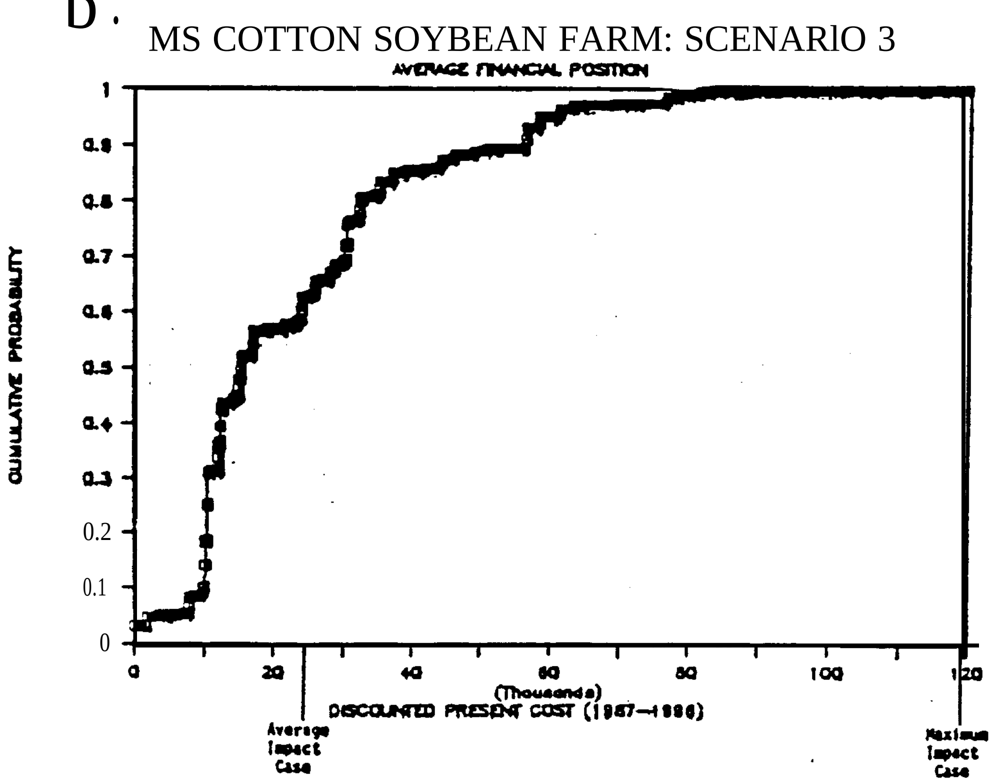
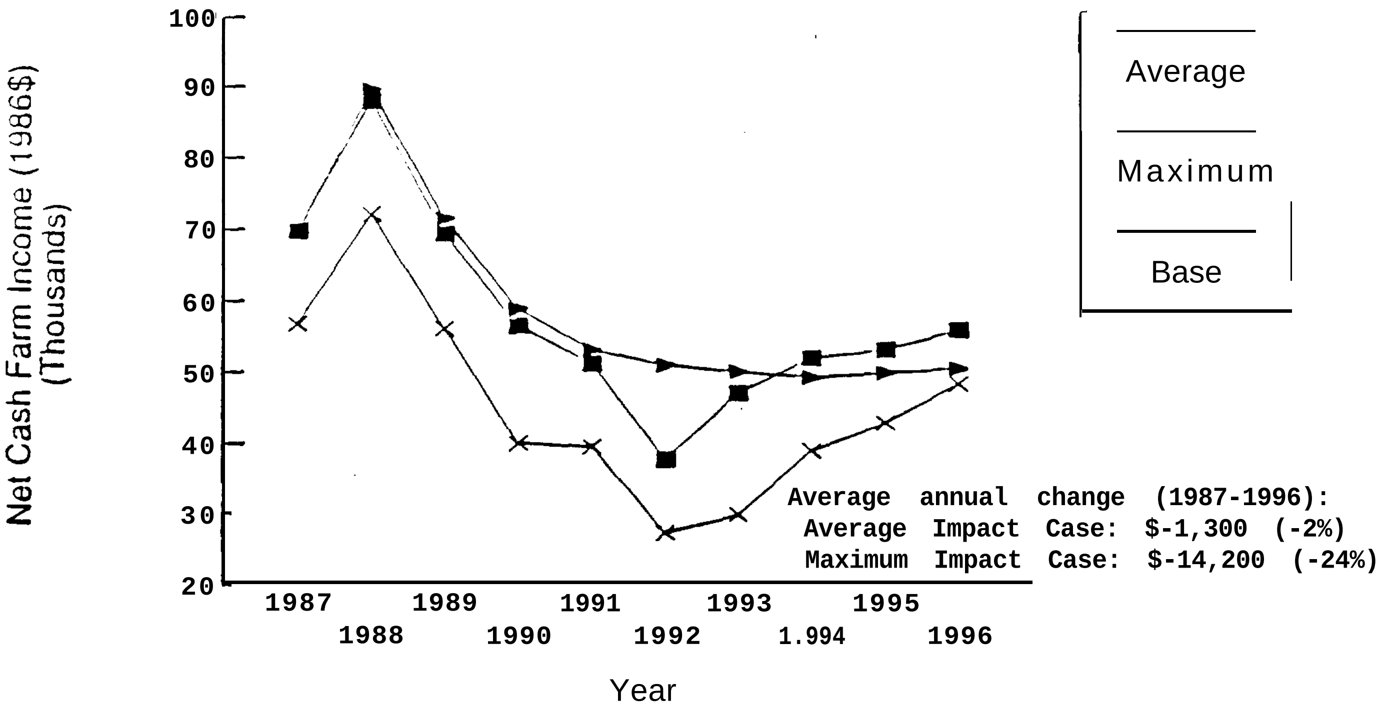


Figure 5. Cumulative probability cost curves for a representative Mississippi cotton soybean farm in average financial condition: Scenarios 1 and 3

MS Cotton Soybean Farm: Scenario 3

a.



b.

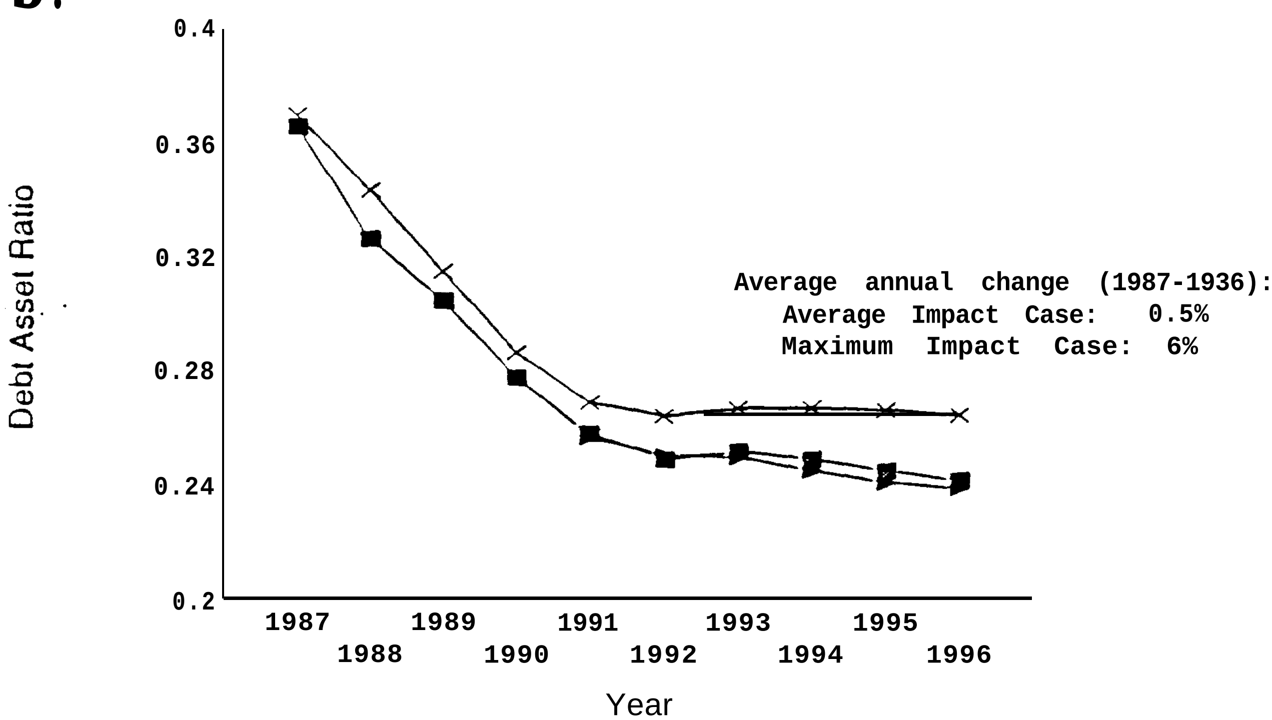


Figure 6. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in average financial condition: Scenario 3

those farmers who incur only the mean cost and yield impacts to actually increase above the baseline in the years 1994-1996. As indicated in Figure 5-b, the average impact case corresponds to a level of cost and yield effects that the representative farmer has approximately a 40 percent chance of exceeding and a 60 percent chance of having lesser impacts.

Mississippi Cotton Soybean Farm in Vulnerable Financial Condition

The results of the Mississippi cotton soybean farm in vulnerable financial condition are presented in Appendix D and are summarized only briefly here. Of the 1,798 MS cotton soybean farms approximately 14 percent were determined to be in vulnerable financial condition and survey observations relating to this group of farms were used to develop the characteristics of the Mississippi cotton soybean farm in vulnerable financial position.
The reduction in net cash farm income experienced by the vulnerable Mississippi cotton soybean farm in each scenario is slightly greater than that experienced by the Mississippi cotton soybean farm in average financial condition -- e.g., for the average impact case under Scenario 1, the vulnerable farm has an average annual loss of income of $2,500, as opposed to the $1,700 loss experienced by the farm in average financial condition. This result occurs because the vulnerable farm has more cotton and soybean acres than the farm in average financial condition and, therefore, experiences greater total cost and yield effects. The larger cost and yield effects and a lower base income level for the vulnerable farm combine to result in larger changes in its financial condition than those experienced by the farm in average financial condition under each scenario. For example, under the average impact case for Scenario 3, the debt to asset ratio increases by over three percent for the vulnerable farm and by 0.5 percent for the farm in average financial condition.

Kansas Wheat Cattle Farm Results

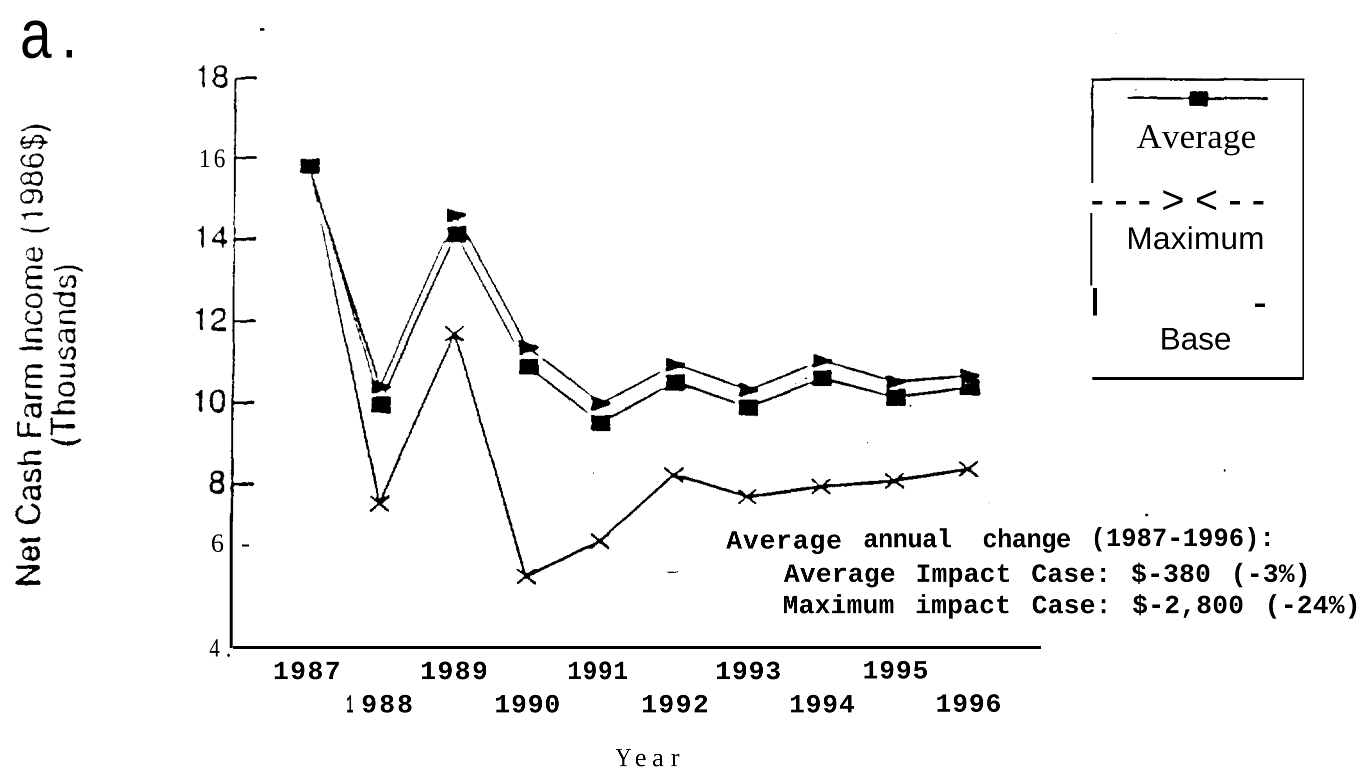
There are 19,966 farms in Kansas that produce wheat and cattle. Survey observations of these farms were used to develop the Kansas wheat cattle REPFARM in average financial condition. There are 50,143 farms in the four state Northern Plains region (Kansas, Nebraska, North Dakota, South Dakota) that fit the wheat cattle farm definition.

Kansas Wheat Cattle Farm in Average Financial Condition

SCENARIO 1

The maximum impact case results in a mean annual decrease in net cash farm income of $2,800 under Scenario 1 (Figure 7-a). The mean decrease in net cash farm income for the average impact case, however, is only $380. The substantial difference between the average and maximum impact cases is due primarily to the underground storage tank regulations which are expected to impact only two

Kansas Wheat Cattle Farm: Scenario 1



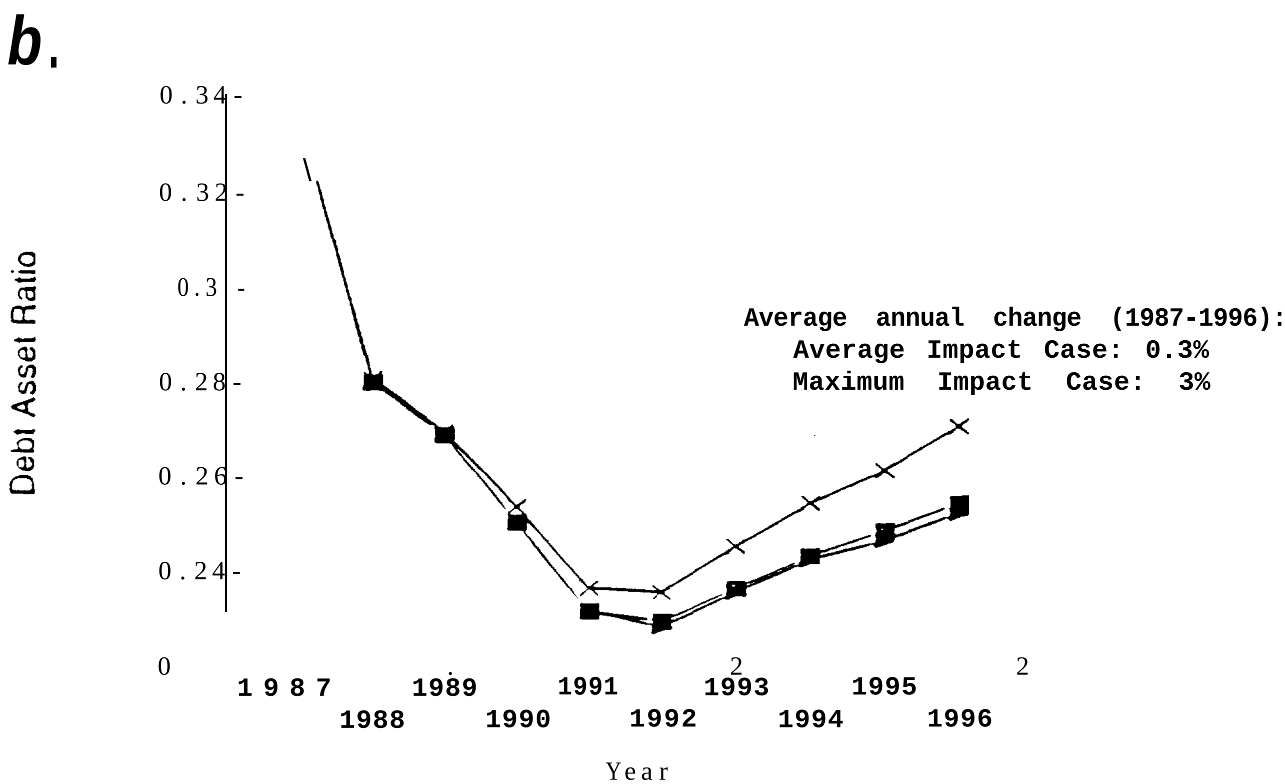


Figure 7. EPA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in average financial condition: Scenario 1

percent of producers in the Northern Plains region. 4/ The representative Kansas wheat cattle farmer has a .65 probability of incurring cost and yield impacts that are less than those assumed in the average impact case (Figure 8-a). These cost and yield impacts are less than one-eighth of those assumed in the maximum impact case.

Under the average impact case, the producer experiences a slight (less than one percent) increase in his debt to asset ratio. The mean annual increase of debts to assets under the maximum impact case is three percent (Figure 7-b).

SCENARIO 3

Under Scenario 3, the maximum impact case results in an average annual decrease in net cash farm income of $9,700 (Figure 9-a) and an average annual increase in debts to assets of 22 percent (Figure 9-b). The reduction in income and increase in debt to assets under the maximum impact case for Scenario 3 is large enough to cause the Kansas wheat cattle farm to enter into the vulnerable farm definition by the end of the forecast period. This is the only case in which this result occurs.

The average impact case, however, results in an average annual increase in net cash farm income of $310. As with the Illinois corn soybean farm, this result occurs because the commodities produced (the representative Kansas wheat cattle farmer produces corn, soybeans, and sorghum as well as wheat and cattle) incur larger cost and yield changes under Scenario 3. These higher costs are passed on to consumers in the form of higher prices, causing the net cash farm income of those farmers who incur only the mean cost and yield impacts to actually increase above the baseline.

As illustrated in Figure 8-b, the representative Kansas wheat cattle producer has a .60 probability of incurring cost and yield impacts that are less than those corresponding to the average impact case for Scenario 3. It should be noted, however, that the discounted present costs presented in Figure 8 do not include the additional expense that the wheat cattle farmer would incur if EPA actions result in higher feed costs. These higher costs have been accounted for, however, in the REPFARM model.

Kansas Wheat Cattle Farm in Vulnerable Financial Condition

The results of the Kansas wheat cattle farm in vulnerable financial condition are presented in Appendix D and are briefly summarized here. Of the 19,966 wheat cattle farms in Kansas, approximately

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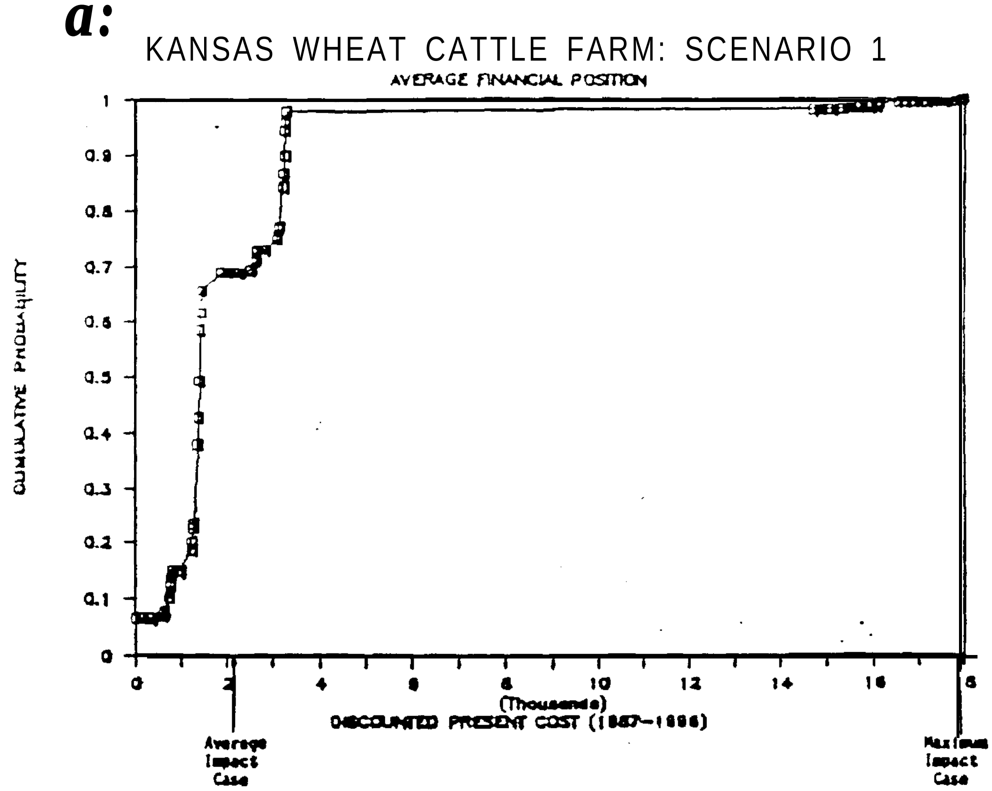
4/ See Footnote 1 for assumptions about the costs for underground storage tanks.

a:



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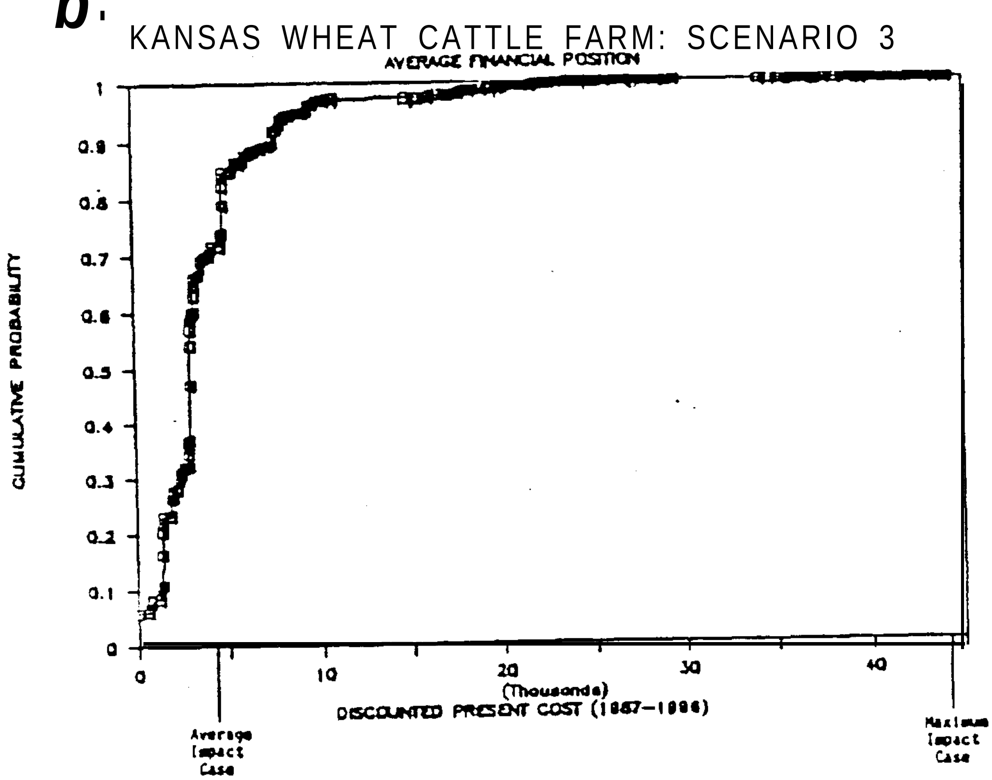
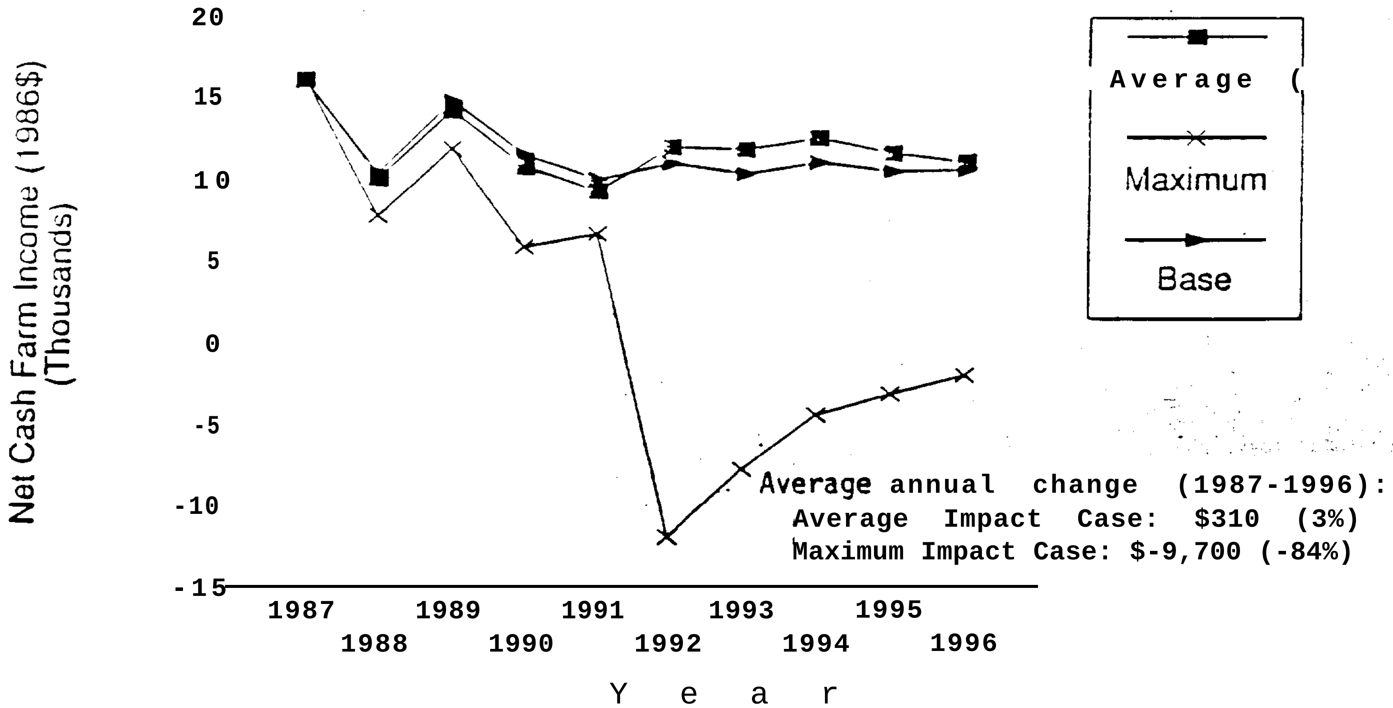


Figure 8. Cumulative probability cost curves for a representative Kansas wheat cattle farm in average financial condition: Scenarios 1 and 3

Kansas Wheat Cattle Farm: Scenario 3

a.



b.

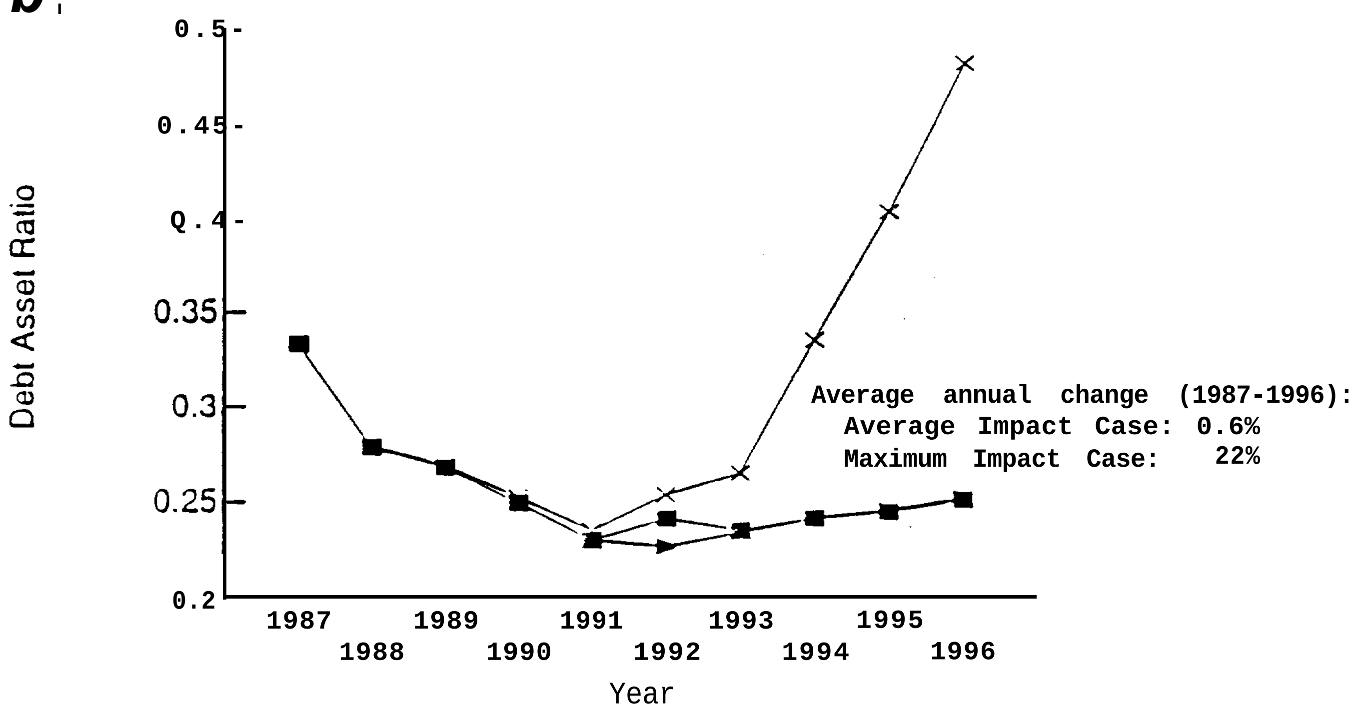


Figure 9. EPA impacts on net cash farm income and **debt asset** ratio for a representative Kansas wheat cattle farm in average financial condition: Scenario 3

seven percent were determined to be in vulnerable financial condition. Survey observations relating to this group of farms were used to develop the characteristics of the Kansas wheat cattle farm in vulnerable financial condition.

In the baseline (no EPA actions) the vulnerable Kansas wheat cattle farm goes out of business in 1993. The decline in net cash farm income experienced by the vulnerable farm under the maximum impact case for Scenario 1 causes it to go out of business one year earlier than in the baseline. The farm does not go out of business earlier than 1993 under any of the other scenarios.

RESULTS OF SPECIALTY CROPS IMPACT ANALYSES

The impact of EPA actions on specialty crop producers was estimated in a two-step process, similar to that used for livestock and major field crops. First, commodity price changes resulting from EPA actions were predicted. Next, the new set of commodity prices, along with the initial cost and yield impacts were used to determine the impacts of EPA actions on the net returns per acre (returns to land and farmer provided labor) of selected producers via income budgeting analyses.

Results of average and maximum impact cases for four of the specialty crops under consideration for Scenarios 1 and 3 are presented below along with a brief introduction of the crop.. Results of the income budgeting analyses for all scenarios are contained in Appendix E along with the initial cost and yield impact estimates.

As this study developed, data deficiencies forced the exclusion of caneberries and peanuts from the analysis. Data which were available are presented in Appendix E along with those of other specialty crops.

Apples

Apple production in the U.S. has approximately doubled since the 1940s. The trend in cultivars has been toward higher quality dessert apples. Current cultivars of major importance are Red Delicious (39 percent), Golden Delicious (17 percent), McIntosh (7 percent), Rome (6 percent), Granny Smith (6 percent), Jonathan (4 percent) and York (4 percent).

Apples are grown widely throughout the U.S., with commercial production in about 35 states. However, the principal states (and their approximate share of total U.S. production) are Washington (36 percent), New York (12 percent) and Michigan (10 percent). Harvested acreage in these states is approximately 161,000, 62,000 and 68,000 acres respectively. According to 1982 estimates, Washington has the largest number of farms with approximately 5,400, followed by Michigan with 2,800 and New York with 2,000.

In recent years apple production has been most profitable in the Washington growing areas where slightly higher yields and higher valued production more than offset higher per acre production costs. Returns have been more modest in New York and Michigan growing areas.

SCENARIO 1

Apple producers in all three study regions (Washington, New York, Michigan) experience similar decreases in net returns per acre under Scenario 1 -- from $2.30 to $6.60 per acre -- but these decreases are higher on a percentage basis in Michigan, because of the state's lower average returns per acre (Figure 10). Decreases in net returns under Scenario 1 are caused by farm worker safety restrictions and restrictions on the use of organophosphates.

SCENARIO 3

Changes in net returns per acre for the average impact case under Scenario 3 differ substantially among production regions (Figure 11). Net returns increased 18 percent in Washington in 1990 while during the same year net returns in New York and Michigan decreased 134 percent and 214 percent respectively. Such dramatic decreases in net returns may bring about substantial structural changes, the discussion of which is beyond the scope of this study. The large differential in net returns among different-regions is due to Proposed restrictions on the use of fungicides in 1990. These restrictions would substantially affect New York and Michigan apple production (e.g., 17 and 12 percent yield reductions) but have no production effect in Washington. 5/ The rise in Washington producers' net returns is due to the 1.8 percent increase in price above the base year caused by the national decline in apple supply.

Potatoes

Potatoes are grown commercially in nearly every state. Total U.S. production ranges from 16 to 20 million tons, depending on the year. Of this production, approximately one-third is used for table stock and one-half for processing. The remainder is used for seed, livestock feed, and export.

While potatoes are grown throughout the U.S., production is concentrated in several areas. The most important area is Southern Idaho, which typically accounts for about 25 percent of total production. South-central Washington is the second largest

5/ The fungicide restrictions considered under Scenario 3 are the cancellation of all EBDCs and chlorothalonil (see Appendix A). See Appendix E, Table E-2 for regional cost and yield impacts.

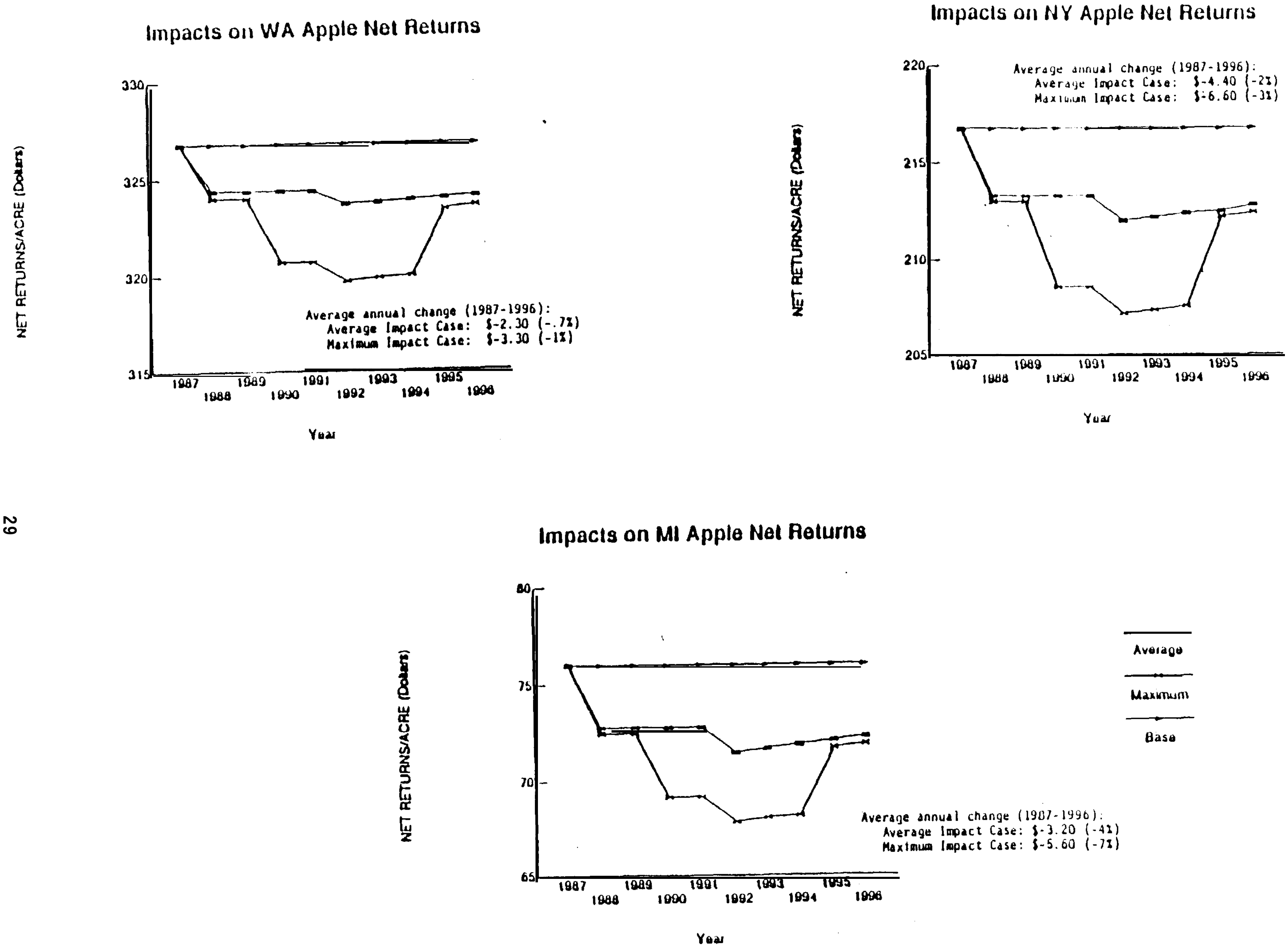


Figure 10. Scenario 1 regulatory impacts on apple production

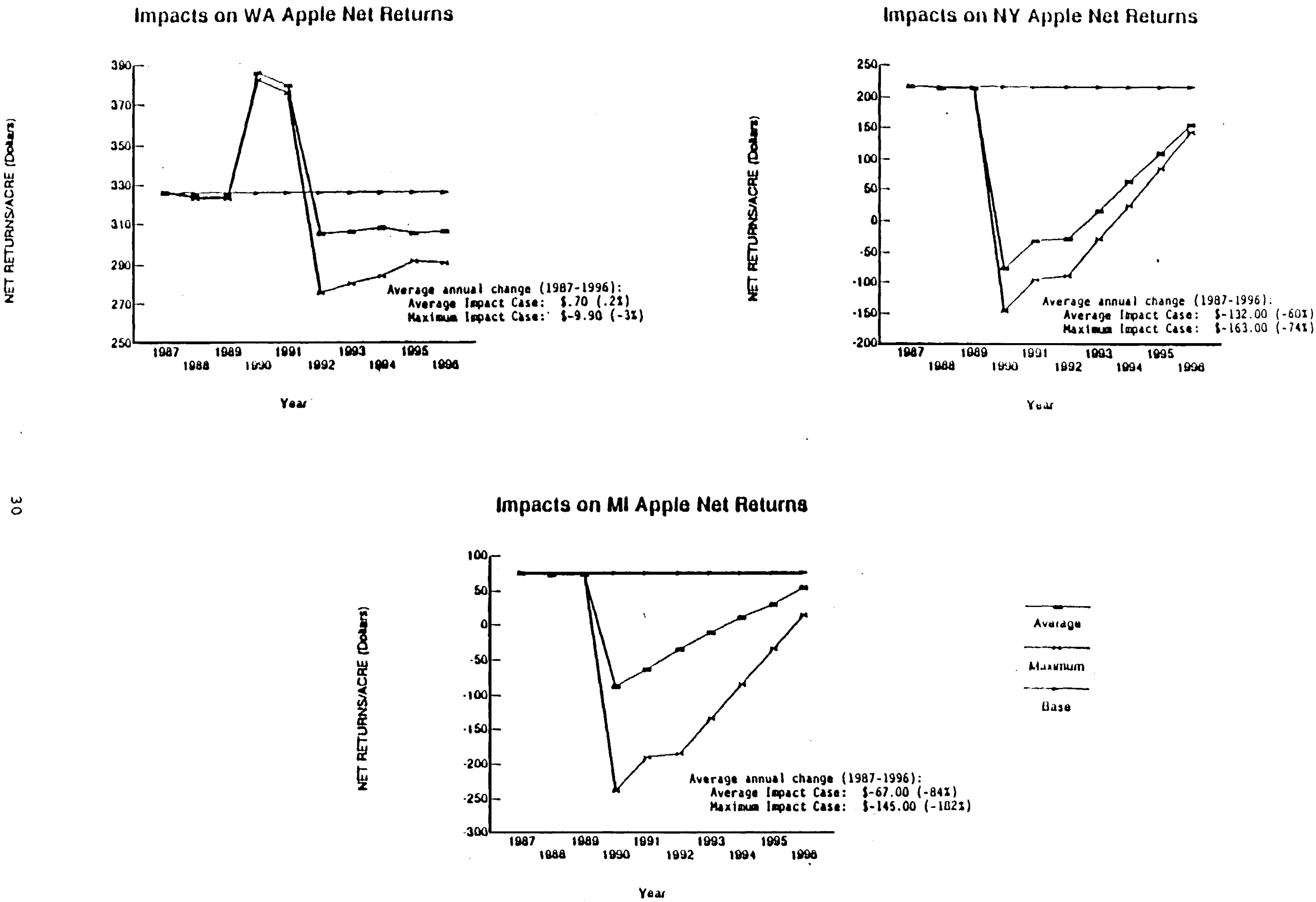


Figure 11. Scenario 3 regulatory impacts on apple production

production area, followed by the Red River Valley of North Dakota and Minnesota, and northern Maine. Together these regions account for up to 60 percent of total U.S. production, with Washington-Idaho harvesting approximately 437,000 acres, North Dakota-Minnesota 194,000 acres, and Maine 98,000 acres. According to 1982 estimates of potato farm numbers, Washington-Idaho has. approximately 2,400, followed by North Dakota-Minnesota with 1,400 and Maine with 1,100.

Cultural practices vary among the major production regions. In Idaho and Washington most of the potato acreage is irrigated and crop yields are among the highest in the country. Acreage in the Red River Valley and Northern Maine is primarily dryland with appreciably lower yields and more modest contributions to farm income from an acre of production.

SCENARIO 1

Net returns per acre in 1987 for the average impact case are slightly lower than the baseline in all regions due to effects of the 1984 cancellation of EDB and the 1987 suspension of dinoseb (Figure 12). In 1990 net returns for Washington-Idaho producers increase above the baseline by .2 percent (average impact case) while net returns for the other regions also increase, but still remain below the baseline. This is explained by the simultaneous increase in the national price (.26 percent above the baseline) and proposed 1990 groundwater regulations which do not affect the Washington-Idaho producers.

In all three production regions the decrease in net returns is substantially larger in the maximum impact case than in the average impact case. Average annual net returns (1987-1996) decreased by .7 percent in Washington-Idaho, four percent-in Minnesota-North Dakota, and 8 percent in Maine under the maximum impact case. Maximum impact estimates are considerably larger than the average for such regulations as the dinoseb cancellation in 1987 and the groundwater regulations in 1990 because only a small percentage of producers are affected.

SCENARIO 3

Results of regulatory impacts on potato producers' net returns per acre are dominated in this scenario by the 1990 proposed restrictions on organophosphate use (Figure 13). Average impact estimates in 1990 include 6.4 and 7.0 percent yield declines in Minnesota-North Dakota and Maine respectively, while the yield decline in Washington-Idaho was estimated at .96 percent (less organophosphates are used in this area). Such a large decline in production results in price increases of 1.8 percent above the base year of 1987 to its highest level during the study period. In Washington-Idaho this increase in price was able to offset the relatively small decline in yield and net returns actually increased above the baseline for the

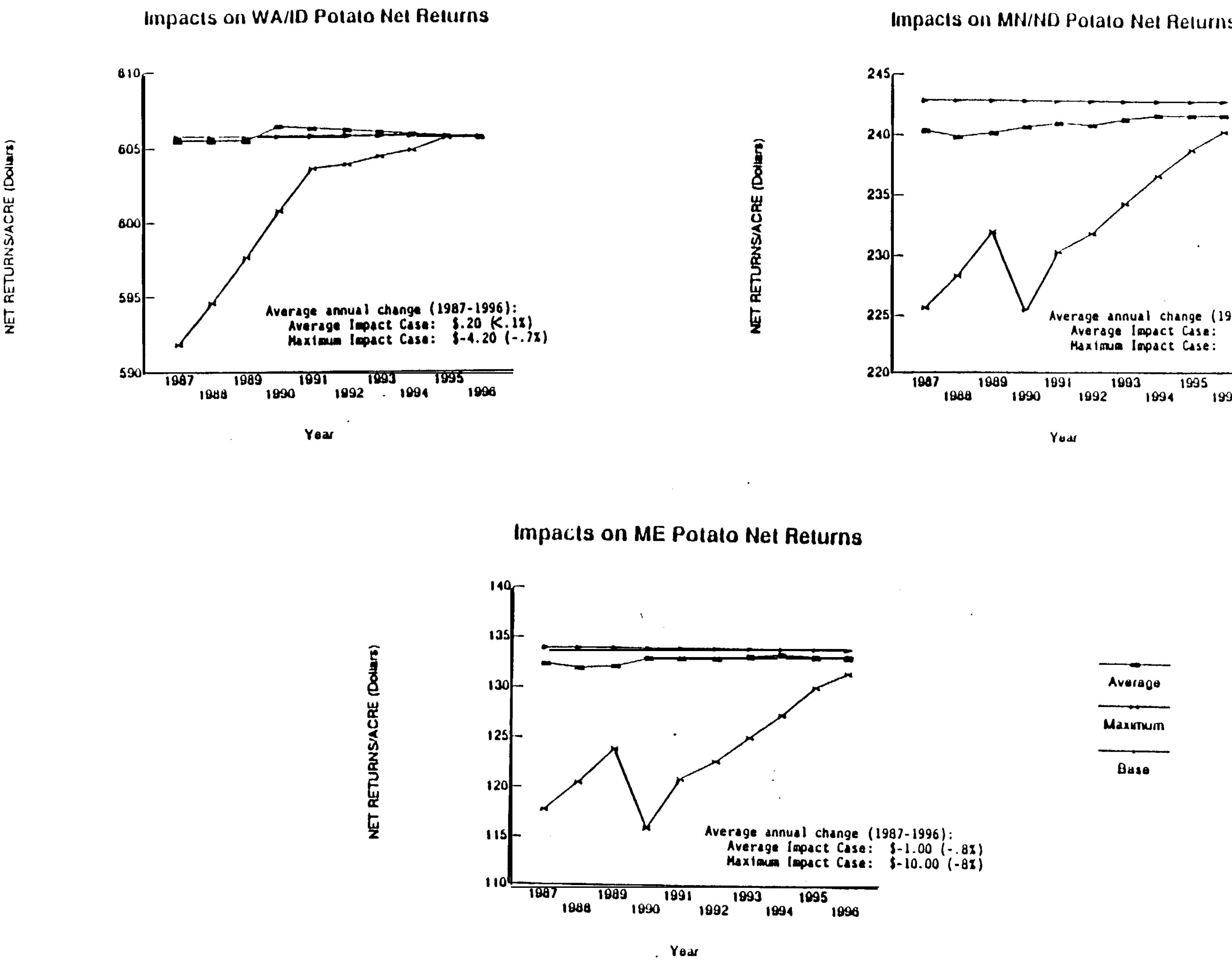


Figure 12. Scenario 1 regulatory impacts on potato production

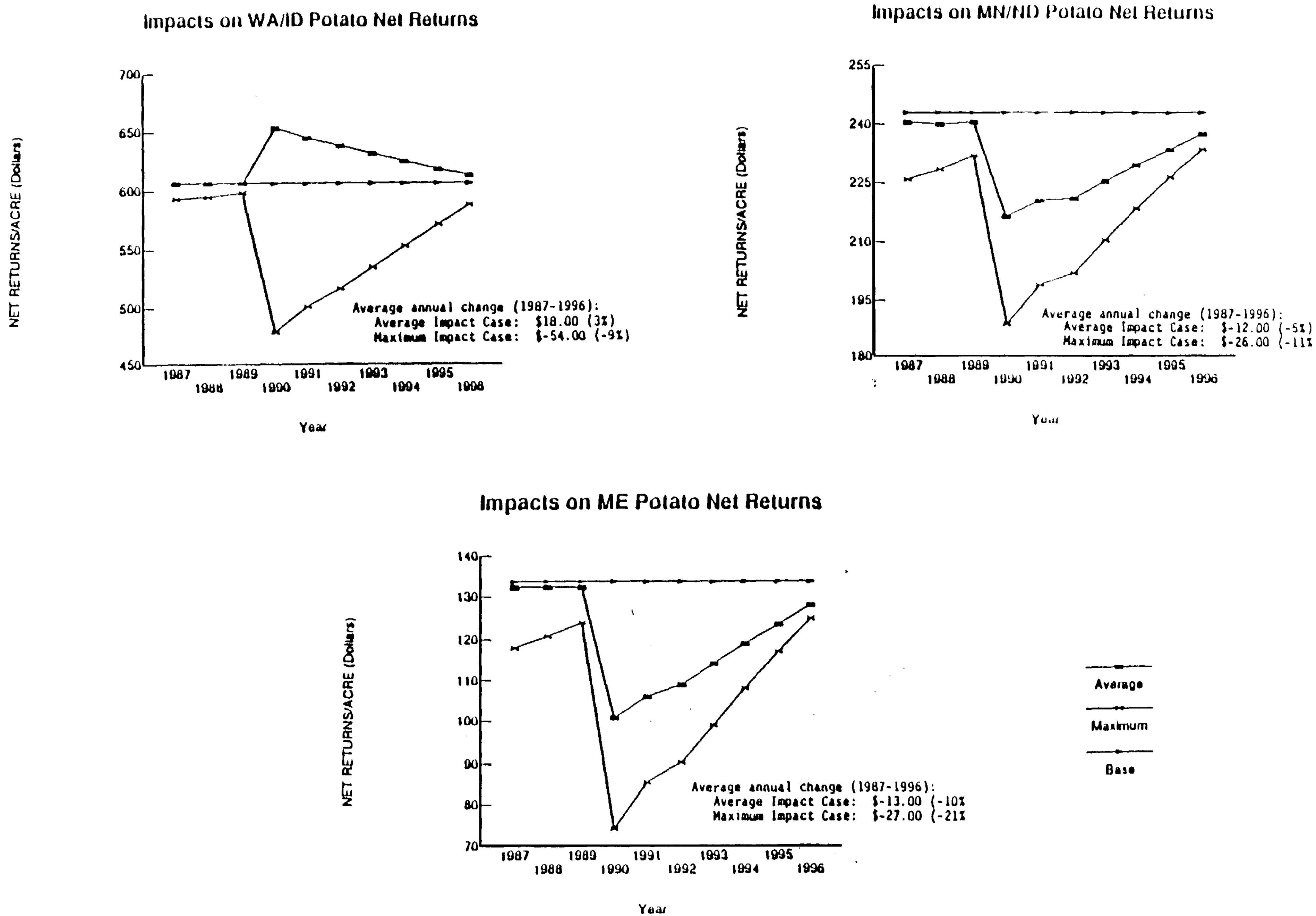


Figure 13. Scenario 3 regulatory impacts on potato production

average impact case. In the other regions, the commodity price increase was modest in relation to the crop yield decreases, and net returns decreased sharply.

Maximum impact results are substantial in all production regions. A yield reduction of eight percent was applied equally in all regions as the result of the proposed 1990 organophosphate restrictions. This reduction in yield when combined with other regulatory actions resulted in an average annual decrease in net returns of nine percent in Washington-Idaho, 11 percent in Minnesota-North Dakota, and 21 percent in Maine during the 1987-1996 period.

Tomatoes

Tomatoes rank second to potatoes in dollar value among all vegetables produced in the U.S. Nearly 85 percent of total production is used for processing, with the remainder utilized fresh.

California is the major tomato growing area, typically accounting for about 75 percent of the total U.S. crop. Ninety to 95 percent of the California crop is used for processing. Florida is the second largest state in terms of production, accounting for six to eight percent of total U.S. production. Unlike 'California, nearly all Florida production is for the fresh market. California harvests approximately 225,000 acres yearly while Florida harvests 45,000 acres. There are approximately 1600 tomato farms in California and 400 in Florida.

The value of tomatoes is much higher for the fresh market, compared to the processing market. Fresh market tomatoes are typically worth approximately $500 per ton at the farm gate, with some variance depending on season, location, and quality. Tomatoes used for processing are typically sold by producers for $70 to $80 per ton.

Yields per acre are also quite different for processed and fresh tomatoes. Tomatoes used for processing are generally direct-seeded (without transplanting) and have relatively higher plant populations per acre. Tomatoes for the fresh market, at least in Florida, are generally transplanted, and the plants are staked; per acre plant populations are much lower.

Net returns per acre of production are considerably higher for fresh tomatoes grown in Florida than for California processing tomatoes. While tomatoes grown in Florida for the fresh market have lower yields and higher growing and harvesting costs, the higher price they command more than offsets these factors. Net returns to management and land are estimated at $1500 per acre compared to $700 per acre for California processing tomatoes.

SCENARIO 1

The impact on net returns per acre from regulatory actions in the tomato producing regions of California and Florida are very similar (Figure 14). The 1988 farm worker safety regulations produce a minimal (less than .3 percent) decline in net returns as measured by average impacts. A more noticeable feature of impacts on tomato producers' net returns is the difference between average and maximum impacts. This difference is explained by the fact that some regulatory actions (e.g., the EDB cancellation which occurred in 1984) have a significant effect on a small number of producers. Under the maximum impact case, the most severe declines in net revenue occur in 1987, with reductions of 1.9 and .8 percent in California and Florida, respectively. Even under the maximum impact cases the decreases in average annual net returns per acre are less than one percent in both Florida and California.

SCENARIO 3

Maximum impacts on yields associated with the proposed 1990 restrictions on fungicides were estimated at 20 percent for both California and Florida. 6/ Such substantial reductions of yield decrease net returns in California by 49 percent and in Florida by 39 percent (Figure 14). Average impacts in California affect net returns less due to a more modest estimate for yield decline of approximately 5 percent.

The impact estimates for tomatoes under Scenario 3 must be viewed with some caution, Yield declines and cost increases were based on information provided by pesticide registrants that has not been thoroughly reviewed by EPA.

Green Peas

Green peas are a relatively minor specialty crop, with production concentrated in the Washington-Oregon and Wisconsin-Minnesota areas. Wisconsin leads all other states in terms of production. Approximately 86,000 acres are harvested yearly in Wisconsin compared to 64,000 acres in Washington. There are approximately 1,700 farms in Wisconsin and 500 in Washington. Yields in Washington average the highest in the nation due. to more capital intensive farming practices such as pivot irrigation. This also accounts for the high cost of production per acre in comparison to other states.

6/ See Appendix E, Table E-5 for the regional cost and yield impacts associated with the fungicide restrictions as well as other actions affecting tomato production.

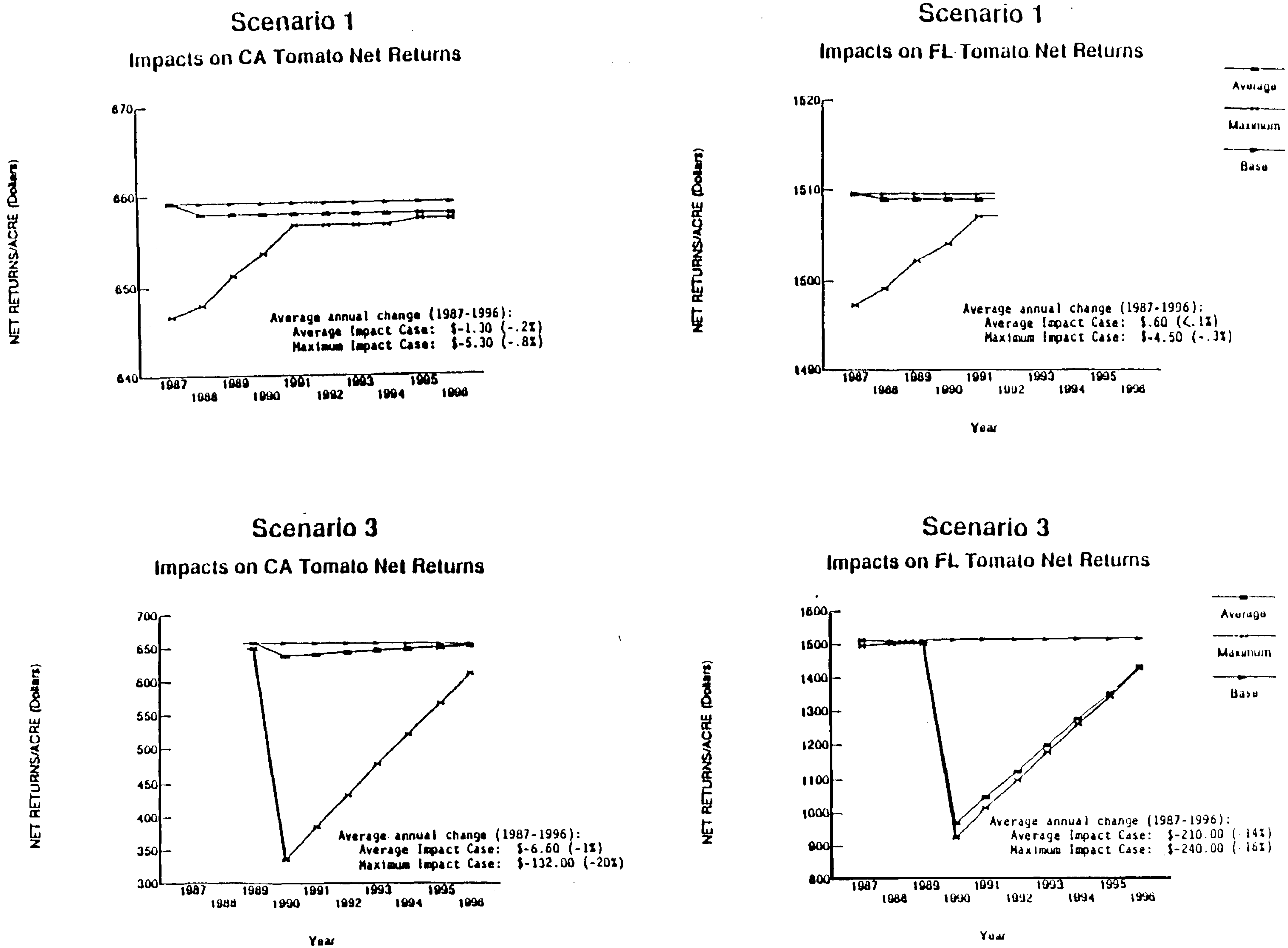


Figure 14. Scenarios 1 and 3 regulatory impacts on tomato production

SCENARIO 1

Average impacts on pea producers' net returns per acre in 1987 result in an initial increase of over one percent in Wisconsin producers' net returns and a corresponding decrease of over seven percent in Washington's net returns (Figure 15). This dichotomy results from the 1987 cancellation of dinoseb which affects only Washington producers. Their response is to decrease production, which results in a commodity price increase of .53 percent over the price in 1986. Wisconsin producers' increase in net returns reflects this price increase. However, the price increase is not enough to offset the costs to Washington producers from the cancellation of dinoseb and their net returns subsequently decline. Additional regulatory impacts (e.g., farm worker safety regulations in 1988 and organophosphate restrictions in 1992) combine with a declining price to decrease net returns in Wisconsin up until 1994.

SCENARIO 3

Regulatory impacts in this scenario are similar to those in Scenario 1 up until 1992 (Figure 15). A noticeable difference occurs in this year when impact estimates of proposed organophosphate restrictions increase sharply over those in Scenario 1. Nevertheless, impacts are still relatively modest even under the maximum impact case when net returns decline 2.0 and 7.8 percent in Wisconsin and Washington, respectively, in 1992, the most severe impact year.

Caneberries

Major caneberry crops include red raspberries, black raspberries, loganberries, boysenberries, and blackberries. Commercial cane-berry crops are grown in the Pacific Northwest, almost exclusively west of the Cascade mountains in the mild marine climates of Oregon, Washington and to a lesser extent in California. Caneberry production has been declining in recent years, due in part to urban expansion in the principal berry regions of Oregon and Washington.

A major problem with the estimation of impacts on caneberries is the lack of information concerning crop production. Very little information is available regarding pesticide use and the efficacy of pesticide alternatives. The cancellation of pesticide registrations can have severe impacts on the industry because of the lack of efficacious alternatives. In general, only a limited number of pesticides are registered for use on caneberries. This is largely' because it is such a minor crop and the cost of registering a pesticide for use outweighs the profits from modest pesticide sales.

Because of the lack of reliable data on caneberry production as well as the caneberry market, impact estimates associated with regulatory scenarios could not be completed.

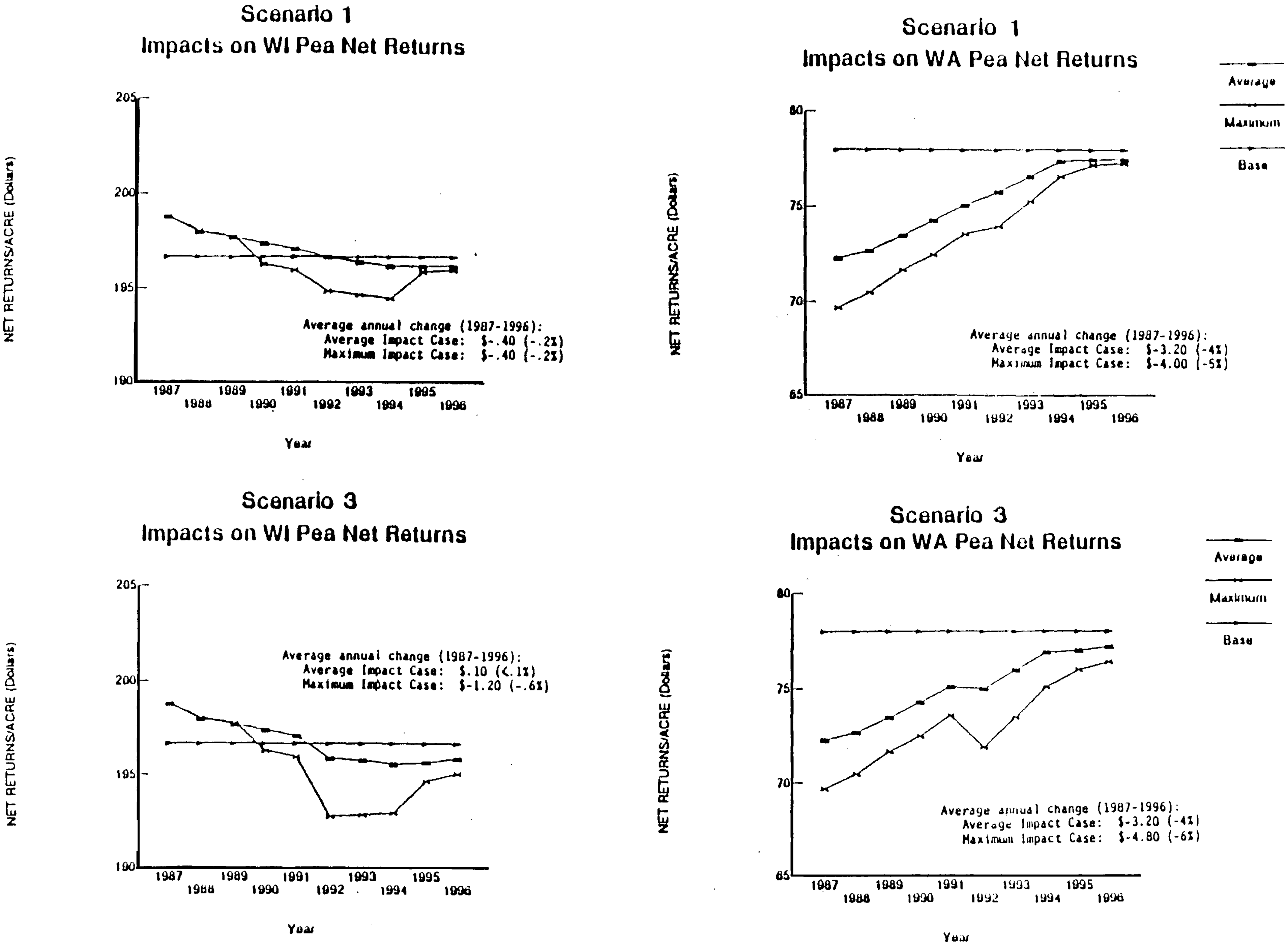


Figure 15. Scenarios 1 and 3 regulatory impacts on peas

Peanuts

The peanut is not actually a nut but rather a legume, more closely related to the pea and bean. The major peanut growing areas, are North Carolina-Virginia, accounting for approximately 15 to 20 percent of total U.S. production, Georgia-Alabama (60 to 65 percent) and Texas-Oklahoma (10 to 15 percent).

Overall profitability of peanut production depends heavily on the U.S. farm program for peanuts. According to the farm program, peanuts are classified as either 'quota' or 'additional', each having a separate pricing system. The price support for quota peanuts is based on the national average cost of production from the previous year, adjusted to reflect any increase in the average cost of production, though restricting annual price increases to 6 percent. Quotas were assigned to farmers on the basis of historical allotments, determined primarily on acreage allotments in place in 1981. (Quotas in 1980 were based on an acreage allotment. Since that time they have been defined based on production, with no regard to acreage.) The quota support price has been $550 per ton since 1983. For purposes of this analysis, quota production was assumed to equal 0.4 million tons at a price of $558 per ton.

Additional or nor-quota peanuts may be grown by anyone. They are used for oil and export (with some buy-back provision if quota production is not adequate to meet domestic edible demand in a given year). The price support for additional peanuts is set to avoid any net cost to the Government, in effect, making the production of additional peanuts- responsive to free-market condition.

Because of unreliable cost and yield estimates associated with various environmental regulations and the lack of critical crop production parameters (e.g., supply elasticities), impact estimates for the regulatory scenarios could not be completed. However, several of the regulatory actions are expected to have significant impacts (over 10 percent decline in yields) on peanut producers including the suspension of toxaphene, the cancellation of certain fungicides and use restrictions stemming from pesticides in groundwater regulations.

SUMMARY AND RECOMMENDATIONS

Summary results for the representative livestock and major field crop farms in average financial condition are presented in Tables 1 and 2. Table 1 indicates the average base net cash farm income for each producer forecasted over the 1987-1996 period and shows the average annual change in income predicted for the same period under Scenarios 1 and 3. Table 2 shows the average base debt to asset ratio and predicted changes for the forecast period. As revealed in these summary results and the preceding report, on average, major field crop and livestock producers are not expected to experience

Table 1. Average Annual Effect of EPA Actions on Net Cash Farm Income (NCFI) 1987-1996 for Farms in Average Financial Condition (1986 $) 1/

	Avg. Base NCFI 1987 - 1996	Scenario 1 Avg. Impact Case	Scenario 1 Max. Impact Case*	Scenario 3 Avg. Impact Case	Scenario 3 Max. Impact Case*
IL Corn Soybean	35,000	-270 (-. 8%)	-2,900 (-8%)	+4,800 (+14%)	-9,200 (-26%)
MS Cotton Soybean	58,900	-1,700 (-3%)	-10,700 (-18%)	-1,300 (-2%)	-14,200 (-24%)
KS Wheat Cattle	11,600	-380 (-3%)	-2,800 (-24%)	+310 (+3%)	-9,700 (-84%)

1/ Average percent changes are indicated In parenthesis.

* All of the representative farms have a 90 percent chance of Incurring coat and yield Impacts that are less than half of those corresponding to the maximum impact case. The maximum impact cases, therefore, must be viewed as very unlikely worst cases.

Table 2. Average Percentage Change In Debt to Asset Ratios (D/A) Caused by EPA Actions (1987-1996) for Farms in Average Financial Condition 1/

	Avg. Base D/A 1987 - 1996	Scenario 1 Avg. Impact Case	Scenario 1 Max. Impact Case*	Scenario 3 Avg. Impact Case	Scenario 3 Max. Impact Case*
IL Corn Soybean	.26	<.1%	1%	-.3%	2%
MS Cotton Soybean	.28	.6%	6%	.5%	6%
KS Wheat Cattle	.26	.3%	3%	.6%	22%

1/ Note that increases In the debt asset ratio (appearing as a positive percentage change In this table) represent a worsening of a farm's financial condition.

l All of the representative farms have a 90 percent chance of incurring cost and yield impacts that are less than half of those corresponding to the maximum impact case. The maximum impact cases, therefore, must be viewed as very unlikely worst cases.

large financial impacts due to EPA actions. For the average impact case, average annual decreases in farm income are three percent or less and the resulting changes in debt to asset ratios are less than one percent. Although the average impact cases indicate that, on average, the losses under these scenarios are minor, the impact on any given producer is a function of both initial financial and production conditions and the extent of the initial cost and yield impacts that are incurred. Large variations in losses incurred by different farmers under any given set of EPA actions are possible.

Maximum impact cases were designed to set an upper bound on the losses that each of the representative farms might incur under each scenario. These cases indicate the income losses that would be incurred if the representative farms were assumed to be impacted by all the EPA actions that could possibly affect them, and represent unlikely worst case scenarios. Even under the extreme maximum impact cases, however, none of the producers in average financial condition go out of business as a result of EPA actions.

Since the ability of farms to withstand losses is a function of their initial financial condition, each scenario of EPA actions was simulated for representative farms in vulnerable financial condition. Although the reductions in net cash farm income were similar for vulnerable farms and farms in average financial condition, these income reductions resulted in larger changes in the debt to asset ratios for vulnerable farms. Only one of the vulnerable farms went out of business any earlier than it otherwise would have due to EPA actions. Under the maximum impact case for Scenario 1, the vulnerable Kansas wheat cattle farm went out of business in 1992, as opposed to in 1993 in the baseline.

Because of limited data availability, the study did not forecast changes in the financial condition of the specialty crop farms. Instead, it examined changes in net returns per acre (which reflect' returns to land and farmer provided labor). Summary results for the specialty crops are provided in Table 3. The base net returns per acre are indicated for each of the crop and regions considered, along with the absolute and percentage changes.

As indicated in Table 3, effects on specialty crop producers are fairly small under Scenario 1. Net returns are reduced by four percent or less under the average impact case, and by eight percent or less under the maximum impact case.

Both average and maximum impact cases result in significant losses for specialty crop producers under Scenario 3. The largest absolute reductions in net returns per acre are incurred by tomato growers in Florida and apple growers in New York and Michigan, with decreases in net returns of $210, $132, and $67, respectively, under the average impact case. These dramatic decreases in net returns may bring about substantial structural changes in the production and markets for the crops affected. Large differences in the impact of EPA regulations on crops grown in different regions occurred-because

Table 3. Average Annual Change in Net Returns Per Acre (NR/A) Caused by EPA Actions 1987-1996 (1986 $)

	Avg. NR/A Base 1987 - 1996 1/	Scenario 1 Avg. Impact Case	Scenario 1 Max. Impact Case	Scenario 3 Avg. Impact Case	Scenario 3 Max. Impact Case
Apples					
WA	330	-2.30 (-0.7%)	-3.30 (-1%)	+0.70 (0.2%)	-9.90 (-3%)
NY	220	-4.40 (-2%)	-6.60 (-3%)	-132.00 (-60%)	-163.00 (-74%)
MI	80	-3.20 (-4%)	-5.60 (-7%)	-67.00 (-84%)	-145.00 (-182%)
Potatoes					
WA/ID	600	+.20 (<0.1%)	-4.20 (-0.7%)	+18.00 (3%)	-54.00 (-9%)
MN/ND	240	-1.90 (-0.8%)	-9.60 (-4%)	-12.00 (-5%)	-26.00 (-11%)
ME	130	-1.00 (-0.8%)	-10.00 (-8%)	-13.00 (-10%)	-27.00 (-21%)
Tomatoes					
CA	660	-1.30 (-0.2%)	-5.30 (-0.8%)	-6.60 (-1%)	-132.00 (-20%)
FL	1,500	+.60 (<0.1%)	-4.50 (-0.3%)	-210.00 (-1.4%)	-240.00 (-16%)
Peas					
WI	200	-.40 (-0.2%)	-.40 (-0.2%)	+.10 (<0.1%)	-1.20 (-0.6%)
WA	80	-3.20 (-4%)	-4.00 (-5%)	-3.20 (-4%)	-4.80 (-6%)

1/ Net returns per acre are based on regional budget information, and are assumed constant over the period 1987-1996 in the base case, and are in 1986 dollars.

some of the proposed restrictions involve pesticides that are used in some regions and not in others. Even though the results of this study must be considered preliminary, these figures show that EPA actions could create economic problems for some specialty crop farms and suggest that the-Agency exercise considerable caution in this area.

Impacts on potato producers under Scenario 3 are significant, although the absolute decreases are relatively small (approximately $26 in each region) these decreases result in an 11 percent and a 21 percent reduction in net returns per acre in Minnesota/North Dakota and Maine, respectively.

Impacts on pea producers are relatively modest. Even under the maximum impact cases for the most expansive EPA scenario, net returns per acre are decreased by less than $5.00 in both of the regions that were examined.

This study illustrates the advantages of examining the impacts of environmental regulations at the farm level as well as at the aggregate national level. While national analyses provide useful information concerning the total losses incurred by different aggregate types of farmers (e.g., corn farmers as a whole), the impact of environmental regulations on farms' financial conditions depends on the distribution of those losses among farmers and on the initial financial conditions of the affected farms. In order to determine the effect of EPA regulations on the ability of farms to survive, both aggregate and farm level analyses are necessary.

This study highlights the data and analytical requirements necessary to determine the impacts of EPA actions on agriculture. Such requirements include:

1. Accurate pesticide usage data,

2. Accurate pesticide efficacy data,

3. Improved information on how initial pesticide cancellation effects change over time,

4. Accurate incidence data for non-pesticide related impacts (e.g., underground storage tanks),

5. Improved national price-quantity models to predict commodity price changes due to EPA actions, and

6. Better information on the initial financial and production conditions of agricultural producers and farm level models for estimating changes in these over time.

The need for better data and modeling capability is greatest for specialty crops, where reliable pesticide usage and efficacy data, often do not exist, limited information is available on producers' initial financial condition, and few models are available. EPA is currently compiling a directory of all specialty crop models. Improvements in pesticide usage data might be obtained by increased cooperation and cost sharing with USDA and states to fund additional pesticide usage surveys or to add pesticide usage questions to surveys designed for. other purposes. In addition, registrants of pesticides might be required to provide usage information. Appendix H provides a discussion of additional options that might be considered for improving the data available to complete studies of this type. Reliable pesticide usage data, efficacy data, national price-quantity models, and farm level models are likely to become increasingly important in the future, as EPA tries to reduce environmental risks associated with agricultural production in a cost-effective manner.

AGRICULTURAL SECTOR STUDY
APPENDICES

APPENDIX A

EPA Actions Considered In This Study

BY.

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Appendix A

EPA Actions Considered in this Study

As part of this study, each of the program offices at EPA submitted a description of the regulations that were passed during the past five years and those that were being considered for the next five years. These regulations were reviewed to determine which ones were likely to have a direct economic impact on the agricultural sector; regulations having an indirect economic impact were not included in this analysis because of the difficulty in determining what portion of their cost would be passed on to agricultural producers. The set of potential direct impacts included:

Air — Lead Phasedown: If lead is banned from gasoline, farmers that use gasoline powered tractors, combines and trucks would have to use a fuel additive or rebuild their valves. These costs were incorporated into Scenario 3.

Air — Agricultural Burning Restrictions: Agricultural open burning of crop residues may be restricted. Possible control techniques include proper fire and fuel management, appropriate burning operations under optimum meteorological conditions, and alternative residue disposal procedures. The impact of this regulation was not quantified in this study because of insufficient information on its cost and incidence.

OPTS — SARA Title III (jointly with OSWER): Title III of SARA requires farmers to provide information on the chemicals that they use and store. The cost of Sections 302-303 are estimated to be approximately $50 per farm, and apply to 33% of all farms. Farms are exempt from 311-312 requirements provided that they do not employ more than 10 full-time employees. This means that virtually all farms are exempt from Section 311-312 requirements. SARA Title III costs were incorporated into Scenarios 1-3.

OSWER — Financial Responsibility Requirements for Petroleum Underground Storage Tanks (USTs): Would require farms with petroleum USTs of greater than a 1,100 gallon capacity to carry insurance. This would cost farms $2,500 per year. Information is available on the number of covered USTs in each USDA production region;: however, no information is available concerning the types of farms most likely to have them. Insurance costs were incorporated into Scenarios 1-3.

OSWER — Technical Standards for Design and Operation of USTs Containing Petroleum or Hazardous Substances: By 1991, farms having USTs will have to begin monitoring. This is estimated to cost $500 and will have to be repeated at least every 3 years. If a leak is found, they will have to be repaired and upgraded. No information is available on the likelihood of finding leaks in farm USTs or the cost of repairing or replacing the tanks. By year 10, all USTs will have to be brought up to standards, again. Monitoring costs were incorporated into Scenarios l-3. Although there is no information specific to farm USTs, national data estimate that 15 percent of all USTs may be leaking. The estimated cost of replacing a 4,000 gallon coated and cathodically protected tank system is $21,000 and the cost of upgrading an existing tank is $3,050.

OSWER Waste Oil Management: There is insufficient information to determine whether this is relevant.

Water Nonpoint Source Guidance and Management Plans: Under legislation passed in February 1987, states were given grants to assess the magnitude of NPS problem and to develop management plans. These plans will have to be submitted by August 1988. EPA has until February 1988 to approve the plans. Information from Office of Water indicates that this should not be considered a direct affect on agriculture because EPA cannot force states to implement their management plans and because actions on the part of farmers will be voluntary.

Water Wellhead Protection Program: Section 1428 of SDWA as amended in June 1986 mandated states to submit wellhead protection programs to EPA. Although states are required to submit plans, there are no federal sanctions for not submitting except for the withholding of grant funds. Twenty states have begun development of plans. The cost question is difficult to address because there are no minimum federal standards or management strategies which states must include as part of an approvable WHP; therefore, impacts are likely to vary considerably from state to state. These costs were not quantified in this study.

Water National Estuary Program: There are no national program guidances and/or regulations yet associated with the NEP. The first is expected in 1989. For agriculture, use of pesticides in certain watersheds may be eliminated or restricted. Target reductions of nutrient loadings may be established and BMPs may be put into place by SCS and state cost sharing programs. No information is currently available to determine the impact of this program on agriculture.

Water	Sewage Sludge Regulations: A proposed rule is planned for October 1988. This rule may limit the amount of municipal sludge farmers are allowed to use on their fields. No information currently exists on the limits that would be imposed or the costs that farmers would bear as a result of this rule.
OPTS	FIFRA/OPP Part 170 (Farm workers): The proposed rule establishes requirements to improve the occupational health and safety of workers performing hand labor in the fields. Specific estimates on per acre production cost increases for various crops were utilized in this analysis and were incorporated into Scenarios 1-3.
OPTS	Pesticides in Groundwater Strategy: Groundwater protection may result in prohibitions of certain water soluble pesticides in areaswith vulnerable groundwater. Three alternative sets of impacts associated with the Pesticide in Groundwater Strategy were developed by OPTS and used-in Scenarios l-3.
OPTS	Endangered Species Act: Actions that bring EPA into compliance with the Endangered Species Act will impose some direct costs on agriculture. No information currently exits to determine the extent of costs imposed by the ESA; therefore, these costs were not included in this analysis.
OPTS	FIFBA/OPP Individual Actions: The following individual actions were included in this study: cancellation of EDB, toxaphene, dinoseb; restricted use of alachlor; cancellation of yield enhancement of cholordimeform; and an expansive, intermediate, and conservative scenario for actions on the following groups of pesticides: fungicides, corn rootworm insecticides, broad spectrum organophosphates, and grain fumigants.

Direct Impacts Included in the Empirical Analysis:

The objective of this study is to examine the cumulative impact that EPA policies promulgated over the period 1983-1992 have on the agricultural sector. It is obviously difficult to predict what future EPA policies might look like: therefore, we have defined three alternative scenarios corresponding to a range of future EPA policies. The scenarios can best be summarized as follows:

SCENARIO 1: Past and current EPA actions plus a conservative (low cost) set of assumptions about future actions.

SCENARIO 2: Past and current EPA actions plus an intermediate (mid cost) set of assumptions about future actions.

SCENARIO 3: Past and current EPA actions plus an expansive (high cost) set of assumptions about future actions.

Past and Near Term Actions Included in Scenarios 1 - 3:

Actions that the Agency has undertaken in the past five years or plans to undertake in the very near future were included. in all three scenarios. These actions are:

EDB - cancellation
Toxaphene - cancellation
Dinoseb - cancellation
SARA Title III
Leaking Underground Storage Tanks
Farm Worker Protection Standards
Chlorodimeform - cancellation of yield enhancement
Alachlor - restricted use.

For actions that there is a great deal of uncertainty over, three alternative plans were considered, with the most conservative plan being incorporated into Scenario 1, the intermediate plan into Scenario 2, and the most expansive plan into Scenario 3. These actions and the alternative plans are listed below:

Fungicides

Scenario 3: EPA would cancel the use of all EBDCs and chlorothalonil. Captan would not be cancelled.

Scenario 2: EPA would cancel the use of all EBDCs. Chlorothalonil and captan would not be cancelled.

Scenario 1: EPA would put additional restrictions on the use of all EBDCs chlorothalonil and captan (e.g., restricted use, pre-harvest restrictions, limited number of applications).

Corn Rootworm Insecticides

Scenario 3: EPA would cancel all of the corn rootworm insecticides.

Scenario 2: EPA would cancel all of the corn rootworm insecticides with the exception of one of the organophosphates and one of the carbamates.

Scenario 1: EPA would cancel soil use, but not foliar use, of all of the corn rootworm insecticides.

Broad Spectrum Organophosphates

Scenario 3: EPA would cancel three-quarters of all of the broad spectrum OPs. The most toxic ones would be cancelled.

Scenario 2: EPA would cancel one-half of all of the broad spectrum OPs. The most toxic ones would be cancelled.

Scenario 1: EPA would place restrictions on the use of OPs (e.g., closed cabs).

Grain Fumigants

Scenario 3: EPA would cancel methyl bromide. Aluminum phosphine and magnesium phosphine would not be cancelled.

Scenario 2: EPA would put additional restrictions on the use of methyl bromide, aluminum phosphine, and magnesium phosphine.

Scenario 1: No action.

Pesticides in Groundwater Strategy

Scenario 3: EPA would cancel the use of aldicarb, alachlor, and three triazines over the next five years in all counties having high drastic scores and 20% of the counties having medium drastic scores.

Scenario 2: EPA would cancel the use of aldicarb, alachlor, and three triazines over the next five years in 25% of the counties having high drastic scores.

Scenario 1: EPA would cancel the use of aldicarb in 25% of the counties having high drastic scores. Restricted use would be instituted for alachlor and the triazines. Monitoring would be-required for the triazines that have not yet had monitoring required.

Lead Phaseout

Scenario 1,2: A total ban of lead in gasoline (for agricultural use) was not assumed in these two scenarios.

Scenario 3: EPA would eliminate lead in gasoline for agricultural use.

<u>Risk Reductions Corresponding to the Actions Considered:</u>

The objective of the preceding report is to estimate cumulative costs associated with EPA actions. To provide some background as to why EPA has undertaken, or might consider, the actions listed above, the following section describes the health and environmental risks and exposure pathways associated-with the substances those actions are meant to control.

EDB:

Health effects were the primary concern that motivated the cancellation of EDB. EDB is classified as a likely human carcinogen and may cause adverse reproductive effects to exposed workers. The exposure routes were: food consumption, drinking water, and worker exposure. Cancer risk estimates due to occupational inhalation of EDB range from 1 x 10^{-1} to 3.6 x 10^{-4}. Millworkers and farmers had the largest populations of workers at risk, with 16,000 millworkers and 14,000 farmers estimated as being exposed to EDB through inhalation. Dietary risks occurred through the consumption of wheat products, citrus, and tropical fruits. Cancer risks from EDB to the average U.S. consumer were estimated to be 3.55 x 10^{-3} due to wheat product consumption and from 2.8 x 10^{-4} to 1.7 x 10^{-5} due to citrus fruit consumption, depending on state requirements about fumigation.

Toxaphene:

Ecological damages were the primary concern motivating the cancellation of toxaphene. Toxaphene was found to cause adverse reproductive effects in fish populations at very low concentrations. It may be carried for long distance in the upper atmosphere and find its way into water bodies far from the locations where it was used. In addition to the concern about fish populations, laboratory experiments indicated that toxaphene has both acute and chronic effects on several bird species. Finally, human exposure may occur both through worker exposure (inhalation and dermal) and dietary exposure. Estimates of lifetime probability of cancer to toxaphene applicators (toxaphene was applied to several crops) ranged from 2 x 10^{-2} to 3 x 10^{-5}. Dietary risk was estimated to be the greatest for local populations of fish consumers in areas where significant fish contamination had been demonstrated.

Dinoseb:

Exposure to dinoseb may cause a variety of hazards such as developmental toxicity, reproductive toxicity, acute toxicity, induction of cataracts, and immunotoxicity. An oncogenicity hazard (resulting in benign tumors) may also exist. A particular concern that led to the emergency suspension of dinoseb was its potential to cause birth defects. Exposure to dinoseb occurred through direct contact by farm workers. Approximately 45,000 workers, including up to 2,200 females, were involved in the application of dinoseb. A large number of farm workers and bystanders had the potential to be exposed to dinoseb during or shortly after application, and other people had a chance of being exposed by a secondary route (e.g., laundering of contaminated clothing). In addition, dinoseb has been found in groundwater in several states, indicating that exposure through drinking water is also possible.

Chlorodimeform:

The registrants of chlorodimeform have voluntarily cancelled it since the beginning of this project. Chlorodimeform was used only on cotton. The health risk of concern was the possibility of cancer in exposed workers.

Alachlor:

Risk of cancer is the primary concern associated with alachlor. There are multiple routes of exposure: worker exposure, consumption of ground water and surface water, and residue on food products.

Farm Worker Safety:

The objective of farm worker safety requirements are to minimize the acute and chronic health effects for pesticide handlers and field workers. There are approximately 500,000 handlers and 1.8 million field workers. The regulations are directed primarily towards minimizing the risk of acute poisoning. There are 20,000 to 300,000 acute poisoning incidences estimated to occur annually due to farm worker exposure.

Underground Storage Tank Regulations:

The proposed underground storage tank regulations would set insurance and monitoring requirements for underground petroleum tanks (with greater than 1,100 gallon capacity) on farms. The primary health risks associated with leakage from these tanks are cancer (caused by benzene, a component of petroleum) and fire and explosion. Ecological damages may occur if leakages found their way into streams. Risks are greatest in small streams where the opportunity for dilution is less than in larger streams.

SARA Title III:

Benefits associated with Title III take the form of "negative reductions in damages". Title III is expected to contribute to human health and welfare in at least two ways: by helping to prevent potentially harmful releases of hazardous substances, and by making it possible to reduce the harm from those releases that still occur.

Fungicides:

The fungicides OPP may consider for cancellation are classified as probable human carcinogens. Exposure routes for fungicides are: worker exposure, dietary, and groundwater. Worker exposure is the primary concern associated with chlorothalonil at this point, with dietary exposure the primary concern for both captan. and EBDCs; however, evidence of thyroid and teratogenic effects (birth defects) have been found for EBDCs. Chlorothalonil and EBDCs (or their breakdown products) have been found in groundwater.

Broad Spectrum Organophosphates:

There are both human health and ecological concerns associated with broad spectrum organophosphates (OPs). The OPs are acutely toxic. They depress an enzyme that causes an interference with nerve transmission, and may result in nausea, diarrhea, dizziness, or death. In addition, some OPs may result in adverse eye effects (myopia) and neurological disorders. Worker exposure, dietary exposure, and groundwater contamination are all of concern. Ecological impacts are also a concern, since broad spectrum OPs are acutely toxic to birds and fish, as well as humans.

Corn Rootworm Insecticides:

The health and ecological concerns associated with corn rootworm insecticides are similar to those for broad spectrum organophosphates. However, worker exposure is not thought to be a problem with corn rootworm insecticides because they are applied in granular form, as opposed to a spray. Hazard to bird populations is a major concern with corn rootworm insecticides.

Grain Fumigants:

Worker exposure is the primary concern with grain fumigants. Methyl bromide may result in acute toxicity (possibly causing nausea, diarrhea, dizziness, or death) while aluminum phosphine and magnesium phosphine are neurotoxins.

Pesticides in Groundwater:

Alachlor effects and exposure routes are discussed above.

Aldicarb is an acutely toxic substance that may result in nausea, diarrhea, dizziness, or death. The exposure paths of concern for aldicarb are residues on food (mainly potatoes and citrus crops) and groundwater contamination.

Triazine herbicide (cyanazine, atrazine, and simazine) exposure may occur through groundwater and surface water. Health effects are the primary concern for these substances. All of the triazines are considered possible human carcinogens, And there is some concern that the triazines can react with nitrites (also found in groundwater) to form nitrosamines, which are potent animal carcinogens. In addition, exposure to cynanzine may cause birth defects.

Lead in Gasoline:

Lead in gasoline has been shown to increase blood lead levels, which in turn have been linked to a variety of serious health effects, particularly in small children. Recent studies linking lead to high blood pressure in adult males also are a source of concern. People are exposed to lead from gasoline through a variety of routes, including direct inhalation of lead particles when they are emitted from vehicles, inhalation of lead contaminated dust, and ingestion of lead contaminated food.

APPENDIX B

AGSIM Model and Results

BY

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Appendix B

AGSIM Model and Results

1.0 Introduction

In examining the impact of EPA actions on the financial condition of agricultural producers, it is crucial to account for the crop and livestock price increases that result from these actions. Failure to account for these price changes would result in an overestimation of the impact of EPA actions on farmers. The crop and livestock price changes resulting from EPA policies were predicted using AGSIM, a regional econometric-simulation model of U.S. crop and livestock markets (Eales, Frank, Taylor 1987a, 1987b, 1987c). The new crop and livestock prices obtained from AGSIM under each scenario, were then used as inputs to representative farm models (along with additional information on production costs and yield impacts) to determine the change in financial condition caused by EPA actions. The-set of crop and livestock prices in the base run of AGSIM (no EPA actions) is presented in Table B-2 (tables appear at the end of this appendix). The change in these prices under Scenarios 1, 2, and 3, are presented in Tables B-6, B-11, and B-16, respectively.

In addition to providing information on price changes, AGSIM is useful in predicting the impact of EPA actions on: crop acreage, livestock production, and changes in aggregate producer and consumer welfare. All of these impacts are examined in this appendix; however, only the price changes are essential to the preceding report. While the examination of these additional impacts does not shed any further light on how representative producers are impacted by EPA actions, it provides a more complete picture of the cost these actions are likely to have on society as a whole.

2.0 Description of AGSIM

AGSIM simulates regional production of major field crops and livestock as well as the demand for those commodities. Together the demand and supply systems provide estimates of commodity production, distribution, prices, and the economic welfare of producers and consumers. Initial impacts of EPA actions under each scenario are expressed as inputs to AGSIM in the form of increased costs of crop production and reduced crop yields.

The crop supply component of AGSIM is comprised of a set of supply equations for each of 11 regions. Results from only 10 regions are presented here to correspond to the principal production regions. Crops included in the model are corn, grain-sorghum, barley, oats, wheat, soybeans, cotton, and hay. Cultivated summer fallow is treated as another land use in semi-arid regions. Region definitions are presented below.

Corn Belt:	Iowa, Illinois, Indiana, Missouri, Ohio
Lake States:	Michigan, Minnesota, Wisconsin
Northern Plains:	Kansas, Nebraska, North Dakota, South Dakota
Southern Plains:	Oklahoma, Texas
Mountain States:	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming
Pacific States:	California, Oregon, Washington
Delta States:	Arkansas, Louisiana, Mississippi
Southeast:	Alabama, Florida, Georgia, South Carolina
Appalachia:	Kentucky, North Carolina, Tennessee, Virginia, West Virginia
Northeast:	Mid-Atlantic States and New England

For each region, the model first determines total acreage planted or placed in summer fallow and total acreage diverted or set-aside under farm programs. Then, a set of equations determine the proportion of acreage planted to each crop. Acreage is modeled as a function of expected returns, which account for target prices. Yield per acre, modeled as a time trend-for each crop in each region is held constant after 1987 (except as altered by EPA actions). Yield per acre is multiplied by acreage to calculate production. Summing crop production across regions and adding inventories determines crop supply.

Crop demands are estimated for cotton lint, hay, grain exports, grain stocks, food, soybeans, feed, and cottonseed. The soybean demand component consists of a crushing, export, and stock demand function as well as demands for the derivative meal and oil products. These functions are primarily determined by relative prices.

Equating crop supply and demand functions and solving the system of price-dependent equilibrium excess supply equations provides annual equilibrium prices. Prices from one simulated year are used to calculate net returns for that year. The system is recursive. A price from one year may affect acreage response the following year. Expected net returns drive the acreage response functions. The maximum of price from the previous simulated year and the effective support price is used to calculate expected net returns. That is, price from the previous year serves as a price expectation for the following year.

The livestock sector of AGSIM is linked to the crop sector through feed and hay prices which determine the supply and inventory of livestock products: beef, veal, pork, chicken, and milk. Also, quantities of feed demanded are influenced by livestock prices.

The model runs twice to simulate a technological change. The initial, or base run simulates commodity market conditions without any technological change. A second run simulates market conditions under the new technology, showing differences attributable to the technology. The three scenarios were simulated by changing the yields, and both fixed and variable production costs of selected crops in particular regions.

The principal limitation on the interpretation of AGSIM results is that the model is not specific and detailed enough to recognize any particular technological change. That is, any two changes having identical impacts on net returns would be treated identically by AGSIM and, thus, calculated economic impacts would be identical. The factors that might limit use of any particular technology may not be incorporated in AGSIM. Overestimating impacts is a real possibility.

Income impacts may be overestimated because AGSIM does not account for the effects of price changes on commodity program payments. Commodity programs may stabilize farm income. When prices rise, revenues derived from commodity sales rise, but deficiency payments fall, thereby partially offsetting the revenue increase. AGSIM calculates farm income based on a market price ignoring deficiency payments and hence the reduction in payments likely to accompany an increase in market price.

AGSIM simulates production and the operation of commodity markets over a ten year horizon. The year-by-year changes cannot be considered market forecasts. Instead, the multi-year information is designed to provide a longrun description of the policy impacts. AGSIM is designed to equilibrate supply and demand forces in each simulated year. Actual commodity markets may operate, at times, with much greater or lesser speed than AGSIM suggests. For example, price expectations modeled-in AGSIM do not rapidly adjust to changed conditions. That expectations mechanism is empirically adequate for historical data. Whether that expectation formation mechanism will hold in the future is a matter of speculation. The particular type of equilibrium assumed for commodity markets in AGSIM leads to stocks being rapidly depleted. In recent years, stocks have demonstrated much more inertia, suggesting that prices may not increase as rapidly as the AGSIM simulations suggest. Again, these examples indicate that the presented time paths variables follow are primarily descriptive, rather than exact.

Information from the AGSIM base run and the three alternative policy runs is presented in this appendix. Information from a base run, which is common to all three policy scenarios, is presented in Tables B-l through B-4. This information includes crop acreage by commodity, commodity prices (farm level prices for crops and retail prices for dairy and livestock commodities), crop and livestock income, and livestock production. Crop income is calculated by subtracting most fixed and variable production costs from gross revenue. Land costs and commodity program payments are not considered in that calculation. Changes in acreage, prices, and income are presented for each policy scenario. Also, several variables measuring income changes throughout the agricultural sector and impacts on consumers are shown.

Gains and losses resulting from regulations affecting crop productivity may go far beyond the farms for which yields and costs of production are immediately affected. The crop sector supplies the dairy and livestock sectors. Increased crop production costs and reduced production may lead to higher feed costs and hence higher meat and dairy products. Other industries depend on the success of crop enterprises. Industries that process and market field crops as well as dairy and livestock products depend on the price and volume of those products. AGSIM provides some estimates of the aggregate gains and losses to industries up and down the food and fiber marketing chain.

The heading, "Crop Consumer Effect" in the boxheads of Tables B-9, B-14, and B-19 refers to the sum of gains or losses to consumers (that is, the effects of higher prices for all food and fiber products) and to all industries beyond the farm gate that depend on crop production. These industries include, but are not limited to, processors, packers, retail grocers, and transportation firms. One should expect that as crop production is carried out less efficiently, farm prices will rise and output will fall. The intermediate industries will have reduced business and the price increase, representing higher input prices to processors, will imply reduced profits for the various processing industries. With higher input and output prices throughout the marketing chain, consumers should face higher retail prices.

Similarly, the heading "Livestock Consumer Effect" refers to the sum of gains and losses beginning with livestock purchasers and ending with consumers of meat and dairy products.' These gains and losses are a subset of those included in the "Crop Consumer Effect". The "Livestock Consumer Effect" is smaller, in absolute value, than the "Crop Consumer Effect" because the latter effect includes crop uses that do not support livestock production. Only a small portion of wheat supply, for example, is used for livestock feed. Cotton is not used for livestock feed, although cottonseed meal is used for feed.

Just and Hueth showed that in vertically related industries where the output of each industry is an input for the industry one step up the marketing chain, the welfare effects of an imposed price distortion in an initial or intermediate market on all forward industries can be captured by measuring the change in consumers' surplus (the difference between what consumers are willing to pay and what they are required to pay to acquire goods and services). That is, if a calculation to compute changes in consumers' surplus were carried out on an initial or intermediate-level general equilibrium demand function, the change should be interpreted as the change in final consumers' surplus plus the changes in all forward industry rents. Chavas and Collins generalized this analysis to include technological change or distortion. These ideas are incorporated in the AGSIM calculations presented here.

3.0 Results

As discussed above, the impact of EPA actions on crop producers are entered into AGSIM in the form of yield decreases and/or production cost increases. These impacts result in a decline in crop production and an increase in crop prices - a cost for crop purchasers. Yield and cost changes in Scenario 1 are the least of the three scenarios. The changes induce losses for both crop consumers and producers. As a result of higher costs of feeding livestock, livestock income decreases, but livestock purchasers are affected less since livestock prices change less then crop prices.

Scenarios 2 and 3 generate greater effects than Scenario 1, primarily because of larger corn yield declines beginning in 1992. Prior to 1992, these two scenarios have somewhat greater cost changes than Scenario 1, while Scenario 3 has greater changes than Scenario 2. Thus, Scenarios 2 and 3 cause somewhat larger-price changes than Scenario 1, during that time period. As a result, crop consumers, livestock producers, and livestock consumers generally lose more and crop producers lose less than in Scenario 1. Beginning in 1992, prices, in Scenarios 2 and 3 increase so much that crop income increases. In effect, the relatively large yield and cost changes of Scenarios 2 and 3 cause an income transfer from crop consumers to crop producers. Crop consumers, livestock producers, and livestock consumers lose more while producers gain more for Scenario 3 than Scenario 2, during 1992-96.

While crop producers gain in aggregate under Scenarios 2 and 3 during 1992-96, income does not increase for all crops and all regions. The cost and yield changes cause a complex change of acreages and prices for different crops. Income decreases for some crops because price increases do not outweigh cost increases and/or yield declines. Crop income declines in some regions. For example, the Northeast and Appalachian States lose in Scenario 3 because they have the highest corn yield losses, despite higher corn prices.

Scenario 1

Scenario 1 assumes the smallest initial direct changes in yields and costs among the three scenarios. Only cotton, soybeans, and wheat yields decrease, all by less than 0.5 percent. Fixed costs generally increase by less than $1 per acre, but never by more than $1.50 per acre. Similarly, variable production costs generally increase by less than $1 per acre. Thus, changes in acreage, output, and prices are smaller than changes estimated for Scenarios 2 and 3.

Acreage and Prices. Total crop acreage steadily decreases, but never by more than 200,000 acres which is less than 0.1 percent of baseline total crop acreage (Table B-5). The acreage of all crops decreases in most years. Price changes for field crops never exceed $0.022 per bushel and are generally less than $0.01 per bushel (Table B-6). Retail prices for livestock products either fail to change or change by less than $0.01 per pound. Price decreases occur for soybean meal in 1991-93 because soybean production increases. AGSIM predicts that higher hay prices encourage the slaughter of cattle and calves. The result is that beef and veal prices fall by less than $0.0l after 1991.

Income. Since the cost increases outweigh the price increases, total crop income (net of fixed and variable costs) decreases in all years (Table B-7). The greatest income loss, $339 million, which is about 4 percent of baseline total crop income, occurs in 1988. The losses become smaller in succeeding years as cost and yield changes decline. On average, the crop income losses are less than $l per baseline crop acre. However, income (net of variable costs) increases for barley in 1992-93 and for hay from. 1991-96. In 1987, there are crop income gains (net of fixed and variable costs) in some regions. These gains are exceeded by losses in the Delta States and Southeast (Table B-8). These two regions have relatively high soybean and cotton yield losses from 1987-89. From 1988 on, income declines in all regions.

Consumer Effects. Crop consumers lose from higher prices and lower production (Table B-9). The losses become steadily larger, varying from $23 million in 1987 and to $95 million in 1996. Livestock producers generally suffer income losses due to higher feed and hay costs and unchanged or lower livestock prices beginning in 1988. The greatest loss, $42 million (less than 0.1 percent of baseline income for the S livestock products), occurs in 1993. Additionally, livestock consumers would gain in some years and lose in others.

Scenario 2

Scenario 2 has greater cost and yield changes than Scenario 1. The largest differences from Scenario 1 are the corn yield declines beginning in 1992 due to restrictions on soil insecticides. Corn yield losses exceed 8 percent in the Corn Belt and Northern Plains and vary from 2 to 6 percent in the remaining regions. The yield losses moderate in later years. Some variable costs increase noticeably in 1992. Cotton costs increase by $5.40 in the Delta States. However, corn costs decrease by less than $2 per acre in the Corn Belt, Northern Plains, Southern Plains, and Pacific States.

Acreage and Prices. Prior to 1992, price and acreage changes are greater than Scenario 1. As a result, total crop acreage declines range from 19,000 in 1987 to 108,000 in 1991 (Table B-10). From 1988 to 1991, total crop acreage declines less for Scenario 2 than for Scenario 1. Higher crop prices in Scenario 2 seem to explain this result. Soybean price increases by $0.18 per bushel in 1988 and by lesser amounts in 1987 and 1989 (Table B-11). During these three years, the Appalachian, Delta, and Southeastern States suffer greater soybean yield losses than in Scenario 1. These initial -soybean yield losses reduce soybean and increase corn and cotton acreage, primarily due to similar changes in the Southeast. The prices of meal and oil products of cotton and soybeans increase during 1987-89 as a result of lower soybean production and higher prices.

The larger corn yield losses (as compared to Scenario 1) beginning in 1992 cause a noticeable change in results from Scenario 1. Total crop acreage decreases by 300,000 in 1992, but increases by 46,000 in 1993 to 226,000 in 1996 (Table B-10). Corn price increases by $0.51 per bushel in 1992 (Table B-11). AGSIM predicts an interesting pattern for corn and soybeans. Soybean acreage increases and price decreases in 1992, because corn cost and yield changes reduce expected corn return-s and, hence, planted acreage. The higher corn price in 1992 encourages farmers to shift acreage from soybeans and other crops to corn. Corn price rises less in following years, and the prices of barley, oats, wheat, soybeans, and cotton also increase as the acreage and production of those crops decrease. As a result, prices of meal and oil products of cotton and soybeans also rise. Since sorghum is a good feed substitute for corn, sorghum demand rises causing its price and acreage to rise. Hay acreage increases in 1988 and later years causing price decreases in most years. In 1992, lower feed and hay prices reduce retail livestock prices. After that, higher feed costs increase all livestock prices in some years. However, all price changes are less than $0.10 per pound. Beef and veal prices increase in some years and decrease in others.

Income. Crop income (net of fixed and variable costs) rises $159 million in 1987, but falls $111 million in 1988 and $315 million in 1991 after fixed costs increase in 1988 (by the same amount as in Scenario 1) and groundwater regulations begin in 1990 (Table B-12). All of those income changes are less than 2 percent of baseline total crop income. Income (net of variable costs only) decreases for all crops except soybeans, barley, oats, and hay in 1987 and soybeans in 1988, because cost increases outweigh price increases. Beginning in 1992, crop income increases because price increases, particularly for corn and soybeans, outweigh cost increases. Crop income increases the most in 1992, $1.9

billion (12 percent of baseline crop income) or an average of about $5 per crop acre, but the increases become smaller as cost and yield changes decline over time. After 1992, income rises for corn (the crop suffering the greatest regulation induced per-acre production loss), and soybeans, but decreases for barley, oats, wheat, and hay in some years.

Prior to 1992, crop income (net of fixed and variable costs) falls in most regions (Table B-13). In 1987, before fixed costs increase, income increases in the Corn Belt, Lake States, Northeast, and Appalachian States. From 1988 to 1991, crop income decreases in all regions but the Corn Belt in 1988-89. In 1992 and later years, income increases in all regions except the Delta States in 1992 because soybean prices fall and in the Mountain and Northeastern States in 1996 because higher crop prices no longer rise enough to outweigh cost increases and yield losses.

Consumer Effects. Consumers lose much more in Scenario 2 than in Scenario 1 (Table B-14). Prior to 1992, crop consumer loss peaks at $272 million and declines to $45 million in 1991. Because of the large price increases after 1992, the consumer loss peaks at $2.8 billion in 1992 but falls to $1.5 billion in 1996. Due to higher feed costs and modest livestock price increases, livestock income declines after 1987. Before the corn yield losses have their full effect on feed prices in 1993, livestock producer losses do not exceed $100 million (less than 0.1 percent of baseline income for the 5 livestock products). In 1993 and some later years, their losses exceed $1 billion (2 percent of livestock income). Before the corn yield losses have their full effect, livestock consumers have losses of less than $100 million while gaining in 1991-92 when beef prices fall. In 1993-94, livestock consumers lose more than $2 billion. However, lower beef and veal prices cause consumer gains in 1996.

Scenario 3

Scenario 3 has greater fixed cost changes throughout the simulation than Scenario 2. Yield losses and variable cost changes are greater during 1990-96. In particular, greater corn yield losses occur after 1991, than in Scenario 2. Corn yield losses are approximately 23 percent for the Northeast, 13 percent for the Appalachian States, and 10 percent for the Corn Belt and Northern Plains in 1992. Production costs are also greater than for Scenario 2; cost increases approach $12 per acre in the Northeast and Southeast and $14 per acre in Appalachian States in 1992. The yield losses and cost changes moderate in later years. Fixed costs also increase more than Scenario 2 but never by more than $2.25 per acre. The result is greater price changes, income changes, and consumer losses than for Scenario 2. The two-scenarios produce identical results for 1987.

Acreage and Prices. Prior to 1992, total crop acreage in Scenario 3 decreases, ranging from 57,000 in 1988 to 141,000 in 1991. These changes are greater than those in Scenario 2 for 1988-91, but less than those in Scenario 1 for 1987-89 (Table B-15). The pattern of individual crop acreage and price changes is very similar to Scenario 2 for 1988-91. However, acreage changes tend to be greater for Scenario 3 than Scenario 2. Also, soybean acreage increases in 1991 rather than decreases. Price changes for Scenario 3 are also greater than Scenario 2, but soybean, soybean meal, and cottonseed meal prices increase in 1990-91 rather than decrease (Table B-16). Some livestock prices do not change during 1988-91, but increases of $0.003 per pound or less occur for beef and pork.

For 1992 and later years when the larger corn yield losses occur, total crop acreage is less for Scenario 3 than Scenario 2. Total crop area decreases by 505,000 acres in 1992, decreases by lesser amounts in 1993-94, and increases by less than 200,000 acres in 1995-96 (Table B-15). Scenario 3 shows the same pattern of corn and soybean acreage changes as Scenario 2, but has greater price changes. Corn price increases by $0.78 per bushel and soybean price decreases by $0.26 per bushel in 199-2, reflecting greater corn acreage decreases and soybean increases for Scenario 3 (Table B-16). The higher corn prices encourage farmers to shift acreage from other crops to corn causing the prices of the crops to increase. As a result, the price of soybeans increases in 1993-96, with its greatest increase, $0.43, in 1994. Barley acreage increases from 1994-96, but did not in Scenario 2. However, hay acreage does not begin to increase until 1995, while in Scenario 2 it began to increase in 1993. Higher feed prices cause higher pork and chicken prices. Most livestock prices do not change by more than $0.10 per pound, but pork price increases by $0.13 per pound in 1994. Beef prices decrease $0.016 per pound or less in 1992 and 1996. Veal prices decrease $0.067 per pound or less through the entire time period.

Income. Total crop income (net of fixed and variable costs) declines during 1988-1991, ranging from $200 million in 1988 to $303 million in 1991, approximately 2 percent of baseline crop income (Table B-17). Income declines more than for Scenario 2 in 1988-90. In 1991, income decreases less for Scenario 3 than Scenario 2 because of higher soybean prices in Scenario 3. Income (net of variable costs only) decreases for all crops except corn and sorghum in 1990-91 and barley and hay in 1991. Beginning in 1992, crop income (net of fixed and variable costs) increases because of price increases that outweigh yield and cost changes. Crop income increases by $2.6 billion in 1992 (16 percent of baseline income), approaching an average of $7 per crop acre, but increases are smaller in later years as cost and yield changes decrease. These crop income increases are greater than those in Scenario 2. After 1992, income (net of variable costs only) increases for all crops in most years.

From 1988-91, regional crop income (net of fixed and variable costs) decreases for all regions except the Corn Belt in 1988-89, when it benefits from higher soybean prices (Table B-18). From 1992-96, most regions gain, but some lose. The Delta States lose in 1992 due to lower soybean prices. The Northeast and Appalachian States lose in all those years, because they incur relatively high corn yield losses. In most regions, corn replaces soybeans as corn price rises. However, corn acreage in the Northeast and Appalachian States is replaced by soybeans, resulting in income declines. In Scenario 2, these two regions generally did not lose although the Northeast lost in 1996.

Consumer Effects. Consumers lose in all years due to higher prices and lower production. Prior to 1992, the greatest consumer loss is $280 million in 1988. Consumer loss falls to $170 million in 1989 but then rises to $206 million in 1991. After the comparatively large price increases beginning in 1992, consumer loss peaks at $4.4 billion in 1992 declining to $2.2 billion in 1996. These consumer losses are larger than those in Scenario 2. Livestock effects are identical for Scenarios 2 and 3 in 1988. Livestock income falls more under Scenario 3 than Scenario 2 from 1989-96 due to higher feed costs which outweigh livestock price increases. Livestock income declines range from $3.5 million in 1989 to $122 million in 1992 (less than 0.2 percent of baseline income for the 5 livestock products). After the corn yield losses have their full effect on feed prices, livestock income decreases by $2.5 billion in 1993 (about 3 percent of baseline livestock income), ranging from about $1 billion to $2 billion in later years. From 1989 to 1993, livestock consumers incur losses of less than $86 million while gaining in 1992 when beef prices fall slightly. After 1992, livestock consumers suffer greater losses than under Scenario 2, exceeding $3 billion in 1993-94.

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Table B-1. AGSIM baseline U.S. crop acreage.

Crop	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
					Thousand acres					
Corn	74784.	76765.	76152.	75558.	76028.	77036.	77683.	78241.	78564.	78967.
Grain sorghum	12253.	12292.	12177.	12175.	12169.	12414.	12515.	12608.	12637.	12717.
Barley	11859.	11395.	10720.	10512.	10184.	10140.	10035.	10199.	10303.	10482.
Oats	12982.	11921.	12595.	13203.	13419.	13519.	13685.	13821.	13932.	14008.
Wheat	76596.	79614.	79888.	81123.	81170.	82045.	82192.	82766.	82827.	83201.
Soybeans	61090.	62067.	64536.	66871.	67480.	67452.	67324.	67340.	67384.	67437.
Cotton	11472.	12143.	12323.	12465.	12478.	12391.	12321.	12310.	12291.	12262.
All hay	57219.	58369.	57535.	57891.	57778.	58369.	58329.	58657.	58640.	58895.
Fallow	27462.	28091.	27642.	28200.	27955.	28343.	28216.	28495.	28443.	28655.
Diverted	11259.	8893.	9418.	10068.	10364.	10464.	10900.	11171.	11495.	11592.
Conservation reserve	16600.	16600.	16600.	16600.	16600.	16600.	16600.	16600.	16600.	16600.
U.S. total	373577.	378150.	379586.	384666.	385625.	388774.	389802.	392208.	393115.	394816.

Table B-2. AGSIM baseline commodity prices

Commodity	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Farm prices:										
Corn ($/bu.)	1.578	1.980	2.371	2.669	2.801	2.791	2.786	2.799	2.846	2.882
Grain sorghum ($/bu.)	1.738	2.001	2.284	2.555	2.742	2.770	2.765	2.771	2.810	2.845
Barley ($/bu.)	1.502	1.579	1.757	1.931	2.163	2.354	2.553	2.636	2.683	2.667
Oats ($/bu.)	1.818	2.921	3.307	3.124	2.966	2.873	2.763	2.674	2.606	2.562
Wheat ($/bu.)	2.495	2.737	3.028	3.212	3.324	3.329	3.325	3.310	3.325	3.337
Soybeans ($/bu.)	5.117	5.856	5.701	5.206	4.963	4.856	4.841	4.867	4.933	5.003
Cotton ($/lb.)	.582	.563	.572	.581	.598	.618	.640	.660	.681	.703
All hay ($/T)	95.499	88.346	92.260	92.408	93.561	89.914	88.761	86.480	86.056	84.635
Cottonseed ($/T)	55.207	63.039	63.075	57.457	54.878	53.695	53.663	53.673	54.439	55.191
Cott meal($/T)	102.150	93.869	94.771	94.092	92.516	89.341	87.137	86.062	85.892	85.447
Cott oil ($/T)	.262	.252	.246	.232	.227	.229	.235	.242	.250	.260
Soybean meal ($/T)	110.021	105.160	104.608	101.289	97.728	93.391	90.167	88.195	86.978	85.541
Soybean oil ($/T)	.302	.343	.341	.304	.290	.293	.306	.322	.342	.365
Retail prices:										
Beef ($/lb.)	2.599	2.408	2.657	2.831	2.884	2.782	2.671	2.584	2.546	2.523
Pork ($/l	1.665	1.382	1.577	1.854	1.948	1.813	1.728	1.757	1.832	1.858
Chicken (.)	.524	.515	.623	.699	.723	.699	.684	.683	.695	.703
Milk ($/lb.)	.163	.168	.170	.169	.170	.174	.179	.181	.180	.180
Veal ($/lb.)	4.157	4.330	4.239	4.365	4.426	4.442	4.480	4.494	4.478	4.423

Table B-3. AGSIM baseline crop income net of fixed and variable costs. 1/

Region	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
					Million dollars					
Corn Belt	1659.70	4150.88	5680.89	6269.13	6501.73	6166.59	6009.25	5936.57	6079.44	6173.54
Lake States	720.85	1417.59	2118.05	2460.47	2662.67	2573.68	2564.51	2532.30	2584.50	2576.21
Northern Plains	-236.75	668.45	1533.90	1988.21	2198.61	2062.58	1958.28	1850.51	1838.08	1801.37
Southern Plains	-135.46	42.22	287.47	432.63	549.54	567.41	588.23	590.33	626.91	654.84
Delta States	217.63	463.11	539.21	502.96	519.98	534.24	570.37	602.09	648.80	687.85
Mountain States	554.83	754.76	990.64	1247.94	1329.51	1363.41	1337.04	1340.75	1331.36	1344.93
Pacific States	726.73	697.61	887.28	974.33	1066.44	1042.20	1056.58	1035.48	1052.81	1047.66
Northeast	521.91	644.28	790.27	857.54	898.10	871.54	863.76	852.40	863.45	864.88
Appalachian States	37.80	291.54	438.12	458.39	446.28	382.94	332.06	281.88	249.71	209.50
Southeast	-170.64	-51.97	35.18	64.38	92.74	106.11	130.32	154.16	187.59	213.53
U.S. Total	3896.60	9078.47	13301.01	15282.98	16265.60	15670.61	15410.40	15176.47	15462.65	15574.31

1/ Excluding commodity program payments.

Table B-4. AGSIM baseline livestock production and income.

Commodity	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
					Million pounds dressed weight					
Production										
Beef	22206.	23841.	22348.	21676.	21663.	22524.	23621.	24781.	25604.	26202.
Pork	15885.	18863.	17345.	15319.	14849.	15928.	16690.	16470.	15947.	15871.
Chicken	17092.	16341.	15516.	15302.	15361.	15441.	15406.	15327.	15275.	15271.
Milk	131785.	127347.	127127.	129340.	129903.	127418.	124407.	123855.	125657.	127090.
Veal	312.	278.	300.	277.	268.	268.	264.	264.	270.	284.
					Million dollars					
Livestock										
Beef	37345.	35326.	37769.	39621.	40233.	39324.	38668.	38457.	38752.	38977.
Pork	20776.	19070.	19961.	21097.	21385.	20569.	20174.	20426.	20973.	21233.
Chicken	1427.	1118.	2344.	3133.	3294.	2846.	2620.	2621.	2785.	2878.
Milk	13178.	13241.	12599.	11961.	11640.	11707.	12043.	12281.	12405.	12479.
Veal	1144.	1064.	1113.	1054.	1032.	1034.	1029.	1035.	1053.	1091.

Table B-5. Change in U.S. crop acreages, scenario 1.

Crop	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
						Thousand acres				
Corn	21.92	-5.86	-23.73	-43.82	-45.72	-45.12	-47.36	-51.27	-51.68	-42.83
Grain sorghum	2.54	.12	-2.28	-3.48	-2.75	-2.29	-2.54	-3.48	-3.70	-4.09
Barley	.31	-10.04	-16.27	-22.46	-25.41	-29.02	-20.11	-12.85	-10.49	-6.89
Oats	-.07	-16.87	-17.16	-16.28	-21.19	-25.53	-28.51	-33.11	-36.18	-38.58
Wheat	-.70	-3.97	-4.07	-6.07	-7.49	-11.35	-23.26	-33.87	-39.75	-47.00
Soybeans	26.83	-23.25	-8.24	4.23	3.87	-.11	-.94	-1.54	-3.05	-12.90
Cotton	-1.21	-2.71	-5.35	-9.20	-12.13	-13.20	-12.22	-9.89	-7.42	-5.61
All hay	-.67	9.52	8.48	-1.13	-2.73	-4.48	-5.10	-7.19	-8.10	-9.31
Fallow	-.04	-3.19	-3.84	-6.29	-6.38	-8.78	-9.09	-10.18	-11.08	-11.99
Total	-4.82	-59.42	-76.28	110.79	126.32	148.68	-158.25	173.58	182.51	191.20

Table B-6. Change in commodity prices, scenario 1.

Commodity	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Corn	-.000	.000	.002	.004	005	.004	.004	.005	.005	.004
Grain sorghum	-.000	.000	.000	.002	003	.003	.003	.003	.003	.003
Barley	.000	.002	.004	.008	013	.018	.019	.016	.013	.010
Oats	.000	.009	.015	.013	014	.016	.017	.019	.020	.022
Wheat	.000	.000	.000	.000	000	.000	.002	.003	.003	.004
Soybeans	.012	.015	.009	.004	003	.003	.003	.003	.003	.006
Cotton	.000	.000	.001	.001	002	.002	.001	.001	.000	.000
All hay	.004	.049	.062	.004	043	.068	.084	.103	.118	.130
Cottonseed	.225	.263	.209	.163	138	.128	.111	.087	.079	.098
Cottonseed meal	.112	.117	.104	.098	087	.080	.070	.060	.056	.064
Cottonseed oil	.000	.000	.000	.000	000	.000	.000	.000	.000	.000
Soybean meal	.080	.081	.033	.000	017	-.015	-.009	.000	.008	.030
Soybean oil	.001	.002	.000	.000	000	.000	.000	.000	.000	.000
Beef	.000	.000	.000	.000	000	-.000	-.001	-.000	.000	.000
Pork	.000	.000	.000	.000	000	.000	.000	.000	.001	.001
Chicken	.000	.000	.000	.000	000	.000	.000	.000	.000	.000
Milk	.000	.000	.000	.000	000	.000	.000	.000	.000	.000
Veal	.000	.000	.000	.000	000	-.001	-.002	-.003	.003	-.002

Table B-7. Change in crop income over variable costs, scenario 1. 1/

Crop	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
					Million dollars					
Crop	-3.14	-76.39	-53.10	-50.88	-47.83	-48.50	-46.62	-43.51	-40.83	-42.89
Grain sorghum	-.12	-4.19	-3.69	-2.84	-2.43	-2.54	-2.62	-2.52	-2.34	-2.40
Barley	-.07	-7.48	-5.86	-4.08	-2.00	.23	.35	-.99	-2.18	-3.62
Oats	.00	-5.12	-3.43	-4.64	-4.13	-3.42	-3.17	-2.49	-2.01	-1.57
Wheat	-.16	-26.17	-25.75	-25.56	-25.26	-25.13	-23.98	-22.99	-21.81	-21.13
Soybeans	-3.81	-33.09	-33.92	-36.36	-36.50	-33.43	-30.34	-27.49	-27.68	-24.02
Cotton	-2.62	-10.05	-7.81	-5.79	-3.94	-2.36	-1.57	-1.02	-1.03	-1.97
All hay	.38	-5.01	-6.35	-.20	3.62	6.15	7.72	9.62	11.15	12.42
Total, net of fixed and variable costs	-9.32	-338.62	-309.65	-297.93	-291.17	-271.49	-260.55	-257.84	-244.76	-243.35

1/ Excluding changes in commodity program payments.

Table B-8. Change in crop income by region, scenario 1. 1/

Region	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
						Million dollars				
Corn Belt	10.63	-75.90	-65.95	-67.95	-69.65	-64.84	-64.42	-62.92	-57.07	-55.38
Lake States	1.88	-43.70	-39.97	-39.56	-41.96	-37.50	-36.68	-39.27	-34.98	-35.11
Northern Plains	.96	-51.09	-45.77	-44.37	-43.12	-38.61	-36.30	-36.54	-32.83	-32.17
Southern Plains	1.57	-21.73	-21.04	-19.78	-20.07	-18.08	-17.92	-19.00	-17.34	-17.52
Delta States	-19.09	-34.58	-31.91	-28.41	-25.58	-20.34	-16.22	-13.17	-11.90	-11.67
Mountain	-.27	-36.08	-34.90	-33.13	-19.55	-30.50	-30.42	-18.84	-30.82	-31.38
Pacific States	.88	-17.49	-17.03	-15.55	-16.69	-13.37	-12.82	-15.18	-12.96	-13.32
Northeast	.22	-18.22	-17.90	-17.76	-20.27	-17.85	-17.93	-20.34	-17.93	-18.11
Appalachian	.07	-20.64	-18.58	-17.95	-19.66	-17.54	-17.24	-18.67	-16.48	-16.14
Southeast	-6.17	-19.18	-16.61	-13.47	-14.62	-12.86	-12.60	-13.90	-12.46	-12.55

1/ Excluding changes in commodity program payments.

Table B-9. Important welfare effects, scenario 1.

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
						Million dollars				
Crop consumer effect	-22.72	-32.44	-36.65	-56.26	-69.11	-78.34	-82.43	-88.57	-91.85	-95.44
Livestock income change	.00	-.45	1.21	-5.21	-25.90	-39.62	-44.45	-41.91	-37.18	-29.86
Livestock consumer effect	.00	.00	-24.01	-35.01	-14.27	5.43	10.81	6.03	-8.57	-25.99

Table B-10. Change in U.S. crop acreages, scenario 2.

Crop	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
						Thousand acres				
Corn	157.22	42.39	-84.30	120.60	-39.80	-800.95	1115.13	1023.33	841.48	706.48
Grain sorghum	4.19	-3.96	-12.05	-12.36	-2.82	31.99	138.12	197.58	183.52	146.83
Barley	-.08	-9.51	-15.34	-20.57	-23.70	-25.74	-18.38	-14.20	-7.93	-3.57
Oats	-.43	-15.66	-11.46	-9.00	-15.48	-20.70	-51.36	-54.04	-33.75	-15.32
Wheat	.47	-17.58	-27.06	-17.00	-3.27	-11.04	18.35	-17.31	-22.34	-23.69
Soybeans	-204.99	-98.40	50.78	90.41	-7.75	607.04	-999.43	-933.60	-601.20	-445.06
Cotton	27.85	41.07	36.13	16.22	.37	-41.71	-152.68	-217.99	-232.57	-215.87
All hay	-3.69	23.78	22.89	7.02	-2.01	-25.83	11.46	58.31	99.06	80.95
Fallow	-.02	-2.01	-3.16	-5.67	-6.78	-8.97	-7.47	-7.40	-.08	-2.17
Total	-19.52	-41.86	-46.71	-77.19	-108.02	-304.88	46.27	27.28	226.13	226.42

Table B-11. Change in commodity prices, scenario 2.

Commodity	1987	1988	1989	1990	1991	1992	1993	1994	995	1996
Corn	-.002	.000	.008	.012	.007	.508	.339	.286	.227	.161
Grain sorghum	-.000	.000	.003	.007	.006	.149	.163	.137	.106	.073
Barley	.000	.002	.004	.008	.012	.017	.017	.016	.012	.007
Oats	.000	.009	.012	.009	.011	.013	.027	.030	.020	.008
Wheat	.000	.001	.003	.003	.002	.001	.005	.010	.010	.008
Soybeans	.156	.180	.076	-.012	-.012	-.153	.216	.367	.322	.243
Cotton	-.000	-.002	-.001	-.000	.000	.003	.008	.011	.013	.013
All hay	.022	-.124	-.172	-.079	.010	.198	.146	-.086	-.479	-.581
Cottonseed	1.403	1.727	.827	-.000	-.039	-1.198	2.713	4.756	4.491	3.547
Cottonseed meal	.822	.759	.344	-.028	-.048	-.660	2.048	3.101	2.552	1.699
Cottonseed oil	.004	.005	.002	.000	.000	-.003	.007	.015	.017	.016
Soybean meal	1.441	1.393	.617	-.101	-.159	-1.330	2.007	3.141	2.339	1.339
Soybean oil	.012	.017	.008	.000	-.000	-.012	.016	.036	.037	.032
Beef	.000	.000	.002	.002	-.002	-.005	.045	.033	.009	-.013
Pork	.000	.000	.002	.002	.002	.000	.048	.088	.056	.013
Chicken	.000	.000	.000	.000	.000	-.000	.027	.025	.016	.007
Milk	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Veal	.000	-.001	.000	.002	.000	-.002	-.047	.003	.002	-.007

Table B-12. Change in crop income over variable costs, scenario 2. 1/

Crop	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
					Million dollars					
Corn	-21.51	-83.82	-21.77	1.28	-35.16	2244.83	1010.27	973.92	747.64	472.29
Grain sorghum	-.41	-4.28	-2.34	-.15	-.71	100.50	113.40	100.51	79.15	54.98
Barley	.00	-7.52	-5.94	-3.88	-1.98	.03	-.03	-1.01	-2.68	-4.27
Oats	.05	-5.25	-4.69	-6.27	-5.44	-4.52	1.00	1.69	-2.45	-6.74
Wheat	-.01	-25.96	-23.21	-22.19	-24.24	-25.75	-15.26	-6.43	-8.06	-15.95
Soybeans	189.94	209.05	68.66	-58.29	-56.26	-292.86	333.95	591.33	514.60	380.52
Cotton	-11.57	-23.22	-20.37	-14.16	-9.23	-17.35	9.46	30.50	42.01	44.28
All hay	2.14	-12.21	-17.26	-8.74	-.00	17.96	17.80	4.46	44.74	-57.97
Total, net of fixed and variable costs	159.46	-111.34	-186.60	-272.97	-314.49	1864.80	1298.05	1469.10	1100.07	611.63

1/ Excluding changes in commodity program payments.

Table B-13. Change in crop income by region, scenario 2. 1/

Region	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
					Million dollars					
Corn Belt	150.16	88.40	21.17	-57.75	-81.11	832.22	549.58	666.42	515.54	306.47
Lake States	27.98	-12.54	-20.44	-34.18	-44.42	486.61	288.87	277.27	199.98	107.03
Northern Plains	23.03	-26.48	-30.59	-36.32	-42.35	246.97	130.53	141.59	89.38	28.80
Southern Plains	-.00	-24.37	-24.10	-22.23	-21.85	84.36	86.67	88.16	72.59	48.74
Delta States	-4.15	-15.72	-28.91	-37.01	-31.56	-47.62	52.42	89.80	74.91	51.85
Mountain States	-.86	-24.33	-22.21	-19.13	-19.77	60.30	32.44	24.79	11.42	-1.74
Pacific States	-.83	-21.13	-20.56	-17.69	-18.21	21.85	17.03	15.25	10.05	2.46
Northeast	3.26	-14.69	-15.45	-16.81	-20.57	54.20	15.49	15.51	7.71	-4.04
Appalachian	2.87	-12.64	-14.89	-19.41	-21.94	88.96	78.48	93.41	72.91	43.74
Southeast	-42.00	-47.83	-30.62	-12.46	-12.71	36.95	46.55	56.89	45.58	28.31

1/ Excluding changes in commodity program payments.

Table B-14. Important welfare effects, scenario 2.

Crop	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
					Million dollars					
Crop consumer effect	-235.82	-272.95	-158.41	-60.75	-44.76	-2881.31	-2607.44	-2564.88	-2062.60	-1477.10
Livestock income change	.00	-6.53	-.63	-29.99	-78.33	-99.18	-1601.30	-621.24	-1067.03	-1421.79
Livestock consumer effect	.00	-38.95	-87.96	-81.74	11.31	109.22	-2251.88	-2626.22	-1350.11	16.92

Table B-15. Change in U.S. crop acreages, scenario 3.

Crop	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
					Thousand acres					
Corn	157.22	38.23	-90.93	-139.25	-106.42	-1639.77	1098.16	1003.95	797.60	664.47
Grain sorghum	4.19	-4.11	-12.30	-11.93	-3.26	43.02	212.86	308.10	285.68	222.23
Barley	-.08	-9.98	-16.01	-27.02	-33.04	-30.21	-4.92	8.08	16.47	16.97
Oats	-.43	-16.27	-12.91	-11.15	-17.83	-23.73	-82.43	-104.37	-85.23	-62.61
Wheat	.47	-19.73	-30.45	-14.20	-7.50	-26.08	-9.36	-85.58	-112.37	-127.91
Soybeans	204.99	101.00	48.62	82.16	45.79	1358.06	-867.56	-776.59	-327.85	-161.86
Cotton	27.85	40.87	35.84	19.73	3.92	-91.45	-287.44	-400.34	-424.51	-385.31
All hay	-3.69	20.26	19.17	.62	-7.26	-72.90	-61.61	-21.95	31.78	8.83
Fallow	-.02	-2.63	-3.86	-6.84	-7.71	-10.78	-7.61	-4.59	8.96	8.41
Total	-19.52	-56.97	-66.72	-114.72	-140.99	-504.65	-17.52	-77.89	199.51	191.65

Table B-16. Change in commodity prices, scenario 3.

Commodity	1987	1988	1989	1990	1991	1992	1993	994	1995	1996
Corn	-.002	.000	.008	.018	.016	.777	.513	.430	.339	.240
Grain sorghum	-.000	.000	.004	.009	.010	.237	.254	.208	.159	.110
Barley	.000	.002	.004	.018	.030	.038	.033	.022	.010	.002
Oats	.000	.009	.013	.011	.013	.017	.043	.058	.051	.038
Wheat	.000	.001	.003	.007	.008	.008	.013	.021	.021	.017
Soybeans	.156	.101	.077	.031	.025	-.257	.222	.425	.354	.243
Cotton	-.000	-.002	-.001	-.000	.000	.010	.018	.025	.029	.027
All hay	.022	-.101	-.137	-.022	.074	.547	.755	.632	.140	-.020
Cottonseed	1.403	1.739	.841	.410	.352	1.450	3.606	6.376	5.852	4.283
Cottonseed meal	.822	.764	.349	.173	.162	-.855	2.873	4.353	3.537	2.263
Cottonseed oil	.004	.005	.002	.001	.001	-.003	.011	.022	.024	.021
Soybean meal	1.441	1.399	.623	.242	.167	2.283	2.068	3.596	2.461	1.145
Soybean oil	.012	.017	.008	.004	.003	-.020	.016	.041	.042	.033
Beef	.000	.000	.002	.002	.000	-.003	.067	.048	.013	-.016
Pork	.000	.000	.002	.002	.003	.003	.072	.130	.082	.020
Chicken	.000	.000	.000	.000	.000	.000	.039	.037	.024	.012
Milk	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Veal	.000	-.001	.000	.001	.000	-.003	-.067	-.000	-.006	-.019

Table B-17. Change in crop income above variable costs, scenario 3. 1/

Crop	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	Million dollars									
Corn	-21.51	-82.72	-19.55	16.07	3.74	3136.56	1308.52	1283.34	982.40	620.88
Grain sorghum	-.41	-4.27	-2.29	.52	1.63	149.84	169.17	147.73	115.10	80.59
Barley	.00	-7.48	-5.86	-1.35	3.63	7.40	4.99	.37	-4.35	-7.60
Oats	.05	-5.14	-4.26	-5.63	-4.73	-3.41	7.35	12.12	8.64	3.75
Wheat	-.01	-25.83	-22.85	-20.84	-18.26	-17.43	-.58	13.81	12.65	2.23
Soybeans	189.94	210.46	70.35	-2.88	-9.25	-480.30	330.17	672.07	553.46	366.99
Cotton	-11.57	-23.23	-20.39	-14.72	-10.11	-27.97	23.03	62.50	83.96	85.64
All hay	2.14	-10.00	-13.85	-3.15	6.22	50.56	77.93	66.93	16.76	-3.31
Total, net of fixed and variable costs	159.46	-199.53	-271.62	-285.89	-302.70	2561.71	1645.41	1930.67	1421.98	763.67

1/ Excluding changes in commodity program payments.

Table B-18. Change in crop income by region, scenario 3. 1/

Region	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	Million dollars									
Corn Belt	150.16	66.23	.11	-15.60	-33.74	1391.40	876.73	1009.11	760.24	438.96
Lake States	27.98	-26.57	-33.96	-43.95	-47.97	641.81	354.27	353.69	255.06	134.95
Northern Plains	23.03	-39.76	-43.14	-41.44	-40.95	483.86	281.46	284.99	193.00	91.53
Southern Plains	-.00	-29.10	-28.59	-23.76	-22.23	151.51	159.98	164.13	139.59	100.32
Delta States	-4.15	-17.16	-30.27	-27.88	-24.70	-93.58	43.84	99.35	80.77	50.84
Mountain States	-.86	-29.80	-27.41	-20.05	-18.46	112.36	73.83	66.26	45.70	26.98
Pacific States	-.83	-24.67	-23.88	-18.36	-17.31	46.50	45.93	49.56	42.41	29.49
Northeast	3.26	-22.95	-23.80	-23.02	-26.01	-137.04	-164.05	-133.20	-115.05	-99.70
Appalachian	2.87	-25.90	-28.07	-59.75	-58.83	-48.75	-51.86	-7.09	-11.48	-23.57
Southeast	-42.00	-49.85	-32.59	-12.09	-12.49	13.55	25.28	43.86	31.74	13.88

1/ Excluding changes in commodity program payments.

Table B-19. Important welfare effects, scenario 3

Crop	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	Million dollars									
Crop consumer effect	-235.82	-280.22	-169.70	-195.30	-205.83	-4403.68	-3893.57	-3805.28	-3055.84	-2188.32
Livestock income change	.00	-6.53	-3.46	-33.35	-97.74	-121.54	-2501.32	-995.59	-1597.77	-2053.40
Livestock consumer effect	.00	-38.95	-85.67	-79.43	-35.48	19.78	-3331.59	-3822.66	-1974.73	-60.06

APPENDIX C

National Price-Quantity Model and Results

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Appendix C

National Price-Quantity Model and Results

1.0 Model Description

The model used to estimate national commodity price-quantity inpacts closely follows the model developed by Lichtenberg et al., 1/ with some modifications required to overcome data deficiencies. With estimates of national impacts on production for each commodity--through both increased costs and decreased yields--changes in marginal costs were estimated. The resulting changes in commodity production and price at the national level were then assessed with consideration of supply and demand elasticities. Specific algebraic equations used to define the model are as follows:

(1) $P_o = MC_0$

(2) $dMC = \dfrac{P_o(dY/Y) + (dC/Y_o)}{l - dY/Y_o)}$

(3) $dP/P_o = (e_S/(e_Se_D))(dMC/MC)$

(4) $dQ/Q = (e_De_S/(e_S - e_D) (dMC/MC)$

where:

P_o = commodity baseline price, farm level

MC_o = baseline commodity marginal cost of production

dY = change in yield per acre of crop production from the regulatory scenario

dC = change in variable cost per acre from the regulatory scenario

e_S = elasticity of supply

e_D = elasticity of demand

Q_o = total baseline quantity of commodity production

Changes in producer and consumer surplus were then approximated. To estimate changes in producer surplus, it was assumed that all planned reductions in output would be achieved by shifts in marginal production inputs (where zero economic profits were

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1/ Lichtenberg, Erik; Douglas Parker and David Zilberman. Economic Impacts of Cancelling Parathion Registration -for Almonds, Western Consortium for the Health Professions, Inc., January 1987.

being earned in the baseline) to an alternative equally profitable crop. Economic profits on this marginal production would be the same before and after the regulatory scenarios. The change from the baseline in total revenue earned by producers would be:

(5) $$dR = P_iQ_i - P_oQ_o$$

and since price equals marginal cost, the cost savings would be:

(6) $$CTS = P_o(Q_o - Q_i).$$

The change in costs for the acreage remaining in production is

(7) $$dTC = A_i dC.$$

Accordingly, the change in producer surplus from the baseline is defined as

(8) $$dPS = dR + CTS - dTC.$$

The change in consumer surplus from the baseline was approximated using the following relationship:

(9) $$dCS = -(P_i - P_o)(Q_i + Q_o)/2$$

where:

dR = change in total revenue

CTS = cost savings

Q_i = production in year i

dTC = change in total production cost

A_i = commodity acreage in year i

dC = change in cost per acre from the regulatory scenario

dPS = change in producer surplus

dCS- = change in consumer surplus.

This model presumes that all other variables not considered will remain constant and thus have no affect on the model results.

2.0 Data Inputs

National information was compiled on baseline price, harvested acreage, production, farm size, and yield for each of the six specialty crops. The baseline commodity prices, harvested acreages, and production quantities used in this study are an average from 1981-1985 as obtained from various issues of Agricultural Statistics (Table C-l). Commodity prices were adjusted by the GNP Implicit Price Deflator to reflect constant 1986 dollars.

Table C-1. Average prices, production and acreages

	Average price 1981-1985	Average acreage harvested 1981-1985	Average production 1981-1985	Typical farm size	Average yield/acre 1981-1985
	(1986 dollars)	(1000)		(acres)	
rish Potatoes					
U.S.	5.02/cwt.	1,280	359,282,000 cwt.	---	280.7 cwt.
ID-WA	4.71/cwt.	437	146,083,000 cwt.	725	386.0 cwt.
ND-MN	4.77/cwt.	194	33,031,000 cwt.	,000	170.3 cwt.
ME	4.12 cwt.	98	24,926,000 cwt.	600	254.4 cwt.
Green Peas					
U.S.	253.00/ton	3,180	490,040 tons	---	1.54 tons
WI	239.64/ton	857	134,400 tons	540	1.57 tons
WA	250.00/ton	638	100,430 tons	1,500	1.57 tons
Apples					
U.S.	264.00/ton	N.A.	4,064,500 tons	---	8.70 tons
WA	287.00/ton	100.8	1,343,000 tons	200	3.32 tons
NY	246.00/ton	64.1	517,000 tons	150	8.06 tons
MI	193.00/ton	46.6	426,000 tons	200	9.14 tons
Peanuts					
Additionals					
U.S.	599.14/ton	1,112.6	1,500,053 tons	---	1.35 tons
GA-AL	549.56/ton	603.3	916,799 tons	500	1.52 tons
NC-VA	579.07/ton	199.2	179,649 tons	400	1.40 tons
TX-OK	565.47/ton	250.4	218,555 tons	1,100	.88 tons
Quotas					
U.S.	587.80/ton	314.9	424,564 tons	---	1.35 tons
GA-AL	587.80/ton	162.7	247,237 tons	500	1.52 tons
NC-VA	587.80/ton	53.7	75,416 tons	400	1.40 tons
TX-OK	587.80/ton	67.5	58,940 tons	1,100	.88 tons
Caneberries (Raspberries)					
U.S.	.641/lb.	107.5*	38,979,000 lbs.	---	3,625 lbs.*
WA	.643/lb.	29.0	15,934,000 lbs.	30	5,494 lbs.
OR	.638/lb.	25.0	13,360,000 lbs.	11	5,344 lbs.
Tomatoes					
Processing					
CA	72.40/ton	225.3	5,944,000 tons	1,200	26.6 tons
U.S.	75.68/ton	280.4	6,981,000 tons	---	24.9 tons
Fresh					
FL	559.70/ton	45.4	660,000 tons	500	14.6 tons
U.S.	522.00/ton	123.7	1,385,000 tons	---	11.2 tons

* - 1982.

In order to assess the impacts of regulatory costs on per acre net returns, a definition of a typical commercial farm, in terms of acreage, was necessary. Such estimates were Obtained from a poll of extension crop production specialists (a DELPHI approach) and from estimates obtained in crop enterprise production budgets. Because farm size is highly variable within each region, the estimates presented in Table C-l and used in the impact analysis must be interpreted with caution.

Estimates of supply and demand elasticities were obtained from several sources, both published and unpublished. Elasticity estimates are presented in Table C-2.

National estimates of variable cost and yield changes associated with environmental regulations for each specialty crop under three scenarios were provided by EPA. The yearly estimates are provided as the change from a base year prior to the initiation of regulatory impacts (Table C-3).

3.0 Model Results

Results of the National Price-Quantity Model are presented in Tables C-4 through C-18 as the percent change in productron, price, consumer surplus and producer surplus from a base year of no regulatory impacts. Effects of each policy scenario are examined under each of the four specialty crops. Data limitations prevented analyses of peanuts and caneberries.

Table C-2. Supply and demand elasticities

Demand Elasticities 1/

Potatoes	-.3688
Apples	-.2015
Tomatoes (fresh)	- .5584
Tomatoes (processing)	-.3811
Other fresh vegetables (peas)	-.2102

Supply Elasticities

	Short-run
Peas	.31 2/
Tomatoes	1.35 3/
Potatoes	. 87 4/
Apples	.11 4/

Sources:

1/ USDA, ERS, By Kuo S. Huang, *U.S. Demand for Food: A Complete System of Price and Income Effects*, Technical Bulletin Number 1714, December 1985.

2/ Askari, Hcssein, and John T. Cummings, *Estimating Agricultural Supply Response with the Nerlove Model: A Survey*, International Economic Review, Vol. 18, No. 2, June 1977.

3/ Chern, W.S. "Acreage Response and Demand for Processing Tomatoes in California". *American Journal of Agricultural Economics*. May 1976.

4/ Unpublished estimates provided by USDA.

Table C-3. Regulatory cost and yield impact estimates for specialty crops

		Change in variable cost from base year ($)						Change in yield from base year					
				Tomatoes						Tomatoes			
	Year	Apples	Potatoes	Fresh	Proc.	Peas	Peanuts	Apples	Potatoes	Fresh	Proc.	Peas	Peanuts
Scenario 1													
	1983	0	0	0	0	0	.01	0	0	0	0	0	0
	1984	0	.26	.66	.66	0	1.66	0	0	0	0	0	.013
	1985	0	.23	.56	.56	0	1.42	0	0	0	0	0	.011
	1986	0	.19	.47	.47	0	1.19	0	0	0	0	0	.010
	1987	0	4.41	.38	.38	3.46	1.60	0	0	0	0	0	.080
	1988	4.86	5.05	7.03	7.03	3.74	2.21	0	0	0	0	0	.067
	1989	4.86	4.40	6.94	6.94	3.25	1.58	0	0	0	0	0	.055
	1990	4.86	4.88	6.84	6.84	2.75	5.13	0	0	0	0	0	.045
	1991	4.86	4.08	6.75	6.75	2.26	4.25	0	0	0	0	0	.033
	1992	6.78	4.05	6.75	6.75	2.06	3.60	0	0	0	0	0	.022
	1993	6.51	3.17	6.75	6.75	1.53	2.95	0	0	0	0	0	.011
	1994	6.23	2.30	6.75	6.75	.99	2.30	0	0	0	0	0	.001
	1995	5.96	2.03	6.75	6.75	.95	1.75	0	0	0	0	0	.001
	1996	5.68	1.76	6.75	6.75	.90	1.19	0	0	0	0	0	.001
Scenario 2													
	1983	0	0	0	0	0	N.A.	0	0	0	0	0	N.A.
	1984	0	.69	.66	.66	0	N.A.	0	0	0	0	0	N.A.
	1985	0	.66	.56	.56	0	N.A.	0	0	0	0	0	N.A.
	1986	0	.62	.47	.47	0	N.A.	0	0	0	0	0	N.A.
	1987	0	4.84	.38	.38	3.46	N.A.	0	0	0	0	0	N.A.
	1988	4.86	5.48	7.03	7.03	3.74	N.A.	0	0	0	0	0	N.A.
	1989	4.86	4.83	6.94	6.94	3.25	N.A.	0	0	0	0	0	N.A.
	1990	-1.71	13.77	22.95	6.97	2.75	N.A.	.050	0	0	0	0	N.A.
	1991	.12	11.75	20.56	6.86	2.26	N.A.	.043	0	0	0	0	N.A.
	1992	13.30	13.78	18.26	6.84	2.64	N.A.	.036	0	0	0	0	N.A.
	1993	12.34	11.23	15.95	6.82	2.02	N.A.	.028	0	0	0	0	N.A.
	1994	11.39	8.68	13.65	6.80	1.40	N.A.	.021	0	0	0	0	N.A.
	1995	10.43	6.74	11.35	6.78	1.27	N.A.	.014	0	0	0	0	N.A.
	1996	9.48	4.80	9.05	6.76	1.15	N.A.	.007	0	0	0	0	N.A.
Scenario 3													
	1983	0	0	0	0	0	.01	0	0	0	0	0	0
	1984	0	.86	.66	.66	0	1.66	0	0	0	0	0	.013
	1985	0	.83	.56	.56	0	1.42	0	0	0	0	0	.011
	1986	0	.79	.47	.47	0	1.19	0	0	0	0	0	.010
	1987	0	5.01	.38	.38	3.46	1.60	0	0	0	0	0	.080
	1988	4.86	5.65	7.03	7.03	3.74	2.21	0	0	0	0	0	.067
	1989	4.86	5.00	6.94	6.94	3.25	1.58	0	0	0	0	0	.055
	1990	-1.71	10.17	-13.08	5.99	2.75	26.09	.050	.048	.196	.050	0	.253
	1991	3.45	8.70	-10.33	6.02	2.26	22.21	.043	.041	.168	.043	0	.211
	1992	18.32	12.44	-7.48	6.14	2.06	22.12	.036	.034	.140	.036	0	.279
	1993	16.58	10.26	-4.64	6.26	1.53	17.97	.028	.027	.112	.029	0	.223
	1994	14.84	8.08	-1.79	6.38	.99	13.82	.021	.021	.084	.021	0	.168
	1995	13.10	6.51	1.05	6.50	.95	9.77	.014	.014	.056	.014	0	.122
	1996	11.36	4.94	3.90	6.62	.90	5.71	.01	.007	.028	.007	0	.077

Table C-4. Production and welfare impacts from Scenario I environmental regulations affecting apples

Year	Percent change from Base Year 1987		Change in welfare from Base Year 1987		
	Production	Price	Consumer Surplus	Producer Surplus	Net
1988	-0.015	0.0747	-799,261	-1,463,990	-2,263,251
1989	-0.015	0.0747	-799,261	-1,463,990	-2,263,251
1990	-0.015	0.0747	-799,261	-1,463,990	-2,263,251
1991	-0.015	0.0747	-799,261	-1,463,990	-2,263,251
1992	-0.021	0.1042	-1,114,985	-2,042,235	-3,157,220
1993	-0.020	0.1000	-1,069,880	-1,959,628	-3,029,508
1994	-0.019	0.0958	-1,024,780	-1,877,029	-2,901,809
1995	-0.018	0.0916	-979,676	-1,794,423	-2,774,099
1996	-0.018	0.0874	-934,574	-1,711,818	-2,646,392

Table C-5. Production and welfare impacts from Scenario II environmental regulations affecting apples

Year	Percent change from Base Year 1987		Change in welfare from Base Year 1987		
	Production	Price	Consumer Surplus	Producer Surplus	Net
1988	-0.015	0.0747	-799,261	-1,463,990	-2,263,251
1989	-0.015	0.0747	-799,261	-1,463,990	-2,263,251
1990	-0.367	1.8230	-19,465,134	-35,590,977	-55,056,111
1991	-0.318	1.5764	-16,836,028	-30,791,483	-47,627,511
1992	-0.305	1.5144	-16,174,993	-29,584,370	-45,759,363
1993	-0.248	1.2296	-13,136,997	-20,034,741	-37,171,738
1994	-0.191	0.9489	-10,141,456	-18,559,526	-28,700,982
1995	-0.135	0.6724	-7,187,490	-13,157,250	-20,344,740
1996	-0.081	0.3997	-4,274,242	-7,826,479	-12,100,721

Table C-6. Production and welfare impacts from Scenario III environmental regulations affecting apples

Year	Percent change from Base Year 1987		Change in welfare from Base Year 1987		
	Production	Price	Consumer Surplus	Producer Surplus	Net
1988	-0.015	0.0747	-799,261	-1,463,990	-2,263,251
1989	-0.015	0.0747	-799,261	-1,463,990	-2,263,251
1990	-0.367	1.8230	-19,465,134	-35,590,977	-55,056,111
1991	-0.328	1.6299	-17,406,795	-31,833,637	-49,240,432
1992	-0.321	1.5944	-17,028,442	-31,142,821	-481,171,263
1993	-0.261	1.2966	-13,852,108	-25,341,353	-39,193,461
1994	-0.202	1.0031	-10,720,085	-19,617,380	-30,337,465
1995	-0.144	0.7139	-7,631,449	-13,969,365	-21,600,814
1996	-0.086	0.4288	-4,585,308	-8,395,821	-12,981,129

Table C-7. Production and welfare impacts from Scenario I environmental regulations affecting potatoes

	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
Year	Production	Price	Consumer Surplus	Producer Surplus	Net
1984	-0.005	0.0142	-236,332	-100,181	-336,513
1985	-0.004	0.0122	-202,571	-85,870	-288,441.
1986	-0.004	0.0101	-168,810	-71,559	-240,369
1987	-0.088	0.2375	-3,958,133	-1,677,149	-5,635,282
1988	-0.100	0.2721	-4,534,309	-1,921,165	-6,455,474
1989	-0.088	0.2373	-3,954,689	-1,675,690	-5,630,379
1990	-0.097	0.2632	-4,386,196	-1,858,441	-6,244,637
1991	-0.081	0.2198	-3,662,095	-1,551,762	-5,213,857
1992	-0.080	0.2182	-3,636,317	-1,540,844	-5,177,161
1993	-0.063	0.1711	-2,850,871	-1,208,126	-4,058,997
1994	-0.046	0.1239	-2,065,289	-875,292	-2,940,581
1995	-0.040	0.1095	-1,825,783	-773,808	-2,599,591
1996	-0.035	0.0952	-1,586,266	-672,313	-2,258,579

Table C-8. Production and welfare impacts from Scenario II environmental regulations affecting potatoes

Year	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
	Production	Price	Consumer Surplus	Producer Surplus	Net
1984	-0.014	0.0374	-622,822	-264,001	-886,823
1985	-0.013	0.0353	-589,064	-249,693	-838,757
1986	-0.012	0.0333	-555,306	-235,384	-790,690
1987	-0.096	0.2607	-4,344,305	-1,840,700	-6,185,005
1988	-0.109	0.2953	-4,920,431	-2,084,674	-7,005,105
1989	-0.096	0.2605	-4,340,861	-1,839,241	-6,180,102
1990	-0.274	0.7424	-12,359,750	-5,232,215	-17,591,965
1991	-0.234	0.6338	-10,553,621	-4,468,530	-15,022,151
1992	-0.274	0.7428	-12,366,205	-5,234,943	-17,601,148
1993	-0.223	0.6054	-10,081,485	-4,268,846	-14,350,331
1994	-0.173	0.4680	-7,795,613	-3,301,768	-11,097,381
1995	-0.134	0.3634	-6,054,275	-2,564,735	-8,619,010
1996	-0.095	0.2588	-4,312,263	-1,827,130	-6,139,393

Table C-9. Production and welfare impacts from Scenario III environmental regulations affecting potatoes

	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
Year	Production	Price	Consumer Surplus	Producer Surplus	Net
1984	-0.017	0.0465	-775,612	-328,760	-1,104,372
1985	-0.016	0.0445	-741,855	-314,452	-1,056,307
1986	-0.016	0.0425	-708,097	-300,145	-1,008,243
1987	-0.100	0.2699	-4,496,968	-1,905,352	-6,402,320
1988	-0.112	0.3045	-5,073,075	-2,149,309	-7,222,384
1989	-0.099	0.2697	-4,493,524	-1,903,893	-6,397,417
1990	-1.518	4.1172	-68,115,431	-28,653,782	-96,769,213
1991	-1.292	3.5024	-58,010,709	-24,431,352	-82,442,061
1992	-1.176	3.1878	-52,830,082	-22,262,674	-75,092,756
1993	-0.940	2.5494	-42,299,748	-17,846,511	-60,146,259
1994	-0.708	1.9199	-31,892,323	-13,471,380	-45,363,703
1995	-0.491	1.3324	-22,157,065	-9,369,425	-31,526,490
1996	-0.278	0.7530	-12,535,455	-5,306,492	-17,841,947

Table C-10. Production and welfare impacts from Scenario I environmental regulations affecting fresh tomatoes

Year	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
	Production	Price	Consumer Surplus	Producer Surplus	Net
1984	-0.004	0.0079	-57,473	-23,772	-81,245
1985	-0.004	0.0068	-49,263	-20,376	-69,639
1986	-0.003	0.0057	-41,052	-16,980	-58,032
1987	-0.003	0.0045	-32,842	-13,584	-46,426
1988	-0.048	0.0851	-615,108	-254,366	-869,474
1989	-0.047	0.0839	-606,901	-250,973	-857,874
1990	-0.046	0.0828	-598,694	-247,580	-846,274
1991	-0.046	0.0817	-590,487	-244,187	-834,674
1992	-0.046	0.0817	-590,467	-244,187	-834,674
1993	-0.046	0.0817	-590,487	-244,187	-834,674
1994	-0.046	0.0817	-590,487	-244,187	-834,674
1995	-0.046	0.0817	-590,487	-244,187	-834,674
1996	-0.046	0.0817	-590,487	-244,187	-834,674

Table C-11. Production and welfare impacts from Scenario I environmental regulations affecting processing tomatoes

Year	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
	Production	Price	Consumer Surplus	Producer Surplus	Net
1984	-0 .010	0.0272	-143,609	-150,002	-293,611
1985	-0.009	0.0233	-123,094	-128,574	-251,668
1986	-0.007	0.0194	-102,579	-107,145	-209,724
1987	-0.006	0.0155	-82,064	-85,717	-167,781
1988	-0.111	0.2910	-1,536,544	-l-,605,324	-3,141,868
1989	-0.109	0.2871	-1,516,050	-1,583,907	-3,099,957
1990	-0. 108	0.2832	-1,495,556	-1,562,490	-3,058,046
1991	-0.106	0.2793	-1,475,061	-1,541,073	-3,016,134
1992	-0.106	0.2793	-1,475,061	-1,541,073	-3,016,134
1993	-0.106	0.2793	-1,475,061	-1,541,073	-3,016,134
1994	-0.106	0.2793	-1,475,061	-1,541,073	-3,016,134
1995	-0.106	0.2793	-1,475,061	-1,541,073	-3,016,134
1996	-0.106	0.2793	-1,475,061	-1,541,073	-3,016,134

Table C-12. Production and welfare impacts from Scenario II environmental regulations affecting fresh tomatoes

Year	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
	Production	Price	Consumer Surplus	Producer Surplus	Net
1984	-0.004	0.0079	-57,473	-23,772	-81,245
1985	-0.004	0.0068	-49,263	-20,376	-69,639
1986	-0.003	0.0057	-41,052	-16,980	-58,032
1987	-0.003	0.0045	-32,842	-13,584	-46,426
1988	-0.048	0.0851	-615,108	-254,366	-869,474
1989	-0.047	0.0839	-606,901	-250,973	-857,874
1990	-0.155	0.2777	-2,006,558	-829,328	-2,835,886
1991	-0.139	0.2488	-1,797,741	-743,082	-540,823
1992	-0.123	0.2209	-1,596,756	-660,058	-256,814
1993	-0.108	0.1930	-1,394,866	-576,647	-1,971,513
1994	-0.092	0.1652	-1,193,818	-493,571	-1,687,389
1995	-0.077	0.1373	-992,739	-410,469	-1,403,208
1996	-0.061	0.1095	-791,629	-327,341	-1,118,970

Table C-13. Production and welfare impacts from Scenario II environmental regulations affecting processing tomatoes

	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
Year	Production	Price	Consumer Surplus	Producer Surplus	Net
1984	-0.010	0.0039	-143,609	-150,002	-293,611
1985	-0.009	0.0034	-123,094	-128,574	-251,668
1986	-0.007	0.0028	-102,579	-107,145	-209,724
1987	-0.006	0.0023	-82,064	-85,717	-167,781
1988	-0.111	0.0422	-1,536,544	-1,605,324	-3,141,868
1989	-0.109	0.0416	-1,516,050	-1,583,907	-3,099,957
1990	-0.110	0.0418	-1,523,111	-1,591,286	-3,114,397
1991	-0.108	0.0412	-1,499,086	-1,566,179	-3,065,265
1992	-0.108	0.0410	-1,494,718	-1,561,615	-3,056,333
1993	-0.108	0.0409	-1,490,350	-1,557,050	-3,047,400
1994	-0.107	0.0408	-1,485,982	-1,552,485	-3,038,467
1995	-0.107	0.0407	-1,481,614	-1,547,920	-3,029,534
1996	-0.107	0.0406	-1,477,245	-1,543,355	-3,020,600

Table C-14. Production and welfare impacts from Scenario III environmental regulations affecting fresh tomatoes

	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
Year	Production	Price	Consumer Surplus	Producer Surplus	Net
1984	-0.004	0.0079	-57,473	-23,772	-81,245
1985	-0.004	0.0068	-49,263	-20,376	-69,639
1986	-0.003	0.0057	-41,052	- 16,980	-58,032
1987	-0.003	0.0045	-32 ,842	-13,584	-46,426
1988	-0.048	0.0851	-615,108	-254,366	-869,474
1989	-0.047	0.0839	-606,901	-250,973	-857,874
1990	-9.520	17.0482	-120,000,000	-46,000,000	-166,000,000
1991	-7.892	14.1338	-98,000,000	-39,000,000	-137,000,000
1992	-6.372	11.4106	-80,000,000	-32,000,000	-112,000,000
1993	-4.947	8.8589	-62,000,000	-25,000,000	-87,000,000
1994	-3.609	6.4634	-46,000,000	-19,000,000	-65,000,000
1995	-2.351	4.2099	-30,000,000	-12,000,000	-42,000,000
1996	-1.165	2.0863	-26,000,000	-6,167,852	-32,167,852

Table C-15. Production and welfare impacts from Scenario III environmental regulations affecting processing tomatoes

Year	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
	Production	Price	Consumer Surplus	Producer Surplus	Net
1984	-0.010	0.0272	-143,609	-150,002	-293,611
1985	-0.009	0.0232	-123,094	-128,574	-251,668
1986	-0.007	0.0194	-102,579	-107,145	-209,724
1987	-0.006	0.0155	-82,064	-85,717	-167,781
1988	-0.111	0.2910	-1,536,544	-1,605,324	-3,141,868
1989	-0.109	0.2871	-1,516,050	-1,583,907	-3,099,957
1990	-1.664	4.3654	-23,000,000	-24,000,000	-47,000,000
1991	-1.430	3.7515	-20,000,000	-21,000,000	-41,000,000
1992	-1.201	3.1515	-17,000,000	-17,000,000	-34,000,000
1993	-0.976	2.5602	-13,000,000	-14,000,000	-27,000,000
1994	-0.753	1.9768	-10,000,000	-11,000,000	-21,000,000
1995	-0.535	1.4027	-7,400,000	-7,700,000	-15,100,000
1996	-0.319	0.8367	-4,413,759	-4,613,538	-9,027,297

Table C-16. Production and welfare impacts from Scenario I environmental regulations affecting peas

Year	Percent change from Base Year 1986		Change in welfare from Base Year 1986		
	Production	Price	Consumer Surplus	Producer Surplus	Net
1987	-0.111	0.5297	-656,421	-444,848	-1,101,269
1988	-0.120	0.5724	-709,320	-480,675	-1,189,995
1989	-0.104	0.4967	-615,598	-417,197	-1,032,795
1990	-0.089	0.4211	-521,862	-353,700	-875,562
1991	-0.073	0.3454	-428,111	-290,182	-718,293
1992	-0.066	0.3156	-391,204	-265,174	-656,378
1993	-0.049	0.2334	-289,309	-196,122	-485,431
1994	-0.032	0.1512	-187,396	-127,046	-314,442
1995	-0.030	0.1446	-179,271	-121,539	-300,810
1996	-0.029	0.1380	-171,145	-116,031	-287,176

Table C-17. Production and welfare impacts from Scenario Ii environmental regulations affecting peas

Year	Percent change from Base Year 1986		Change in welfare from Base Year 1986		
	Production	Price	Consumer Surplus	Producer Surplus	Net
1987	-0.111	0.5297	-656,421	-444,848	-1,101,269
1988	-0.120	0.5724	-709,320	-480,675	-1,189,995
1989	-0.104	0.4967	-615,598	-417,197	-1,032,795
1990	-0.089	0.4211	-521,862	-353,700	-875,562
1991	-0.073	0.3454	-428,111	-290,182	-718,293
1992	-0.085	0.4037	-500,359	-339,131	-839,490
1993	-0.065	0.3089	-382,887	-259,538	-642,425
1994	-0.045	0.2141	-265,392	-179,912	-445,304
1995	-0.041	0.1949	-241,669	-163,834	-405,503
1996	-0.037	0.1758	-217,946	-147,754	-365,700

Table C-18. Production and welfare impacts from Scenario III environmental regulations affecting peas

Year	Percent change from Base Year 1986		Change in welfare from Base Year 1986		
	Production	Price	Consumer Surplus	Producer Surplus	Net
1987	-0.111	0.5297	-656,481	-444,848	-1,101,269
1988	-0.120	0.5724	-709,320	-480,675	-1,189,995
1989	-0.104	0.4967	-615,598	-417,197	-1,032,795
1990	-0.089	0.4211	-521,862	-353,700	-875,562
1991	-0.073	0.3454	-428,111	-290,182	-718,293
1992	-0.066	0.3156	-391,204	-265,174	-656,378
1993	-0.049	0.2334	-289,309	-196,122	-485,431
1994	-0.032	0.1512	-187,396	-127,046	-314,442
1995	-0.030	0.1446	-179,271	-121,539	-300,810
1996	-0.029	0.1380	-171,145	-116,031	-287,176

APPENDIX D

REPFARM Model and Results

BY

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Appendix D

REPFARM Model and Results

1.0 Description of REPFARM Model

REPFARM is a whole-farm, recursive programming-simulation model which is capable of using a wide variety of farm policy, production, and market environments in order to provide financial impact information for a variety of representative farms across the United States. REPFARM essentially links a set of accounting decision subroutines with a set of optimizing subroutines. The optimizing subroutines annually adjust the mix of crop enterprises produced on the farm based upon estimated returns for each enterprise. The accounting subroutines calculate farm income and expenses, value of assets and liabilities, as well as other financial information associated with the production decisions made each year.

REPFARM is capable of simulating the annual production and financial operations of a representative farm for a period of l-10 years. The model utilizes user-specified data sets which contain information relative to the particular representative farm being simulated. Information about a particular farm contained in a data set includes farm size, acres owned and leased, initial values of farm assets and liabilities, off-farm income, family living expenses, itemized expenses for the farm such as taxes and insurance, as well as acreages, yields, production costs, and labor requirements of each crop enterprise produced on the farm and herd size, input costs, and labor requirements of each livestock enterprise produced on the farm. Additional information which must also be supplied by the user on an annual basis includes itemized inflation indexes for various production expense items, interest rates for short-term, intermediate-term, and long-term loans, machinery depreciation rates, income tax rates, market prices for all crop and livestock enterprises included on the farm as well as farm policy-data such as loan rates, target prices, crop set-asides, diversion payment rates, and payment limitations.

REPFARM can simulate a representative farm in a deterministic or stochastic mode. In the deterministic mode, the farm is simulated with specified crop and livestock market prices and-crop yields for each year of simulation. Model output consists of annual financial statements for the farm. These financial statements include itemized income statements, cashflow statements, and balance sheets. Additional production information is also provided relating to the acreage and production of each crop enterprise. In the stochastic mode, several iterations are performed for each year of simulation using variable crop yields and crop and livestock market prices. Model output in this mode consists primarily of annual mean and variance estimates of selected financial measures and production items. REPFARM was simulated in the deterministic mode in this study.

Three key assumptions -that were made in the baseline projections of each of the REPFARM models are:

1) production costs were assumed to increase at two percent per year,

2) crop yield was assumed to increase at two percent per year, and

3) the current farm bill was assumed to be in effect through 1990 and policy variables were held constant at the 1990 level for the remaining forecast period.

If these assumptions overestimate the financial well-being of the representative producers in the baseline, then the ability of the producers to bear the costs of environmental regulations will be overestimated. Likewise, if these assumptions result in an underestimation of producers. well-being, then the ability of producers to bear the costs of environmental regulations will be underestimated.

2.0 Description of Representative Farms

Representative farms evaluated in this study were developed from data obtained from the USDA's 1986 Farm Costs and Returns Survey. Three general types of farms considered included a Mississippi cotton soybean farm, and Illinois corn soybean farm, and a Kansas wheat cattle farm. For each one of these general farm types, two representative farm data sets were constructed: one representing a farm in an average financial position and another representing a farm in a vulnerable financial position. Representative farm data sets for farms in an average financial position were developed from data on all farms meeting the specified state/enterprise definition; Representative farm data sets for farms in a vulnerable financial position were developed from data on all farms meeting the state/enterprise definition plus the additional requirements of a negative net cash income and a debt to asset ratio greater than 0.40.

2.1 Illinois Corn Soybean Farms

The two representative Illinois corn soybean farms were developed from survey information on farms in Illinois which were classified as cash grain farms (cash grain sales represented the largest portion of gross income for the farm) and produced corn and soybeans. Survey observations fitting this description represent an expanded number of 30,837 farms in Illinois (Table D-l) and were used to estimate the characteristics of the corn soybean farm in an average financial position (Table D-2). Of these 30,837 farms, approximately 9.9% were determined to be in a vulnerable position (as defined above) and survey observations relating to this group of farms were used to develop the characteristics of the corn soybean farm in a vulnerable financial position (Table D-2).

2.2 Mississippi Cotton Soybean Farms

The two representative Mississippi cotton soybean farms were developed from survey information on farms in Mississippi which were classified as field crop farms (field crop sales represented the largest portion of gross income for the farm) and produced cotton and soybeans. Survey observations fitting this description represent an expanded number of 1,798 farms in Mississippi (Table D-l) and were to estimate the characteristics of the cotton soybean farm in an average financial position (Table D-3). Of these 1,798 farms, approximately 14.2% were determined to be in a vulnerable financial position (as defined above) and survey observations relating to this group of farms were used to develop the characteristics of the cotton soybean farm in a vulnerable financial position (Table D-3).

2.3 Kansas Wheat Cattle Farms

The two representative Kansas wheat cattle farms were developed from survey information on farms in Kansas which produced wheat and had sales of cattle. Survey observations fitting this description represent an expanded number of 19,966 farms in Kansas (Table D-l) and were used to estimate the characteristics of the wheat cattle farms in an average financial position (Table D-4). Of these 19,966 farms, approximately 7.1% were determined to be in a vulnerable financial position (as defined above) and survey observations relating to this group of farms were used to develop the characteristics of the wheat cattle farm in a vulnerable position (Table D-4).

3.0 EPA Supplied REPFARM Inputs

EPA actions are entered into the REPFARM model as:

* changes in variable production costs,
* changes in fixed production costs,
* changes in crop yields, and
* changes in crop and livestock prices.

The changes in crop and livestock prices were obtained from AGSIM and are described in Appendix B. The first year cost and yield impacts assumed for each of the REPFARM models are described in

Table D-l
1986 Farm Numbers

Illinois Corn Soybean:

Corn Belt -- 345,871 total farms
-- 220,763 farms produce corn for grain
-- 112,489 classified as cash grain farms producing corn and soybeans 1/

Illinois -- 65,672 total farms
-- 49,083 farms produce corn for grain
-- 30,837 classified as cash grain farms producing corn and soybeans 1/

Mississippi Cotton Soybean:

Delta States - 73,747 total farms
- 7,438 farms produce cotton
- 3,576 classified as field crop farms producing cotton and soybeans 2/

Mississippi - 27,542 total farms
- 3,435 farms produce cotton
- 1,798 classified as field crop farms producing cotton and soybeans 2/

Kansas Wheat Cattle:

Northern Plains -- 153,884 total farms
-- 84,097 farms produce wheat
-- 50,143 produce wheat and raise cattle

Kansas -- 54,024 total farms
-- 31,000 farms produce wheat
-- 19,966 produce wheat and raise cattle

1/ Cash grain farms are farms on which the largest portion of gross income is accounted for by sales of cash grains such as corn, soybeans or wheat.
2/ Field crop farms are farms on which the largest portion of gross income is accounted for by sales of field crops such as cotton or tobacco.

Source: 1986 Farm Costs and Returns Survey

Table D-2
Initial Characteristics of Representative Farms
Simulated for EPA's Agricultural Sector Study

Illinois Corn Soybean Farms:

	Average Financial Position	Vulnerable Financial Position
Farm acreage:		
Cropland owned	160	92
Cropland rented	363	445
Pastureland owned	0	0
Pastureland rented	0	0
Total land operated	523	537
Cropland, percent tillable	98%	84%
Number of full-time hired workers	0	0
Value of assets ($) 1/:		
Cropland & buildings	194,293	130,656
Pastureland	0	0
Farm machinery	86,920	85,980
Livestock	0	0
Non-farm investments	12,777	6,736
Beginning cash reserve	2,000	2,000
Debt to Asset Ratio	.28	.67
Off-farm income ($)	17,766	36,072
Family living expenses ($)	15,500	15,500
Crop acreage 2/:		
Corn	325	280
Soybeans	190	173
Crop yields (bu.) 3/:		
Corn	122.4	109.5
Soybeans	36.8	32.8

1/ As of January 1, 1987.
2/ Planted acreage plus set-aside acreage.
3/ State average yields (1981-1987) were used for representative producers in average financial condition. (Source: Crop Production, 1983, 1986, and 1987 Annual Summaries). These yields were adjusted (based on survey information) for vulnerable producers.

Source: Data developed from 1986 Farm Costs and Returns Survey

Table D-3
Initial Characteristics of Representative Farms
Simulated for EPA's Agricultural Sector Study

Mississippi Cotton Soybean Farms:

	Average Financial Position	Vulnerable Financial Position
Farm acreage:		
Cropland owned	413	409
Cropland rented	1,016	1,442
Pastureland owned	0	0
Pastureland rented	0	0
Total land operated	1,429	1,851
Cropland, percent tillable	81%	84%
Number of full-time hired workers	2	2
Value of assets ($) 1/:		
Cropland & buildings	429,943	340,204
Pastureland	0	0
Farm machinery	140,557	153,280
Livestock	0	0
Non-farm investments	11,506	15,069
Beginning cash reserve	2,000	2,000
Debt to Asset Ratio	.33	.83
Off-farm income ($)	16,856	5,193
Family living expenses ($)	15,500	15,500
Crop acreage 2/:		
Cotton	545	657
Soybeans	611	889
Crop yields 3/:		
Cotton (lb.)	722.5	722.5
Soybeans (bu.)	22.0	18.7

1/ As of January 1, 1987.
2/ Planted acreage plus set-aside acreage.
3/ State average yields (1981-1987) were used. (Source: crop Production, 1983, 1986, and 1987 Annual Summaries).

Source: Data developed from 1986 Farm Costs and Returns Survey

Table D-4
Initial Characteristics of Representative Farms
Simulated for EPA's Agricultural Sector Study

Kansas Wheat Cattle Farms:

	Average Financial Position	Vulnerable Financial Position
Farm acreage:		
Cropland owned	326	318
Cropland rented	431	743
Pastureland owned	224	176
Pastureland rented	296	409
Total land operated	1,277	1,646
Cropland, percent tillable	77%	78%
Number of full-time hired workers	0	0
Value of assets ($) 1/:		
Cropland & buildings	145,356	114,326
Pastureland	50,176	39,424
Farm machinery	69,740	80,143
Livestock	9,390	24,540
Non-farm investments	15,187	8,571
Beginning cash reserve	2,000	2,000
Debt to Asset Ratio	.31	.85
Off-farm income ($)	20,123	15,366
Family living expenses ($)	15,500	15,500
Crop acreage 2/:		
Wheat	342	430
Soybeans	39	123
Sorghum	165	223
Corn	37	52
Crop yields (bu.) 3/:		
Wheat	35.4	32.2
Soybeans	26.5	15.4
Sorghum	62.8	60.9
Corn	120.8	97.0

Continued...

Table D-4. (Continued)

Kansas Wheat Cattle Farms:

	Average Financial Position	Vulnerable Financial Position
Livestock inventory:		
cows	15	40
Replacement heifers	3	6
Feeder steers 4/	75	50

1/ As of January 1, 1987.
2/ Planted acreage plus set-aside acreage.
3/ State average yields (1981-1987) were used for representative producers in average financial condition. (Source: Crop Production, 1983, 1986, and 1987 Annual Summaries). These yields were adjusted (based on survey information) for vulnerable producers.
4/ Feeder steers are purchased and sold within the calendar year.

Source: Data developed from 1986 Farm Costs and Returns Survey

Tables D-5 through D-7. These cost and yield effects were provided by EPA Program Offices. Impacts of pesticide cancellations were assumed to dissipate evenly over a seven year period.

4.0 REPFARM Output

The impact of EPA actions on the financial condition of each of the representative farms was determined by examining:

* the change in net cash farm income due to EPA actions, and
* the change in debt asset ratios due to EPA actions.

Three major field crop and livestock farms in two financial conditions were created, resulting in a total of six different representative farms:

* an Illinois Corn Soybean Farm
  - in average financial condition
  - in vulnerable financial condition

* a Mississippi Cotton Soybean Farm
  - in average financial condition
  - in vulnerable financial condition

* a Kansas Wheat Cattle Farm
  - in average financial condition
  - in vulnerable financial condition

For each REPFARM in each scenario, two alternative sets of impacts were considered:

* A Maximum Impact Case: In this case it is assumed that the producer is impacted by every regulation that may possibly affect a producer of that type.

* An Average Impact Case: In this case it is assumed that the producer experiences the average impact of producers of that type - e.g., if 50% of all producer of a given type experience a $2.OO/acre cost, we would assume a $l.OO/acre cost for the average impacted producer.

The net cash farm income and debt to asset ratios of each of these farms is examined for each of the three alternative EPA scenarios defined in this study. This output is presented in Figures D1 - D18.

Table D-5
Potential Impacts on Illinois Corn Soybean Farm 1/

Variable Cost: First Year Impacts

Scenario	Action	Crop	Cost 2/	Yield(%)	Acres(%)3/
1-3	Alachlor-restricted use	corn	.50	0	38.6
		soybeans	.50	0	25.4
1-3	Farm Worker Safety	corn	.98	0	90
		soybeans	.62		80
1	Corn Rootworm Insecticides Plan I	corn	.70	0	20
2	Groundwater Plan II: alachlor	corn	1.80	0	1.5
		soybeans	1.60	0	1
2	Groundwater Plan II: cyanazine	corn	17.87	-11.07	0.2
2	Groundwater Plan II: atrazine	corn	17.87	-11.07	1.6
2	Corn Rootworm Insecticides Plan II	corn	-8.50	-24.0	34
3	Groundwater Plan III: alachlor	corn	1.80	0	6.1
		soybeans	1.60	0	8.3
3	Groundwater Plan III: cyanazine	corn	17.87	-11.07	4.3
3	Groundwater Plan III: atrazine	corn	17.87	-11.07	14.6

Continued...

Table D-5 (continued)

Scenario	Action	Crop	Cost 2/	Yield(%)	Acres(%)3/
3	Corn Rootworm Insecticides Plan III	corn	-8.50	-24.0	34

Fixed Costs:

Scenario	Action	Impact
l-3	Underground Storage Tank	Insurance: $2,500/yr. 2 tank tightness test @ $500, there are 5,428 USTs in the cornbelt distributed over 310,000 farms.
l-3	Enclosed Cabs	Cost of enclosing cab = $2,500. Assumed the l/3 of all cabs must be enclosed.
3	Lead Ban	Assumed impacted farm incurred 1,000 cost to rebuild a tractor, truck or combine engine. Predicted 7,280 trucks, 4,865 combines and 23,112 tractors in cornbelt would need to be rebuilt.
l-3	SARA Title III, Section 302-304	cost = $50/covered farm. Assumed l/3 of all farms covered.

1/ Supplied by EPA Program Offices.
2/ Cost per acre (1986$).
3/ Percent of indicated crop acres in the cornbelt likely to be affected.

Table D-6
Potential Impacts for Mississippi Cotton Soybean Farm 1/

Variable costs: First Year Impacts

Scenario	Action	Crop	Cost 2/	Yield(%)	Acres(%)3/
l-3	Dinoseb Cancellation				
		cotton	5.00	-1.5	24.1
		soybeans	16.00	0	10.5
l-3	Toxaphene cancellation				
		soybeans	6.8	0	1.2
l-3	Chlorodimeform - cancellation of yield enhancement				
		cotton	3.88	0	24
l-3	Alachlor-restricted use				
		soybeans	.50	0	10
l-3	Farm Worker safety				
		cotton	.44	0	95
		soybeans	. 65	0	85
l-2	Groundwater Plan I & II: aldicarb				
		cotton	6.42	0	0.4
1	Groundwater Plan II: alachlor				
		soybeans	1.60	0	1
2	Organophosphates Plan II				
		cotton	4.15	0	1
2	Groundwater Plan II: cynazine				
		cotton	5.00	6	1.3
3	Groundwater Plan III: alachlor				
		soybeans	1.60	0	5
3	Organophosphates Plan III				
		cotton	8.92	0	93.5

Continued...

Table D-6 (continued)

Scenario	Action	Crop	Cost 2/	Yield (%)	Acres (%) 3/
3	Groundwater Plan III: aldicarb	cotton	6.42	0	2.4
3	Groundwater Plan III: cyanazine	cotton	5.00	6	23.1

Fixed Costs:

Scenario	Action	Impact
l-3	Underground Storage Tank	Insurance = $2,500/yr Tank tightness test (2) = $500. There are 2,099 UST in the Delta distributed over 132,000 farms.
l-3	Enclosed Cabs	Cost of Enclosing Cab = $2,500. Assumed that l/3 of all cabs must be enclosed.
l-3	SARA Title III, Sections 302-304	cost = $50/covered farm. Assumed l/3 of all farms covered.
3	Lead Ban	Assumed impacted farm incurred $1,000 cost to rebuild a tractor, truck or combine engine. Assumed 1,150 tractors, 1,124 trucks and 303 combines in Delta need to be rebuilt.

1/ Supplied by EPA Program Offices.
2/ Cost per acre (1986$).
3/ Percent of indicated crop acres in the cornbelt likely to be affected.

Table D-7
Potential Impacts for Kansas Wheat Cattle Farm 1/

Variable Costs: First Year Impacts

Scenario	Action	Crop	Cost 2/	Yield(%)	Acres(%)3/
l-3	Alachlor-Restricted Use				
		corn	.50	0	37.1
		soybeans	.50	0	19
l-3	Farm Worker				
		corn	98	0	90
		soybeans	.65	0	75
		wheat	.45	0	80
1	Corn Rootworm Insecticides Plan I				
		corn	.70	0	35
2	Groundwater Plan II: alachlor				
		corn	1.82	0	0.3
		soybeans	1.60	0	0.1
		sorghum	1.82	0	0.2
2	Groundwater Plan II: atrazine				
		corn	18.41	-1	0.5
		sorghum	18.41	-1	0.5
2	Groundwater Plan II: cyanaz ine				
		corn	18.41	-1	0.2
2-3	Corn Rootworm Insecticides Plan II, III				
		corn	-8.50	-16	58
2-3	Fungicides Plan II, III				
		wheat	-3.71	-44	0.7
3	Groundwater Plan III: alachlor				
		corn	1.82	0	1.3
		soybeans	1.60	0	0.5
		sorghum	1.82	0	3.4

Continued...

Table D-7 (continued)

Scenario	Action	Crop	Cost 2/	Yield(%)	Acres(%)3/
3	Groundwater Plan III: atrazine				
		corn	18.41	-1	9.6
		sorghum	18.41	-1	11.4
3	Groundwater Plan III: cyanazine				
		corn	18.41	-1	2.7
		sorghum	18.41	-1	0.10

Fixed Costs:

Scenario	Action	Impact
l-3	Underground Storage Tanks	Insurance = $2,500/yr Tank Tightness Test = $500/each (need 2) There are 4,045 UST in the Northern Plains distributed over 196,000 farms.
l-3	Enclosed Cabs	Cost of Enclosing cab = $2,500. Assumed l/3 of all cabs must be enclosed.
l-3	SARA Title III: Sections 302-304	cost = $50/covered farms. Assumed l/3 of all farms are covered.
3	Lead Ban	Assumed impacted farm incurred $l,000 cost to rebuild a tractor, truck or combine engine. Assumed 8,580 trucks, 8,380 tractors and 3,015 combines in the Northern Plains would need to be rebuilt.

1/ Supplied by EPA Program Offices.
2/ Cost per acre (1986$).
3/ Percent of indicated crop areas in the cornbelt like to be affected.

Illinois Corn Soybean Farm: Scenario 1

Average Financial Condition

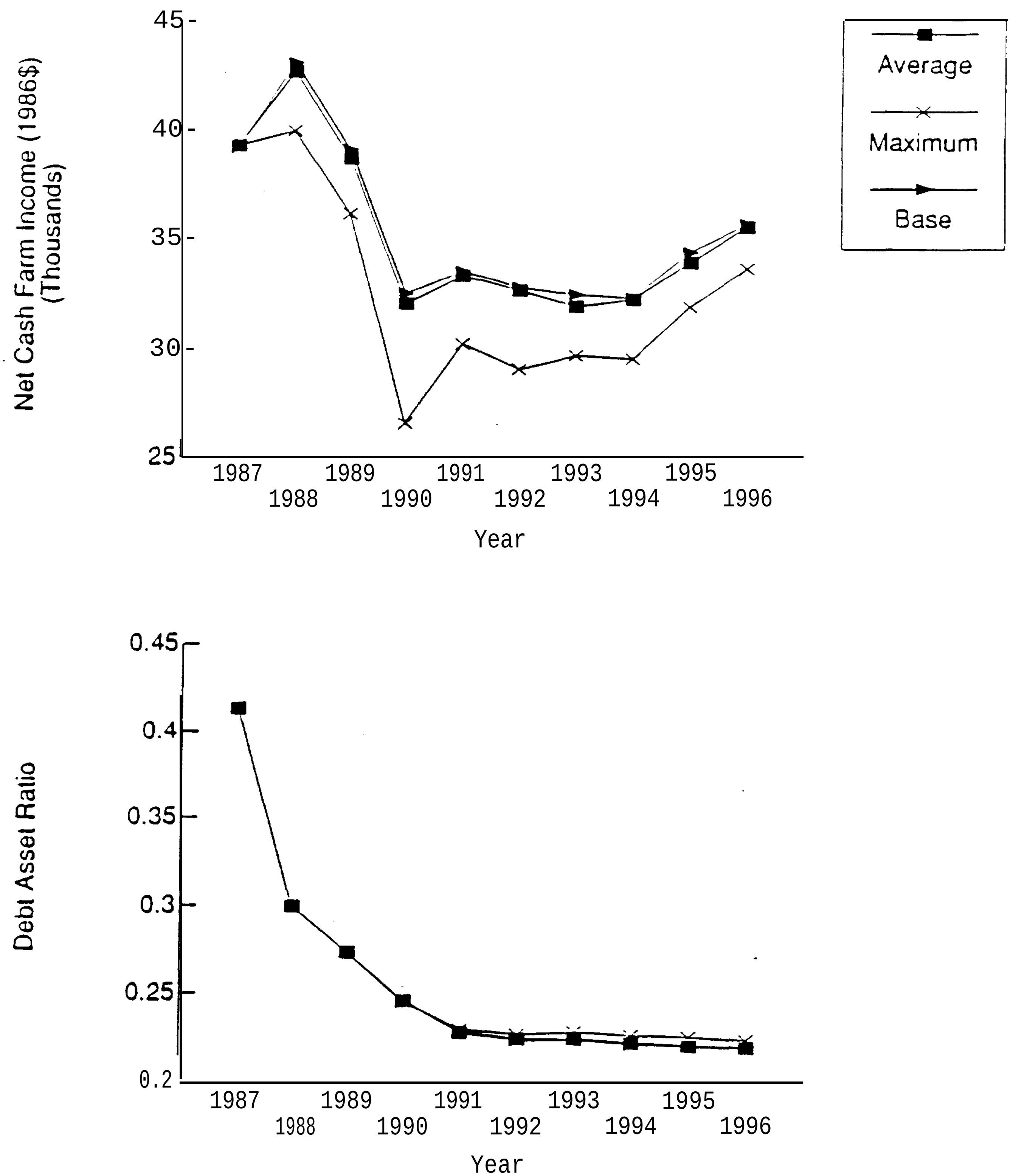


Figure D-1. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in average financial condition: Scenario 1

Illinois Corn Soybean Farm: Scenario 1

Vulnerable Financial Condition

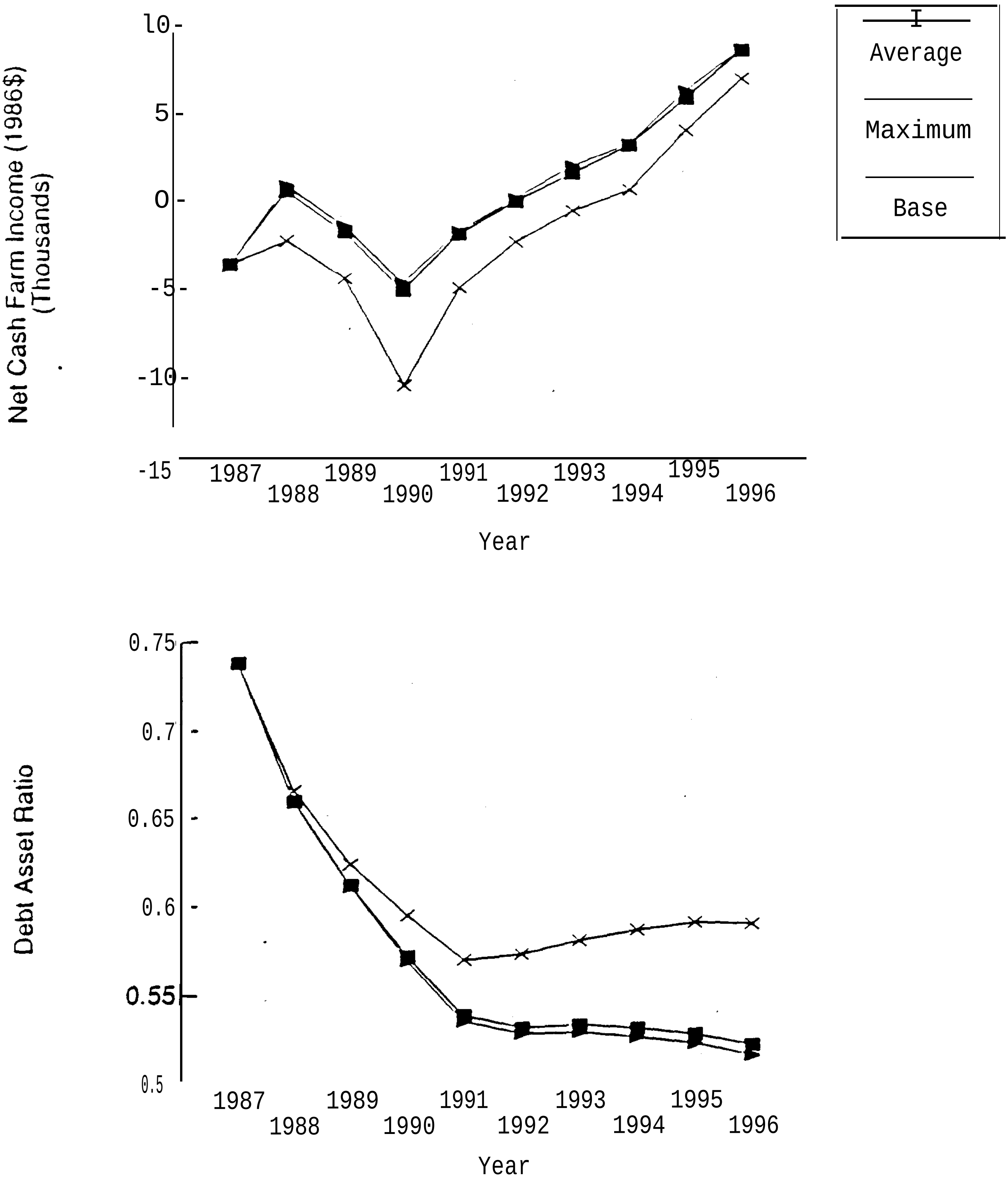


Figure D-Z. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in vulnerable financial condition: Scenario 1

Illinois Corn Soybean Farm: Scenario 2

Average Financial Condition

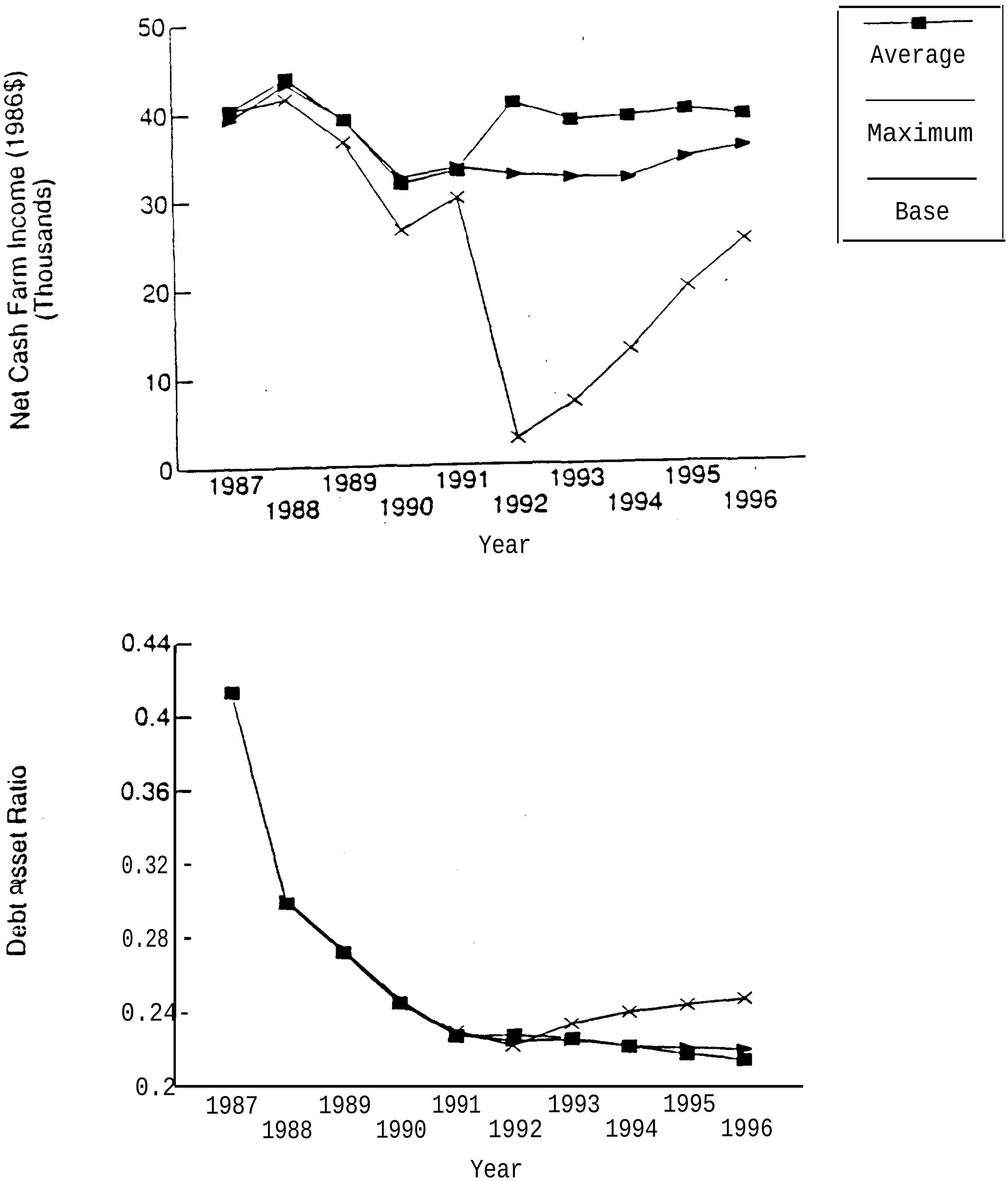


Figure D-3. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in average financial condition: Scenario 2

Illinois Corn Soybean Farm: Scenario 2

Vulnerable Financial Condition

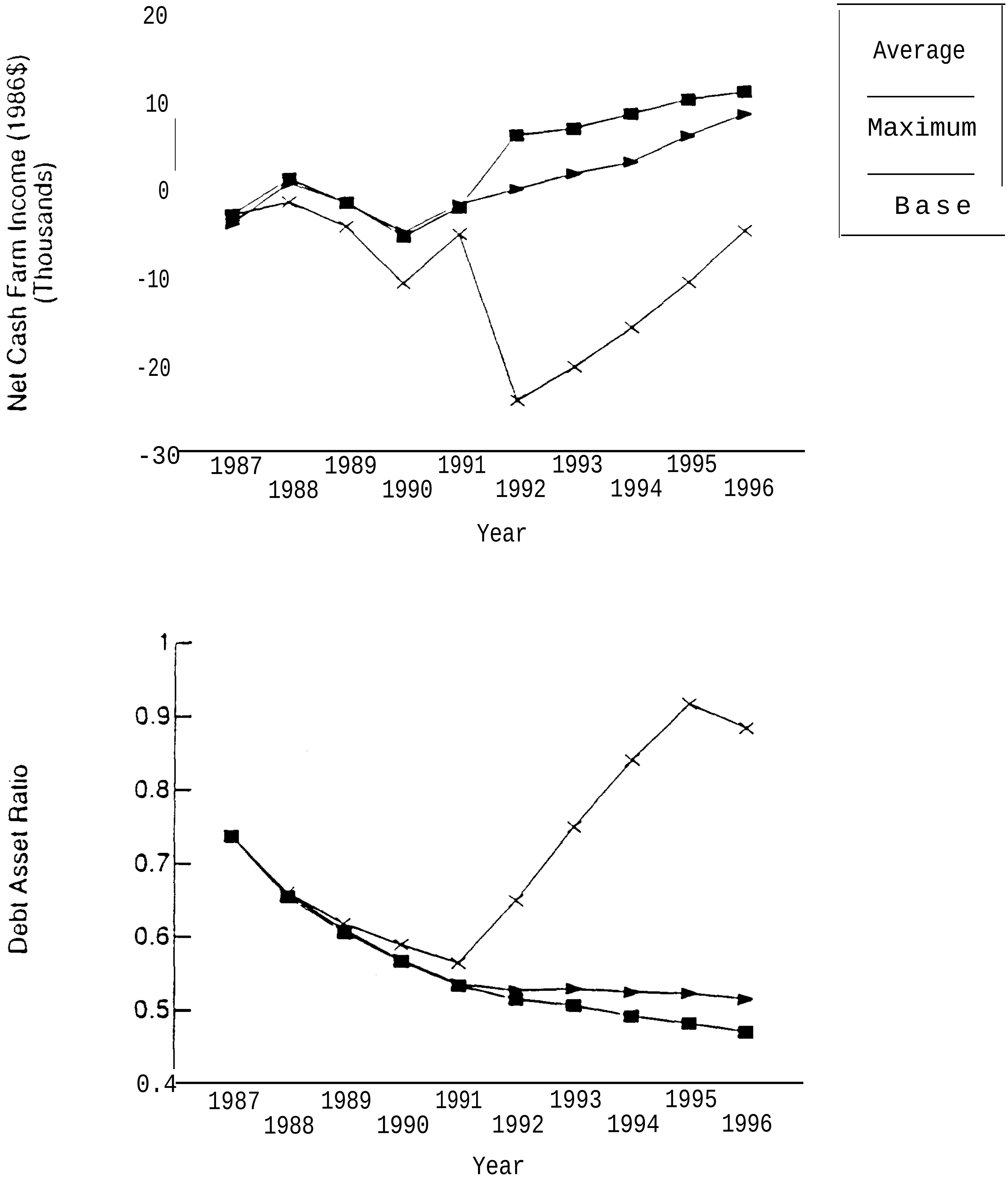


Figure D-4. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in vulnerable financial condition: Scenario 2

Illinois Corn Soybean Farm: Scenario 3

Average Financial Condition

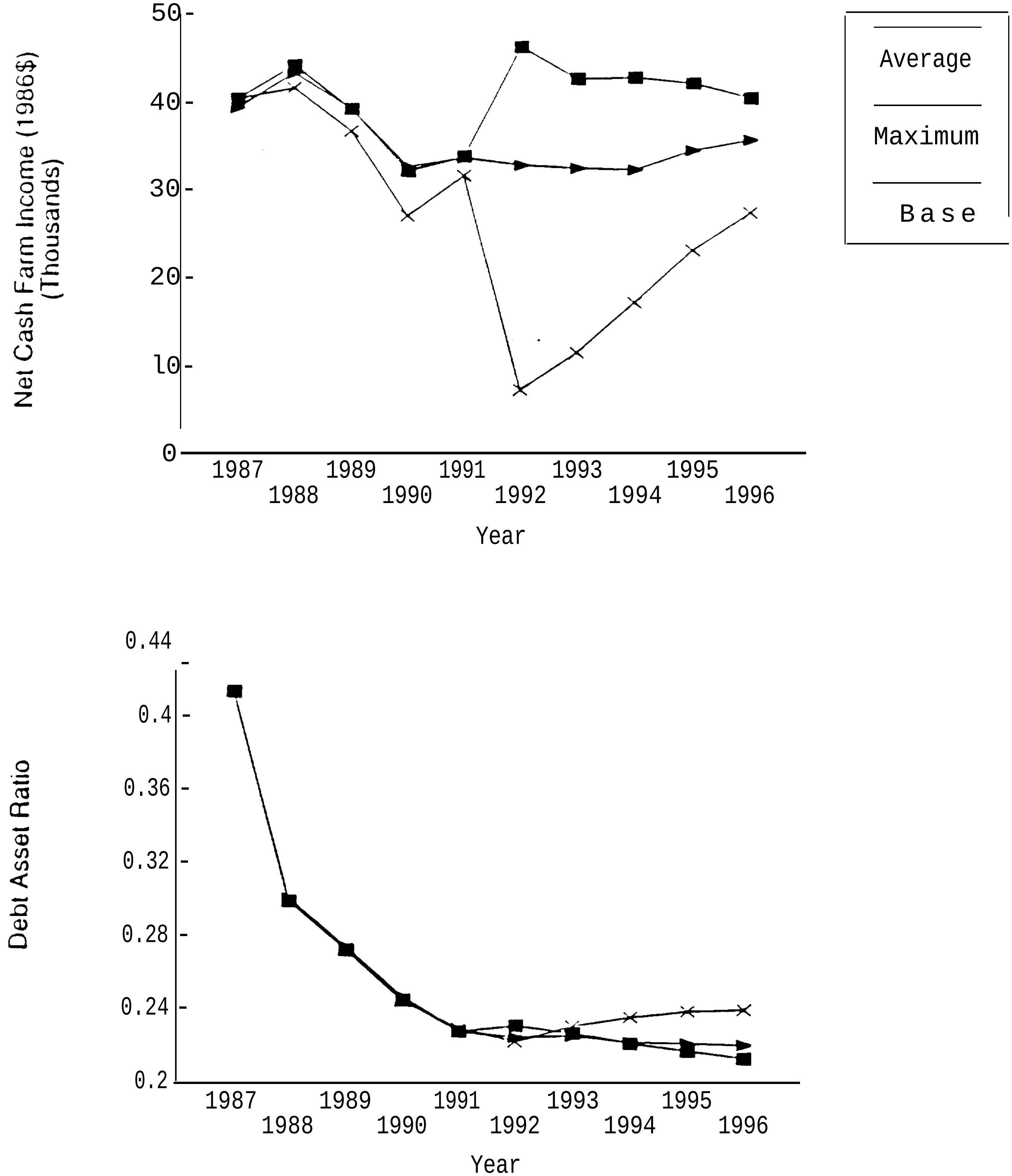
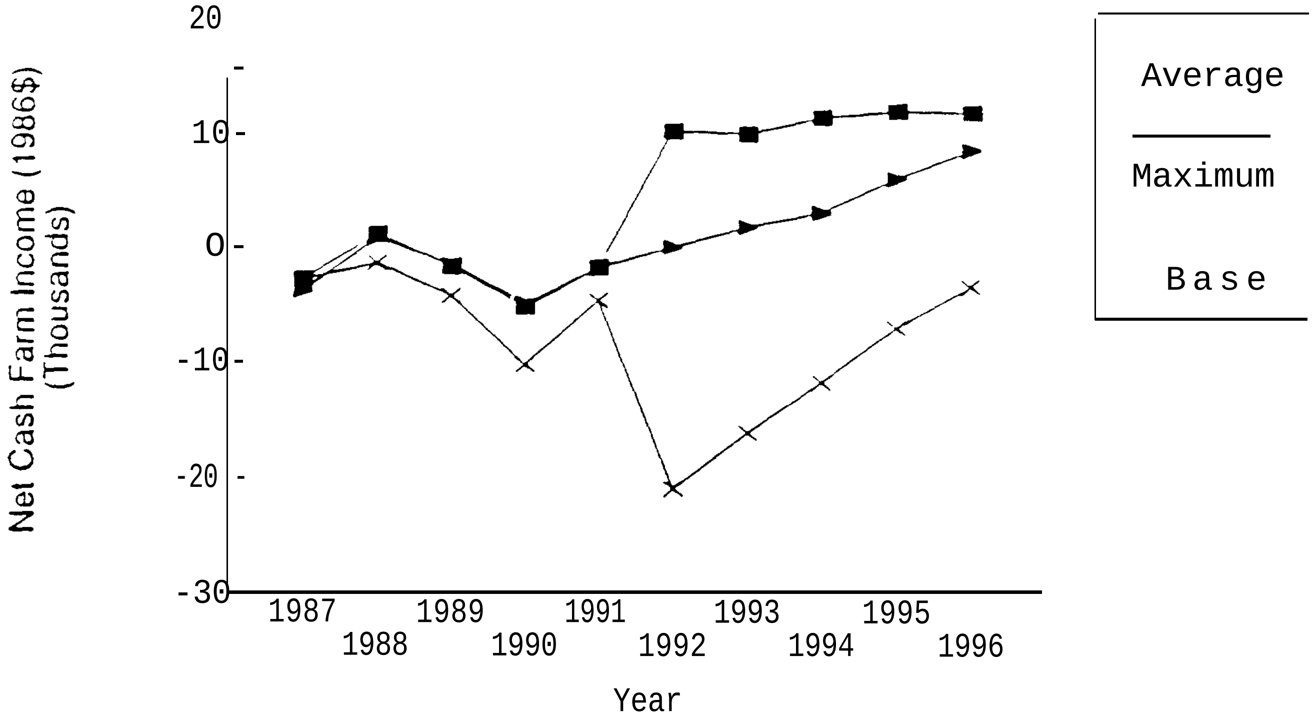


Figure D-S. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in average financial condition: Scenario 3

Illinois Corn Soybean Farm: Scenario 3

Vulnerable Financial Condition



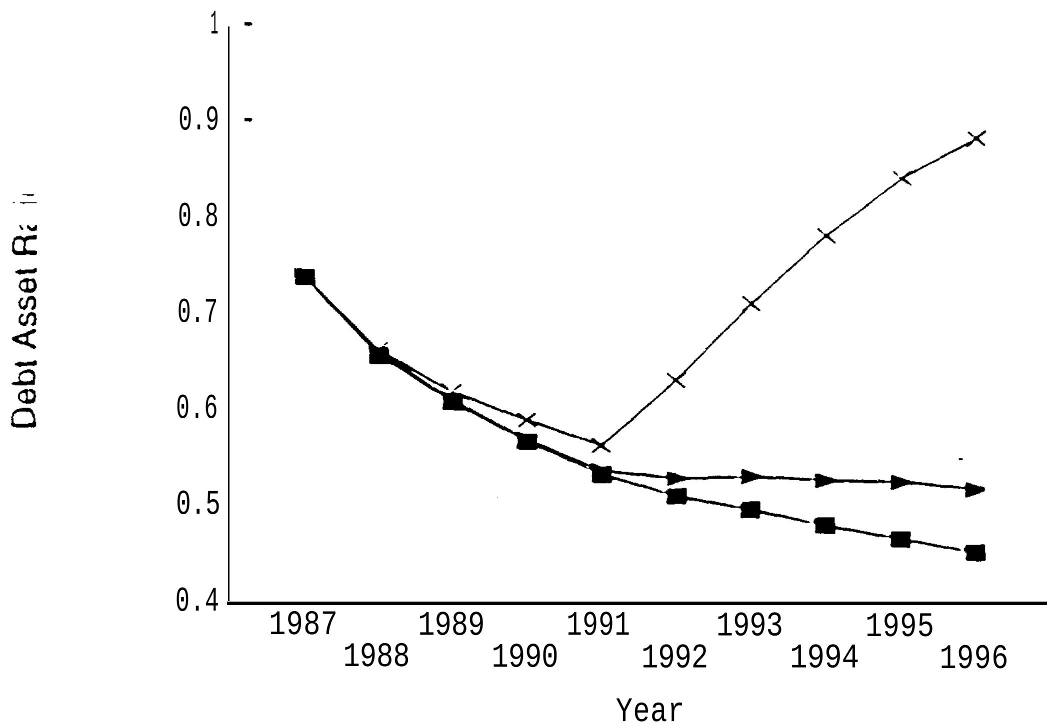


Figure D-6. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in vulnerable financial condition: Scenario 3

MS Cotton Soybean Farm: Scenario 1

Average Financial Condition

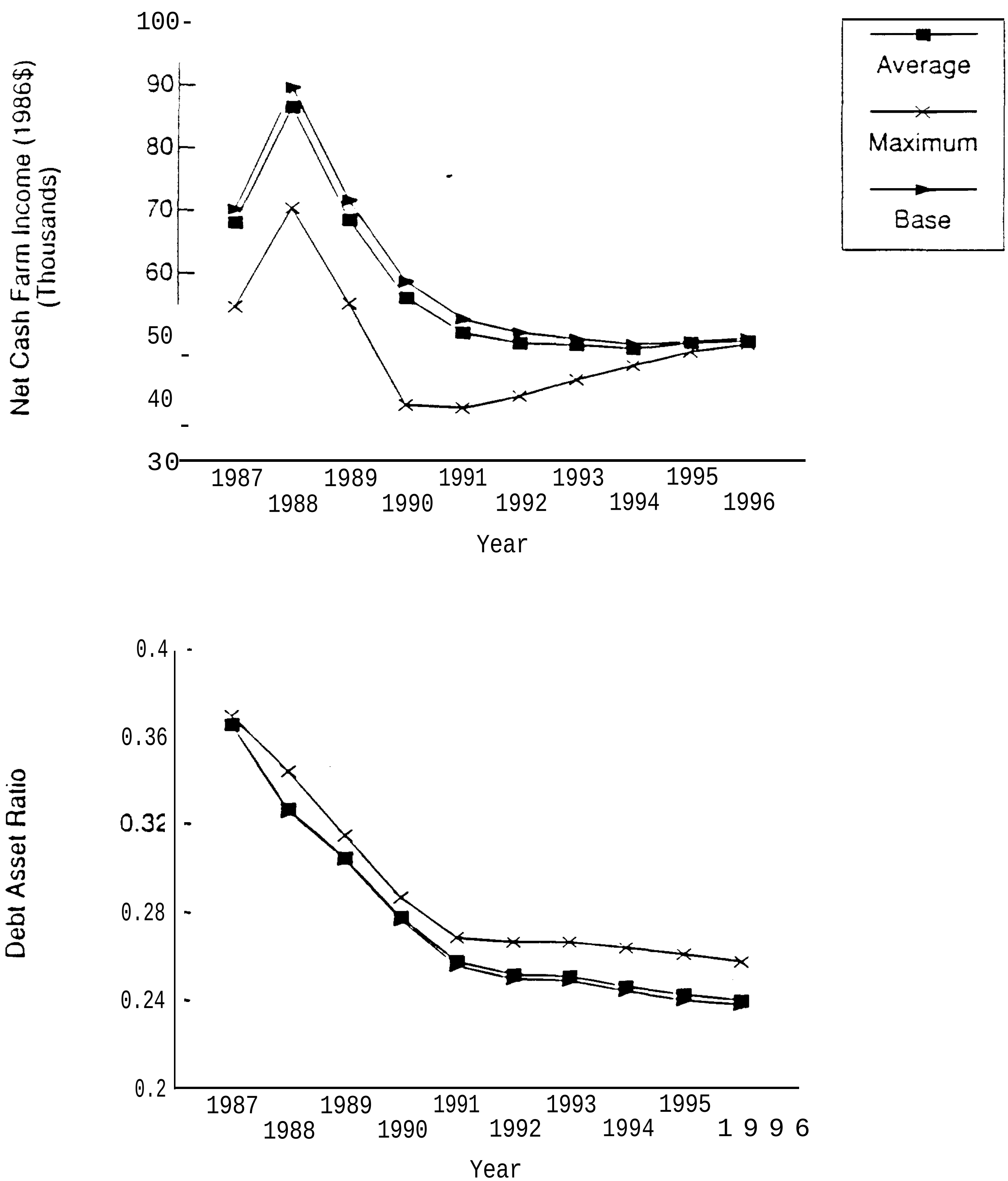


Figure D-7. EPA impacts on net cash farm income and debt asset ratio for a representative ,Mississippi cotton soybean farm in average financial condition: Scenario 1

MS Cotton Soybean Farm: Scenario 1

Vulnerable Financial Condition

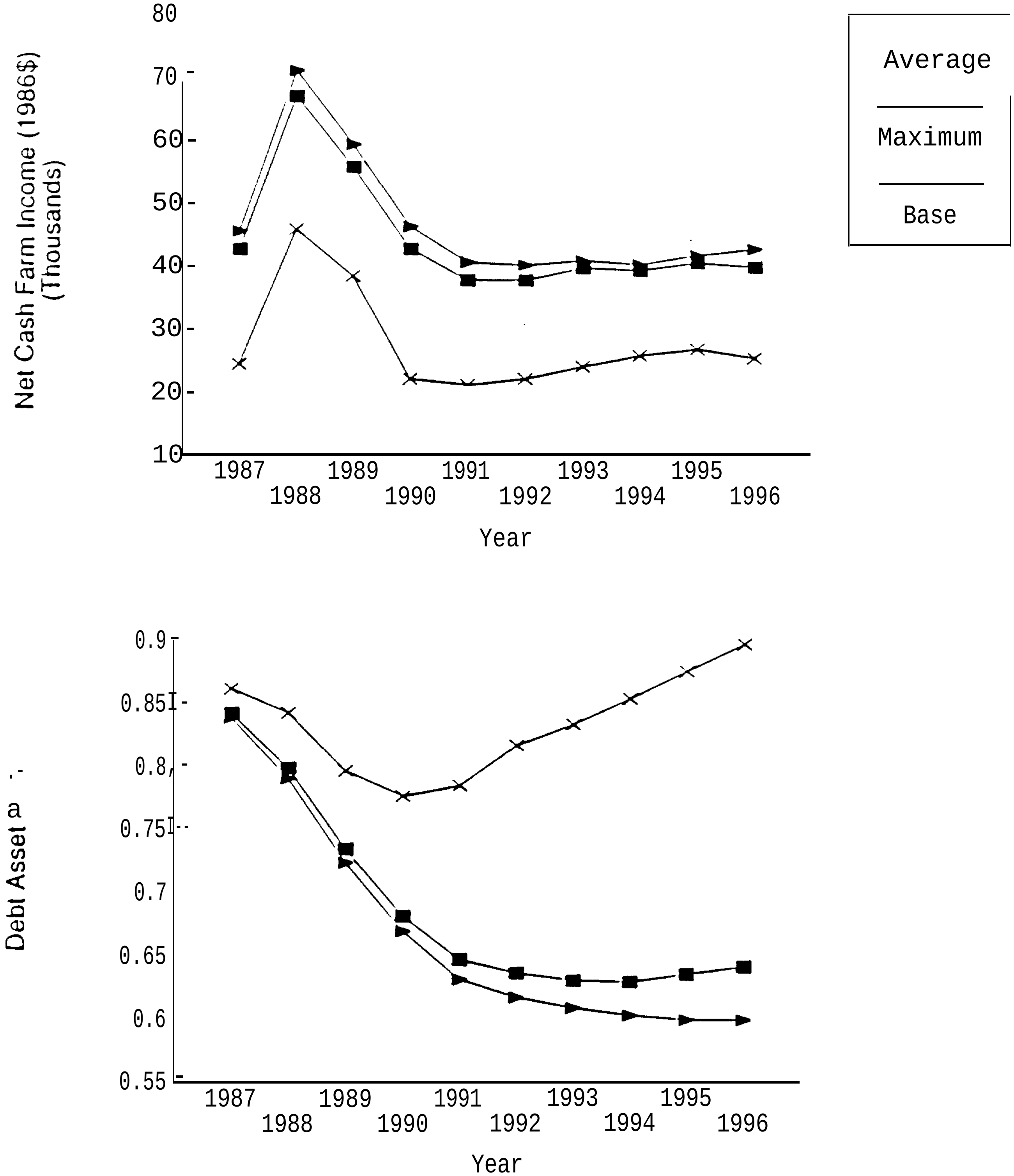
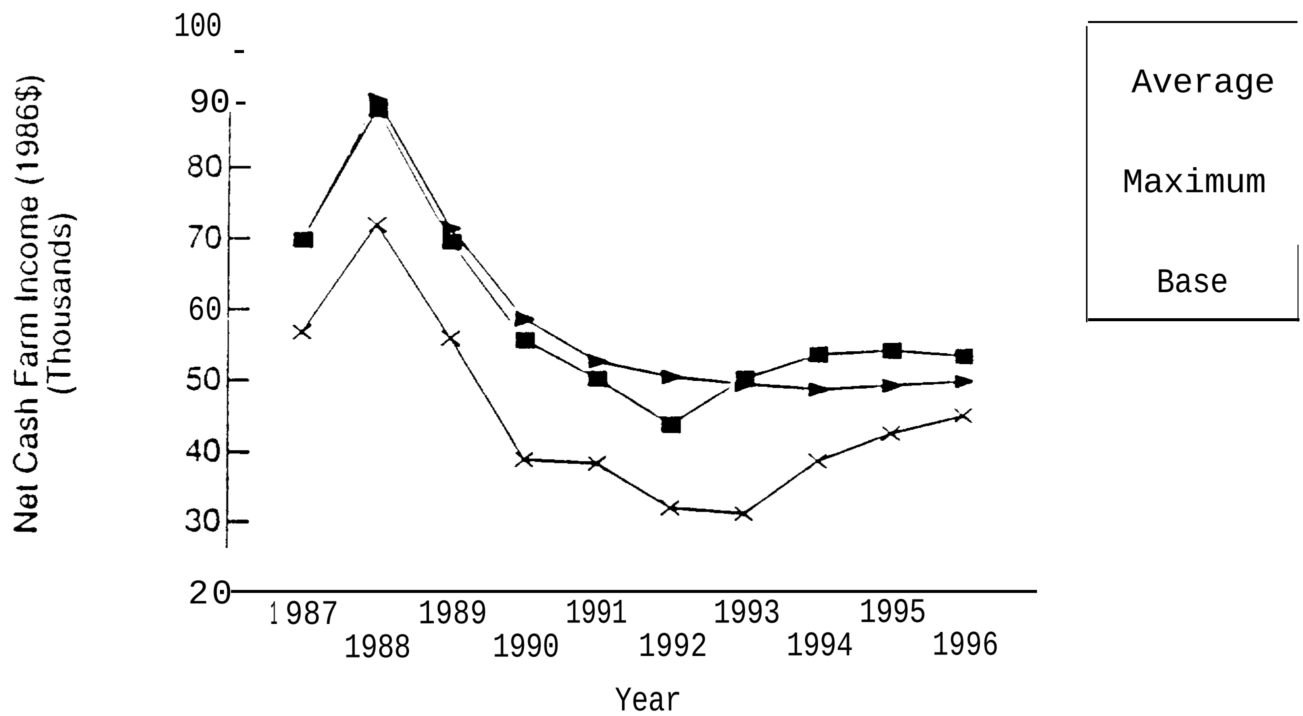


Figure D-8. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in vulnerable financial condition: Scenario 1

MS Cotton Soybean Farm: Scenario 2

Average Financial Condition



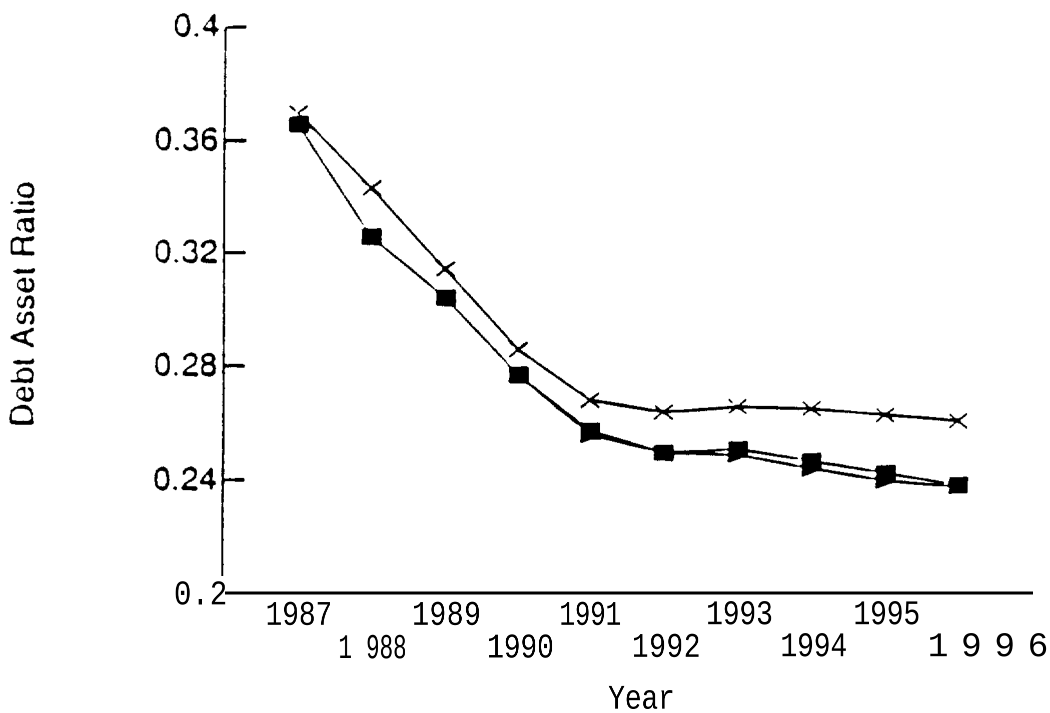


Figure D-9. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in average financial condition: Scenario 2

MS Cotton Soybean Farm: Scenario 2

Vulnerable Financial Condition

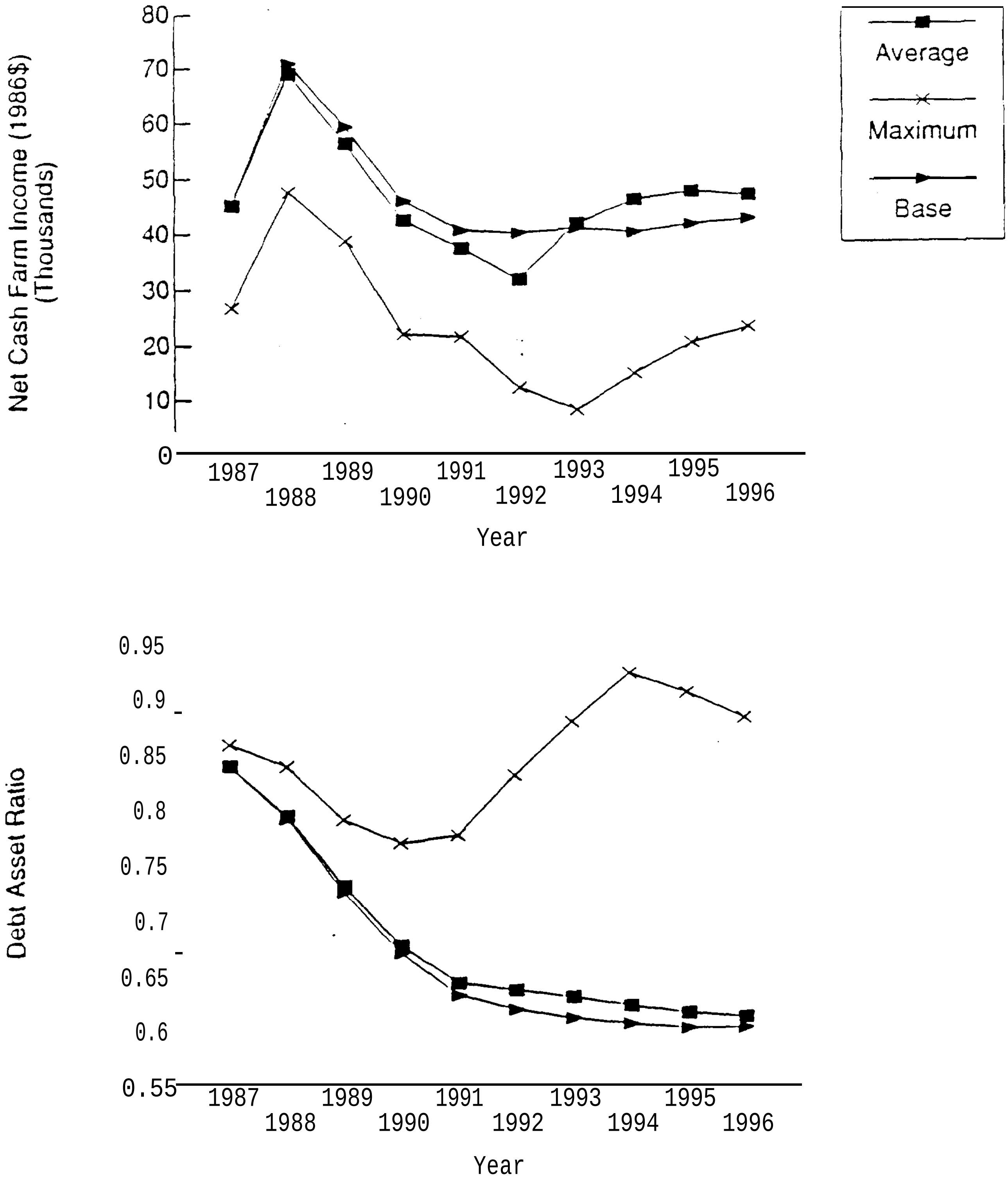


Figure D-10. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in vulnerable financial condition: Scenario 2

MS Cotton Soybean Farm: Scenario 3

Average Financial Condition

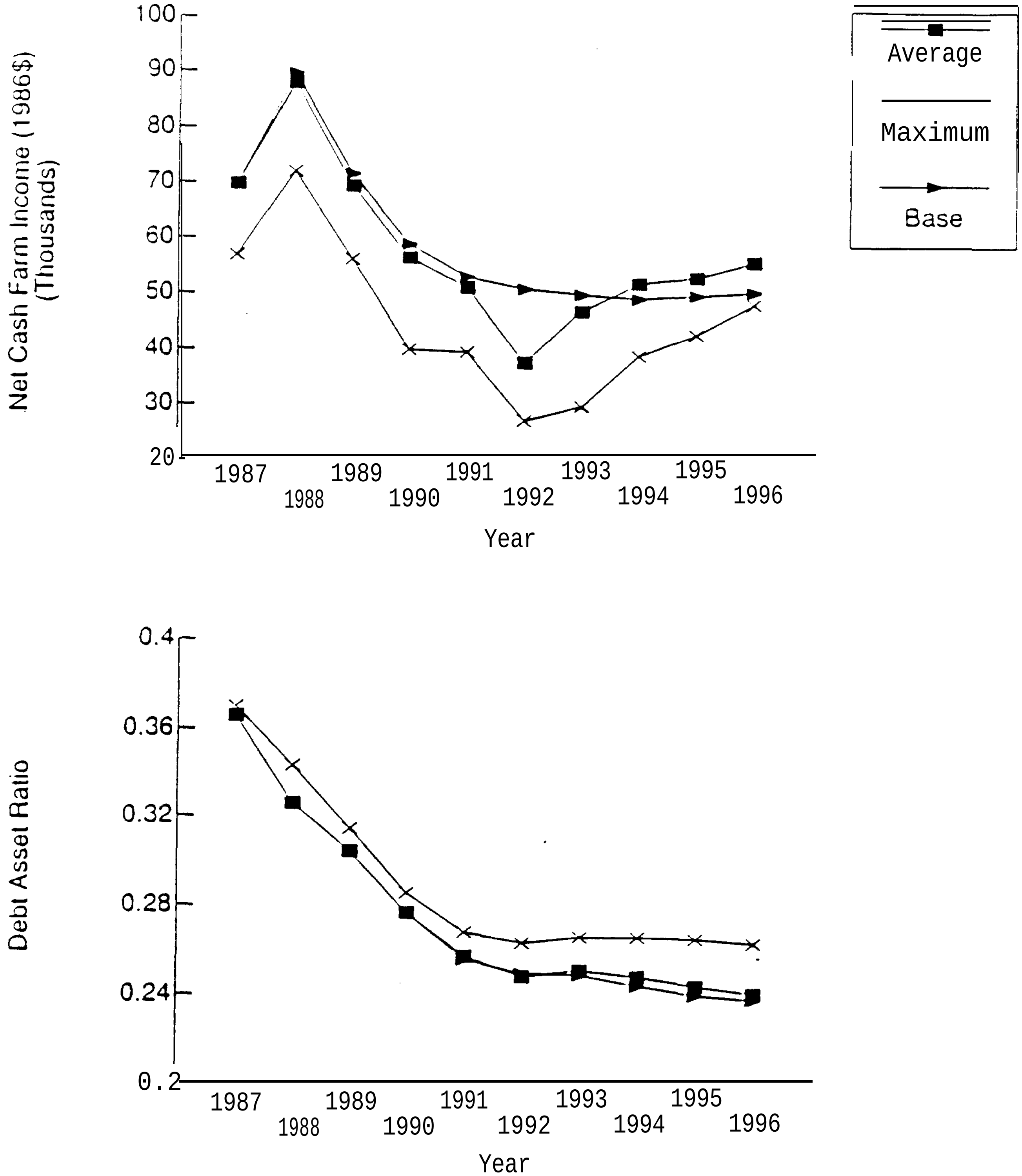
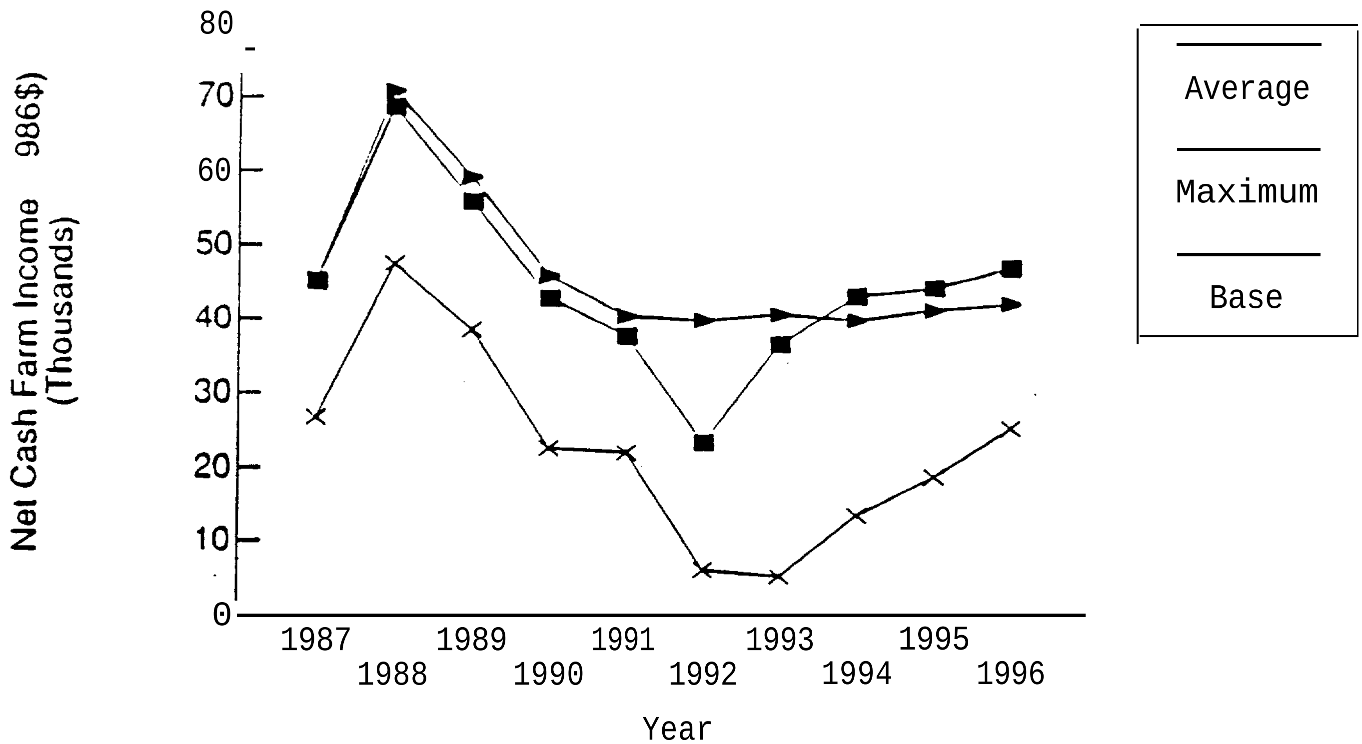


Figure D-11. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in average financial condition: Scenario 3

MS Cotton Soybean Farm: Scenario 3

Vulnerable Financial Condition



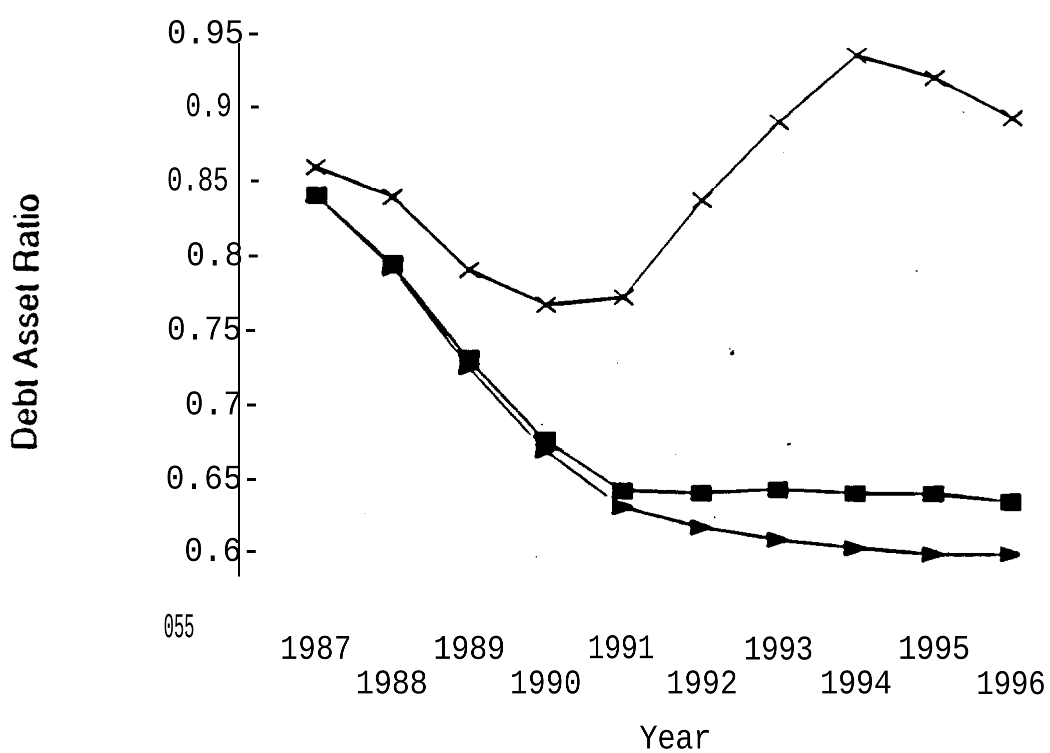
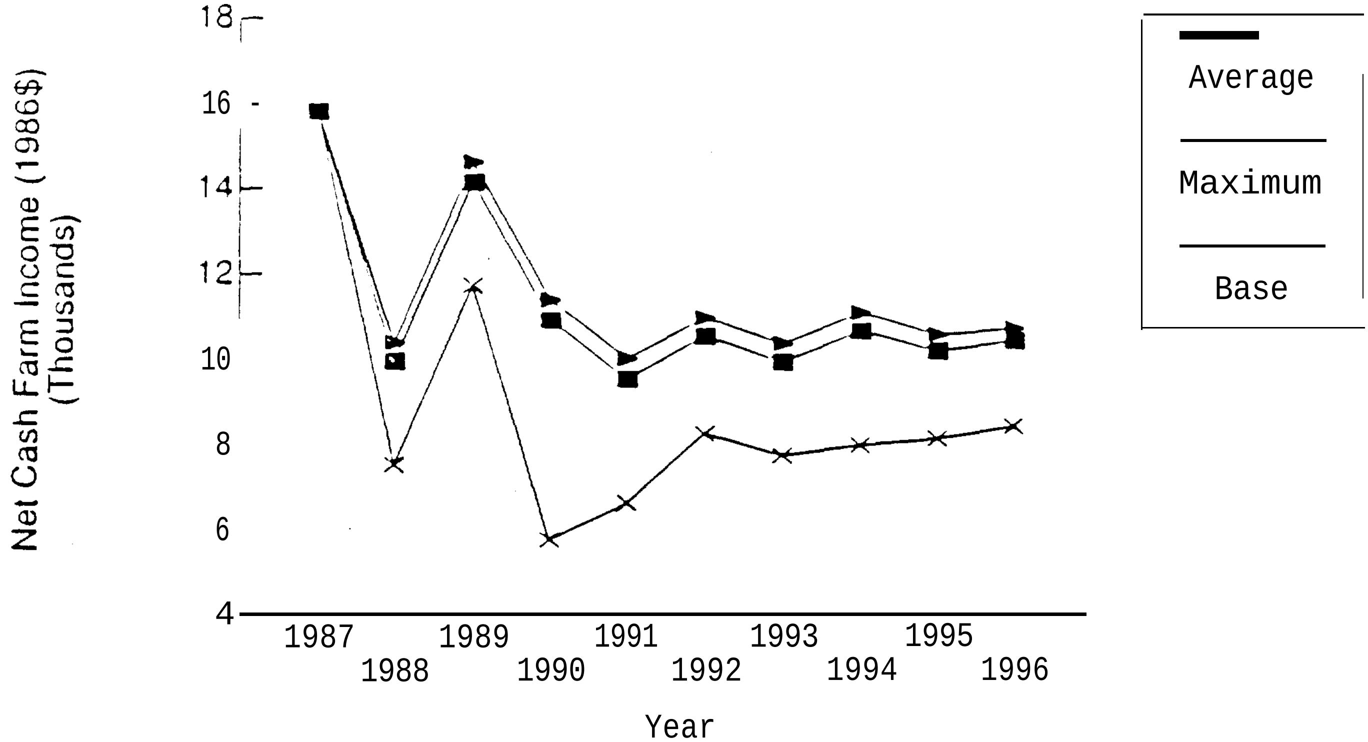


Figure D-12. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in vulnerable financial condition: Scenario 3

Kansas Wheat Cattle Farm: Scenario 1

Average Financial Condition



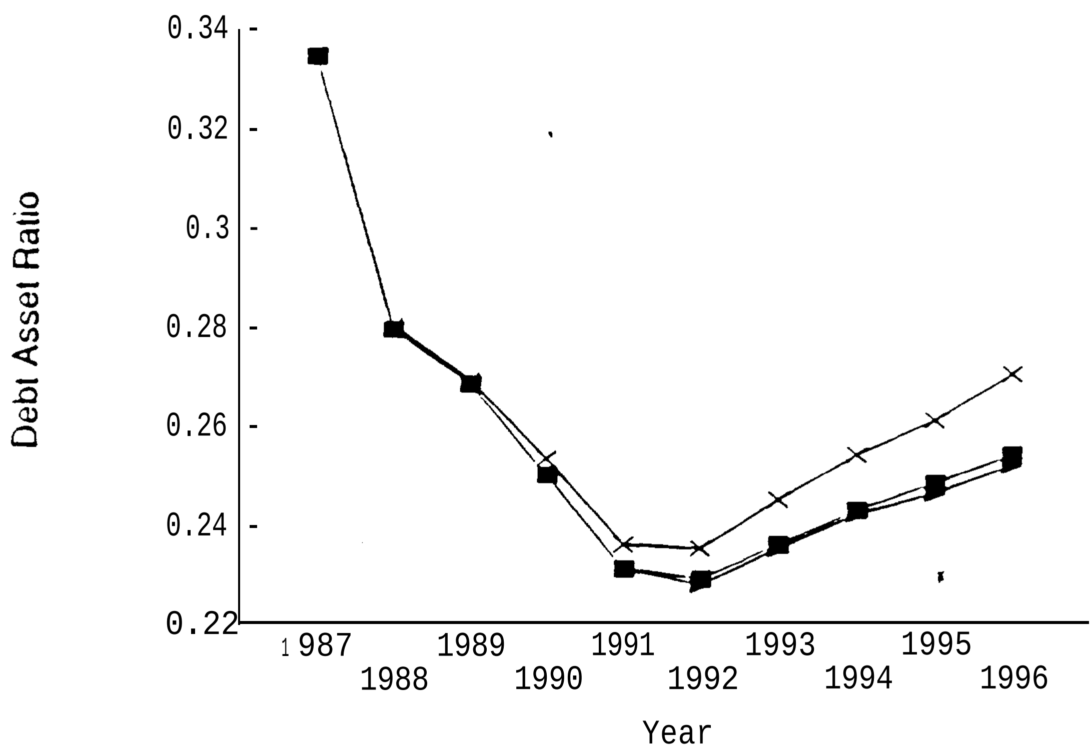


Figure D-13. EPA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in average financial condition: Scenario 1

Kansas Wheat Cattle Farm: Scenario 1

Vulnerable Financial Condition

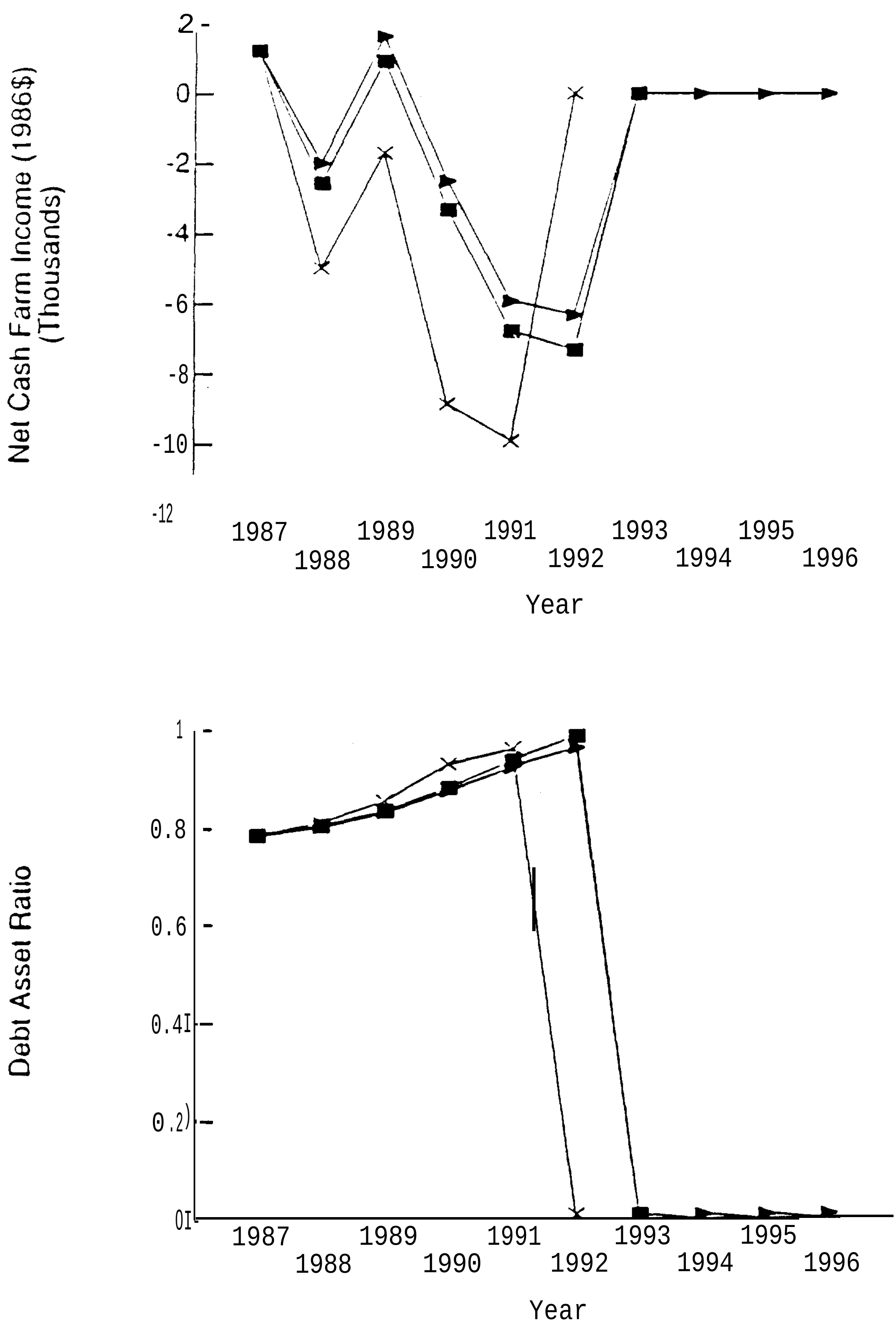


Figure D-14. EPA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in vulnerable financial condition: Scenario 1

Kansas Wheat Cattle Farm: Scenario 2

Average Financial Condition

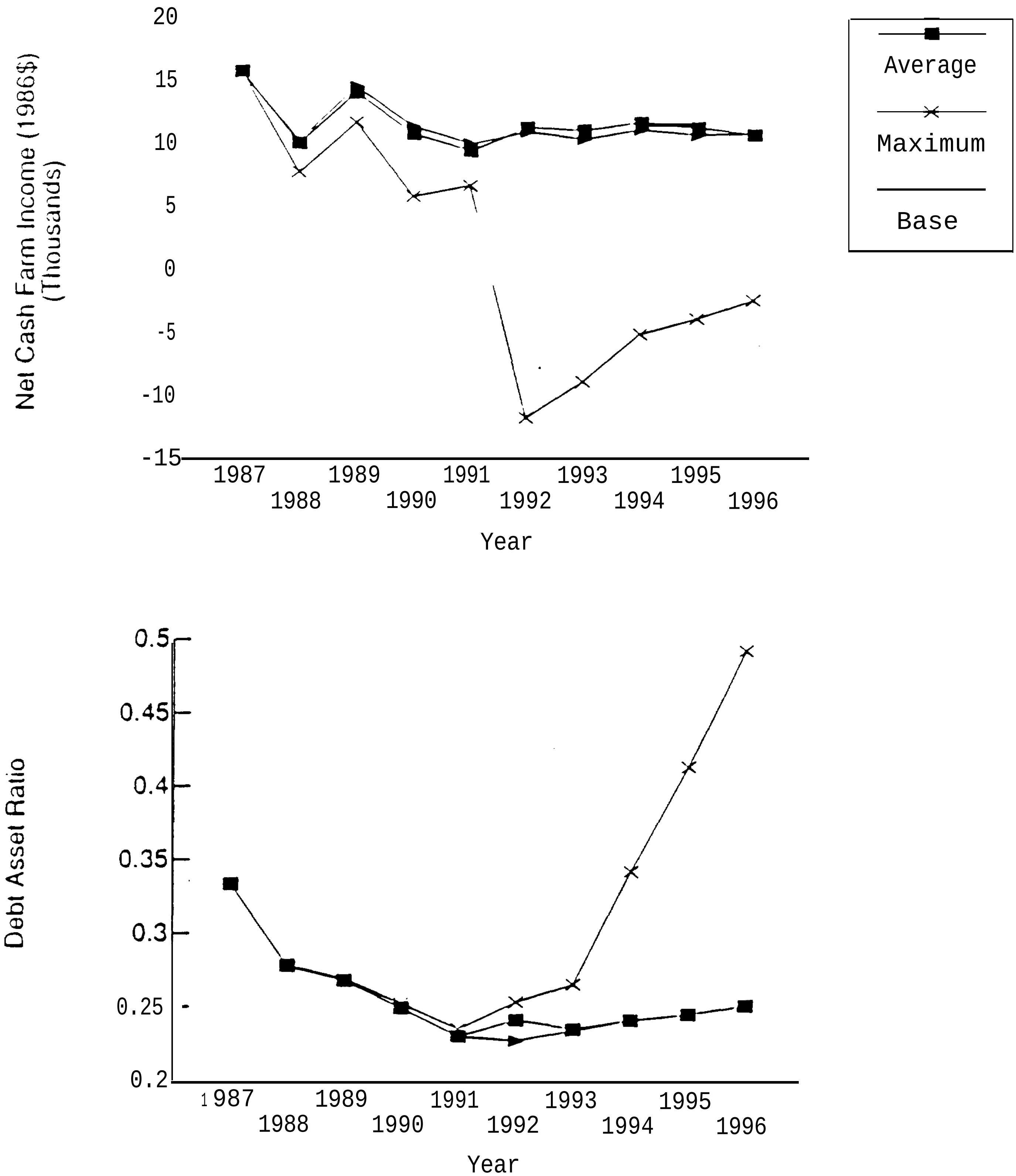


Figure D-15. EPA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in average financial condition: Scenario 2

Kansas Wheat Cattle Farm: Scenario 2

Vulnerable Financial Condition

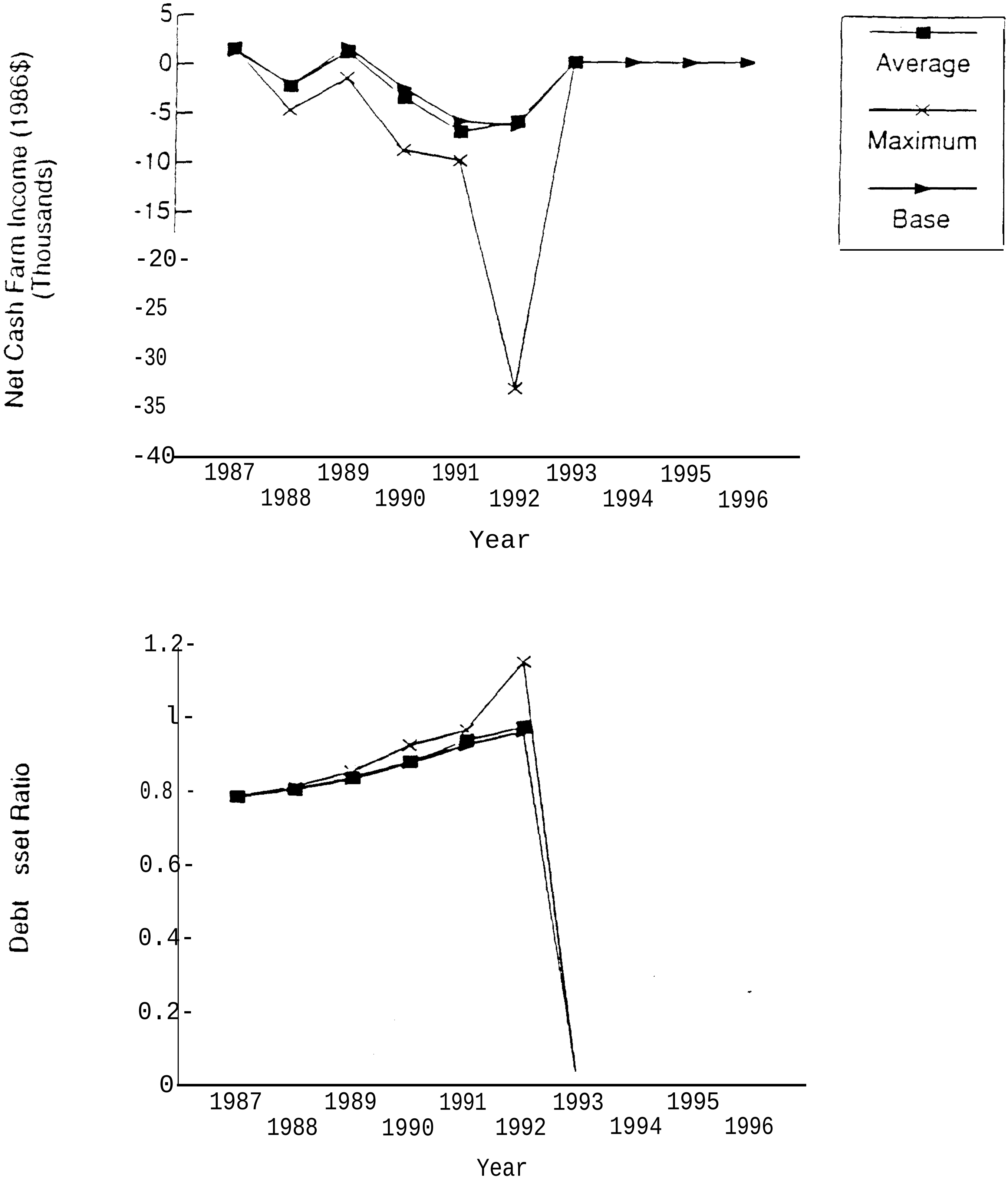


Figure D-16. WA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in vulnerable financial condition: Scenario 2

Kansas Wheat Cattle Farm: Scenario 3

Average Financial Condition

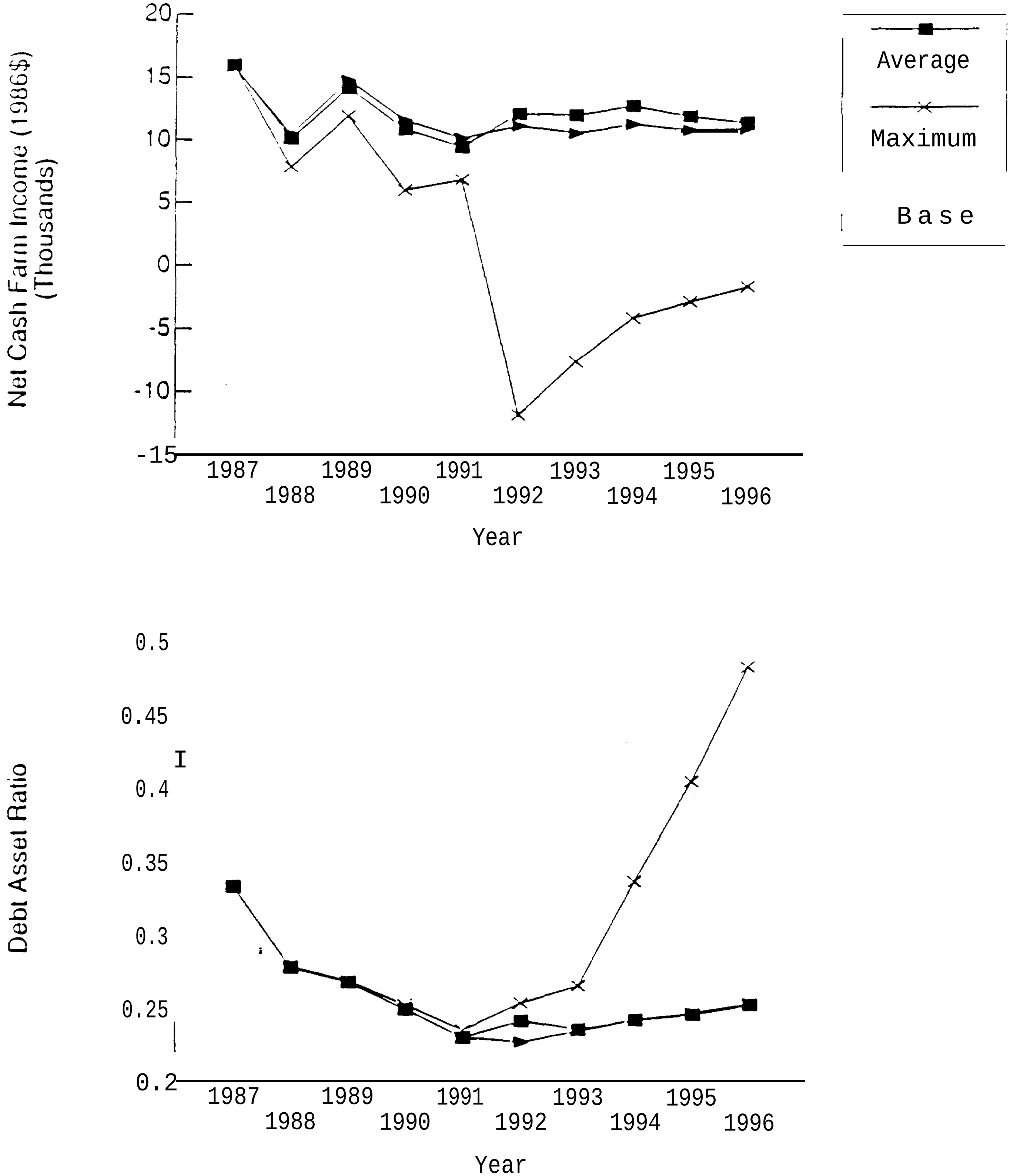
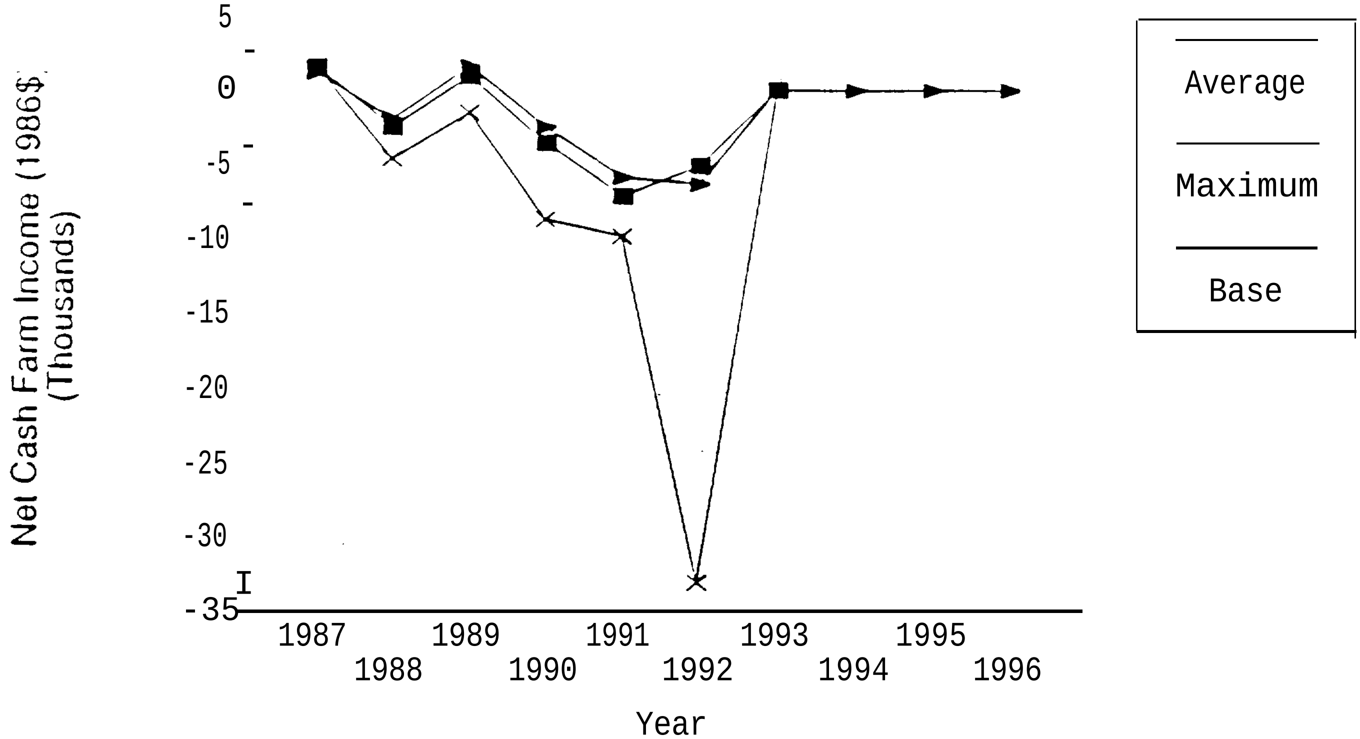


Figure D-17. EPA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in average financial condition: Scenario 3

Kansas Wheat Cattle Farm: Scenario 3

Vulnerable Financial Condition



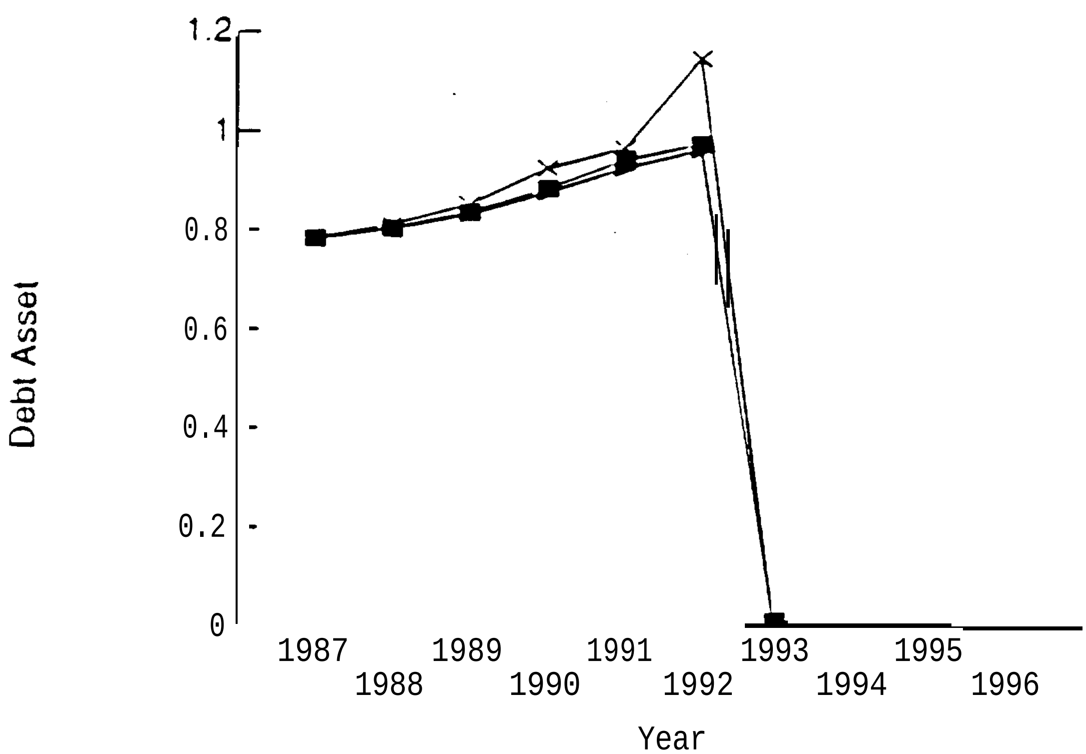


Figure D-18. EPA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in vulnerable financial condition: Scenario 3

APPENDIX E

Income Budget Analysis and Results

BY

Craig Simons
and
Roger Lloyd 1/

1/ DPRA Incorporated

Appendix E

Income Budget Analysis and Results

1.0 Budgeting Analysis

To more clearly assess regulatory impacts on an individual unit of production for a given commodity and region, a budgetinq analysis was used. Baseline conditions were defined as net returns to management and land for one acre of production prior to any regulatory action. These conditions were calculated from regional production cost and yield estimates and national price estimates. Total production cost estimates were obtained from crop enterprise budgets compiled by the USDA Cooperative Extension Service in each appropriate state. Crop enterprise budgets typically categorize total costs as variable and fixed. Variable costs are those which vary according to the level of production. Fixed costs are those which (in the short run) are unrelated to production levels.

Enterprise budgets vary in their treatment of expensing the cost of owner provided inputs. For this study, the cost of owner provided land and management were excluded. Any net returns would then be attributable to these factors of production. To the extent possible, all budgets were adjusted to be comparable. In instances where a production region consisted of two or more states (e.g., Idaho and Washington potatoes) a production weighted total cost of production was calculated. All costs were adjusted by the Index of Prices Paid by Farmers to reflect 1986 dollars.

The baseline-conditions were then adjusted by the cost and yield impact estimates and the national price change estimates (developed from the national price-quantity model and adjusted for regional differences) to estimate the post-impact net returns per acre for each regulatory scenario by region and crop. It is expected net returns per acre will typically decrease from the influence of regulatory impacts because of:

1. increased variable costs per acre of production, and
2. decreases in yield which lowers production and thus lowers revenue per acre.

Ameliorating these negative effects on net revenue would be an increase in price caused by a national decline in supply due to decreased production nationwide.

Algebraically, the farm income budgeting model can be expressed as:

$$NR_i = NR_o + dTR - dC.$$

Since TR is dependent on price and production,

$$dTR = P_iQ_i - P_oQ_o.$$

Thus,

$$NR_i = NR_o + P_iQ_i - P_oQ_o - d C .$$

Where:

NR_i = Net returns per acre of commodity production after the regulatory scenario,

NR_o = Net returns per acre or commodity production before the regulatory scenario,

dTR = change in total revenue,

dC = change in total costs,

P_i = commodity price after the regulatory scenario,

P_O = commodity baseline price

Q_i = commodity production per acre after the regulatory scenario, and

Q_o = commodity production per acre under baseline conditions.

2.0 Data Inputs

Production cost estimates and baseline net returns for each specialty crop production region (Table E-l) along with an estimate of an average price and production (Appendix C, Table C-l) were required to complete this analysis. Regional estimates of average and maximum variable cost and yield changes associated with environmental regulations for each specialty crop under each scenario were provided by EPA. First year production cost and yield changes are presented in Tables E-2 through E-5.

3.0 Model Results

Regulatory impacts on net returns which consider effects on product price, quantity of production and production costs are presented graphically in Figures E-l through E-9. Average and maximum impacts are measured from a baseline net return (no regulatory impact) for each of the specialty crops under the three policy scenarios.

Table E-1.
Base line production costs and net returns

Crop/Region	Per acre production costs: Variable costs	Fixed costs	Total costs	Baseline net returns
		(1986$)		
Irish Potatoes				
ID - WA	983.14	229.22	1,212.36	606.00
ND - MN	332.90	235.19	568.09	243.00
ME	762.67	149.88	912.55	134.00
Green Peas				
WI	132.35	47.20	179.55	197.00
WA	245.81	59.68	314.49	78.00
Apples				
WA	2,593.41	897.66	3,491.07	327.00
NY	1,785.00	162.07	1,947.07	217.00
MI	1,112.70	544.44	1,657.14	76.00
Peanuts 1/				
GA - AL	322.16	126.84	449.00	286.00
NC - VA	338.65	185.98	524.63	386.00
TX - OK	222.27	88.99	311.26	186.00
Caneberries (Red Raspberries)				
WA	3,274.21	1,588.81	4,863.02	NA
OR	3,962.45	1,922.78	5,885.23	NA
Tomatoes				
FL (Fresh)	6,310.31	351.59	6,661.90	1,510.00
CA (Processing)	1,092.05	174.50	1,266.55	659.00

1/ Net returns are for additional peanuts. Net returns for quota peanuts are $298, $444 and $206 for GA-AL, NC-VA and TX-OK, respectively.

Source: Crop enterprise budgets from the individual states.

Table E-2
Potential Impacts for Selected Apple Producers

Variable Cost: First Year Impact

Scenario	Action	Region	Cost 1/	Yield(%)	Acres(%)
1-3	Farm Worker Safety	WA	5.40	0	90
		NY	5.40	0	90
		MI	5.40	0	90
1	Organophosphates Plan I	WA	2.00	0	86
		NY	2.00	0	100
		MI	2.00	0	100
2	Organophosphates Plan II	WA	25.08	0	62
		NY	14.38	0	75
		MI	14.38	0	75
3	Organophosphates Plan III	WA	33.08	-2	86
		NY	9.39	-2	100
		MI	9.39	-2	100
1	Groundwater Plan I	WA	0.0	0	0
		NY	0.0	0	0
		MI	0.0	0	0
2	Groundwater Plan II	WA	11.83	0	5
		NY	10.90	0	10
		MI	10.90	0	10
3	Groundwater Plan II	WA	11.83	0	25
		NY	10.90	0	45
		MI	10.90	0	45
1	Fungicides Plan I	WA	0.0	0	0
		NY	0.0	0	0
		MI	0.0	0	0
2	Fungicides Plan II	WA	0.0	0	0
		NY	-13.06	-20	83
		MI	-13.06	-20	58
3	Fungicides Plan II	WA	0.0	0	0
		NY	-13.06	-20	83
		MI	-13.06	-20	58

Continued...

Table E-2 (continued)

Fixed costs:

Scenario	Action	Impact
l-3	SARA Title III Section 302-304	cost = $50/covered farm. Assumed l/3 of all farms covered.
l-3	Enclosed Cabs	Cost = $2,500. Assumed l/3 of all cabs must be enclosed.
l-3	Underground Storage Tanks	Some farms may incur costs due to Underground Storage Tank regulations, however, due to the significant amount of uncertainty as to whether specialty crop farms would have covered UST's. These costs were not included.
3	Lead Phasedown	Under a total ban of lead in gasoline for agricultural use, farmers having gasoline powered tractors, combines, and trucks may incur a cost to rebuild the valves. This cost would be approximately $1,000 for a combine and a truck, and $750 for a tractor. These costs were not included in the budget analyses for apple producers.

1/ Cost per acre (1986$)

Table E-3
Potential Impacts for Selected Potato Producers

Variable Cost: First Year Impacts

Scenario	Action	Region	Cost 1/	Yield(%)	Acres(%)
1-3	EDB Cancellation	WA/ID	16.80	0	2.2
		MN/ND	18.48	0	1.1
		ME	18.48	0	1.1
1-3	Dinoseb Cancellation	WA/ID	8.51	0	50.0
		MN/ND	8.51	0	50.0
		ME	8.51	0	50.0
l-3	Farm Worker Safety	WA/ID	1.43	0	90.0
		MN/ND	1.43	0	90.0
		ME	1.43	0	90.0
1	Groundwater Plan I	WA/ID	0.00	0	0.0
		MN/ND	10.00	0	3.5
		ME	11.00	0	'1.9
2	Groundwater Plan II	WA/ID	0.00	0	0.0
		MN/ND	10.00	0	3.5
		ME	11.00	0	1.9
3	Groundwater Plan III	WA/ID	39.13	0	12.4
		MN/ND	10.00	0	14.6
		ME	11.00	0	7.5
1	Organophosphates Plan I	WA/ID	1.00	0	74.0
		MN/ND	1.00	0	74.0
		ME	1.00	0	74.0
2	Organophosphates Plan II	WA/ID	5.88	0	68.0
		MN/ND	5.88	0	68.0
		ME	5.88	0	68.0
3	Organophosphates Plan III	WA/ID	7.00	-8	74.0
		MN/ND	7.00	-8	74.0
		ME	7.00	-8	74.0
1	Fungicides I	WA/ID	0.00	0	0.0
		MN/ND	0.00	0	0.0
		ME	0.00	0	0.0
2	Fungicides II	WA/ID	8.81	0	7.0
		MN/ND	6.61	0	54.0
		ME	11.05	0	80.0

Continued.

Table E-3 (continued)

3	Fungicides III	WA/ID	-0.60	-8	12.0
		MN/ND	-0.45	-8	80.0
		ME	-0.75	-8	80.0

Fixed costs:

Scenario	Action	Impact
1-3	SARA Title III Section 302-304	cost = $50/covered farm. Assumed l/3 of all farms covered.
l-3	Enclosed Cabs	cost = $2,500. Assumed l/3 of all cabs must be enclosed.
l-3	Underground Storage Tanks	Some farms may incur costs due to Underground Storage Tank-regulations, however, due to the significant amount of uncertainty as to whether specialty crop farms would have covered UST's. These costs were not included.
3	Lead Phasedown	Under a total ban of lead in gasoline for agricultural use, farmers having gasoline powered tractors, combines, and trucks may incur a cost to rebuild the valves. This cost would be approximately $1,000 for a combine and a truck, and $750 for a tractor. These costs were not included in the budget analyses for potato producers.

1/ Cost per acre (1986$)

Table E-3
Potential Impacts for Selected Pea Producers

Variable Costs: First Year Impacts

Scenario	Action	Region	Cost 1/	Yield(%)	Acres(%)
1-3	Dinoseb Cancellation	WA	10.40	0	75
		WI	0.00	0	0
1-3	Farm Worker Safety	WA	0.86	0	90
		WI	0.86	0	90
1	Organophosphates Plan I	WA	1.00	0	30
		WI	1.00	0	30
2	Organophosphates Plan II	WA	2.92	0	30
		WI	2.92	0	30
3	Organophosphates Plan III	WA	3.08	0	35
		WI	3.08	0	35

Fixed costs:

Scenario	Action	Impact
1-3	SARA Title III Section 302-304	cost = $50/covered farm. Assumed 1/3 of all farms covered.
1-3	Enclosed Cabs	Cost = $2,500. Assumed 1/3 of all cabs must be enclosed.
1-3	Underground Storage Tanks	Some farms may incur costs due to Underground Storage Tank regulations, however, due to the significant amount of uncertainty as to whether specialty crop farms would have covered UST's. These costs were not included.

Continued...

Table E-4 (continued)

Lead Phasedown	Under a total ban of lead in gasoline for agricultural use, farmers having gasoline powered tractors, combines, and trucks may incur a cost to rebuild the valves. This cost would be approximately $1,000 for a combine and a truck, and $750 for a tractor. These costs were not included in the budget analyses for pea producers.

1/ Cost per acre (1986$)

Table E-5
Potential Impacts for Selected Tomato Producers

Variable Costs: First Year Impacts

Scenario	Action	Region	Cost 1/	Yield(%)	Acres(%)
1-3	EDB Cancellation	CA	22.65	0	2.9
		FL	22.65	0	2.9
1-3	Farm Worker Safety	CA	7.50	0	90.0
		FL	7.50	0	90.0
1	Fungicides Plan I	CA	0.00	0	0.0
		FL	0.00	0	0.0
2	Fungicides Plan II	CA	1.50	0	9.0
		FL	20.93	0	77.0
3	Fungicides Plan III	CA	-3.39	-20	25.0
		FL	-20.34	-20	98.0

Fixed costs:

Scenario	Action	Impact
1-3	SARA Title III Section 302-304	cost = $50/covered farm. Assumed 1/3 of all farms covered.
1-3	Enclosed Cabs	cost = $2,500. Assumed 1/3 of all cabs must be enclosed.
1-3	Underground Storage Tanks	Some farms may incur costs due to Underground Storage Tank regulations, however, due to the significant amount of uncertainty as to whether specialty crop farms would have covered UST's. These costs were not included.

Continued...

Table E-5 (continued)

3	Lead Phasedown	Under a total ban of lead in gasoline for agricultural use, farmers having gasoline powered tractors, combines, and trucks may incur a cost to rebuild the valves. This cost would be approximately $1,000 for a combine and a truck, and $750 for a tractor. These costs were not included in the budget analyses for tomato producers.

1/ Cost per acre (1986$)

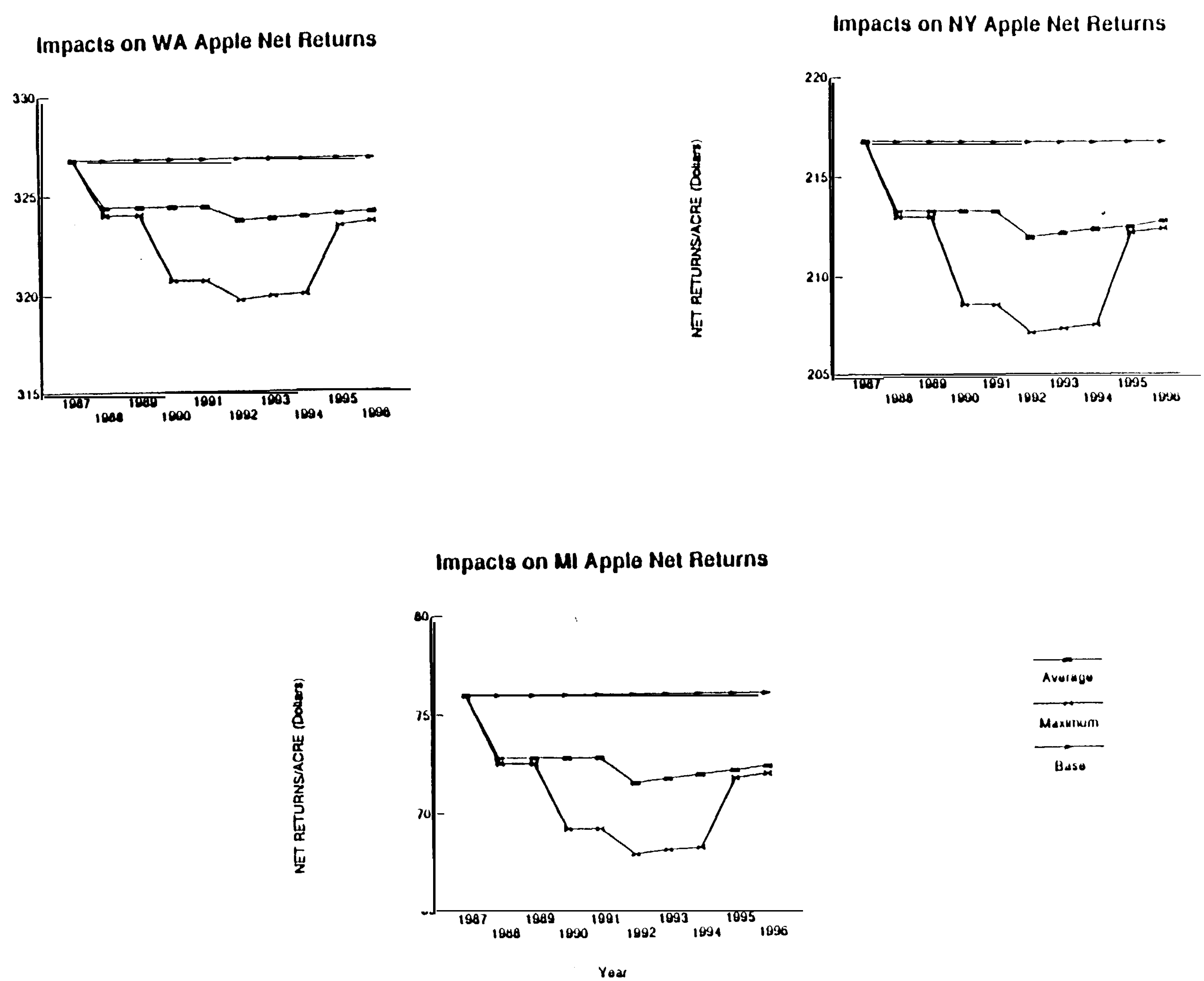


Figure E-1 Scenario 1, egulatory impacts on apple net returns

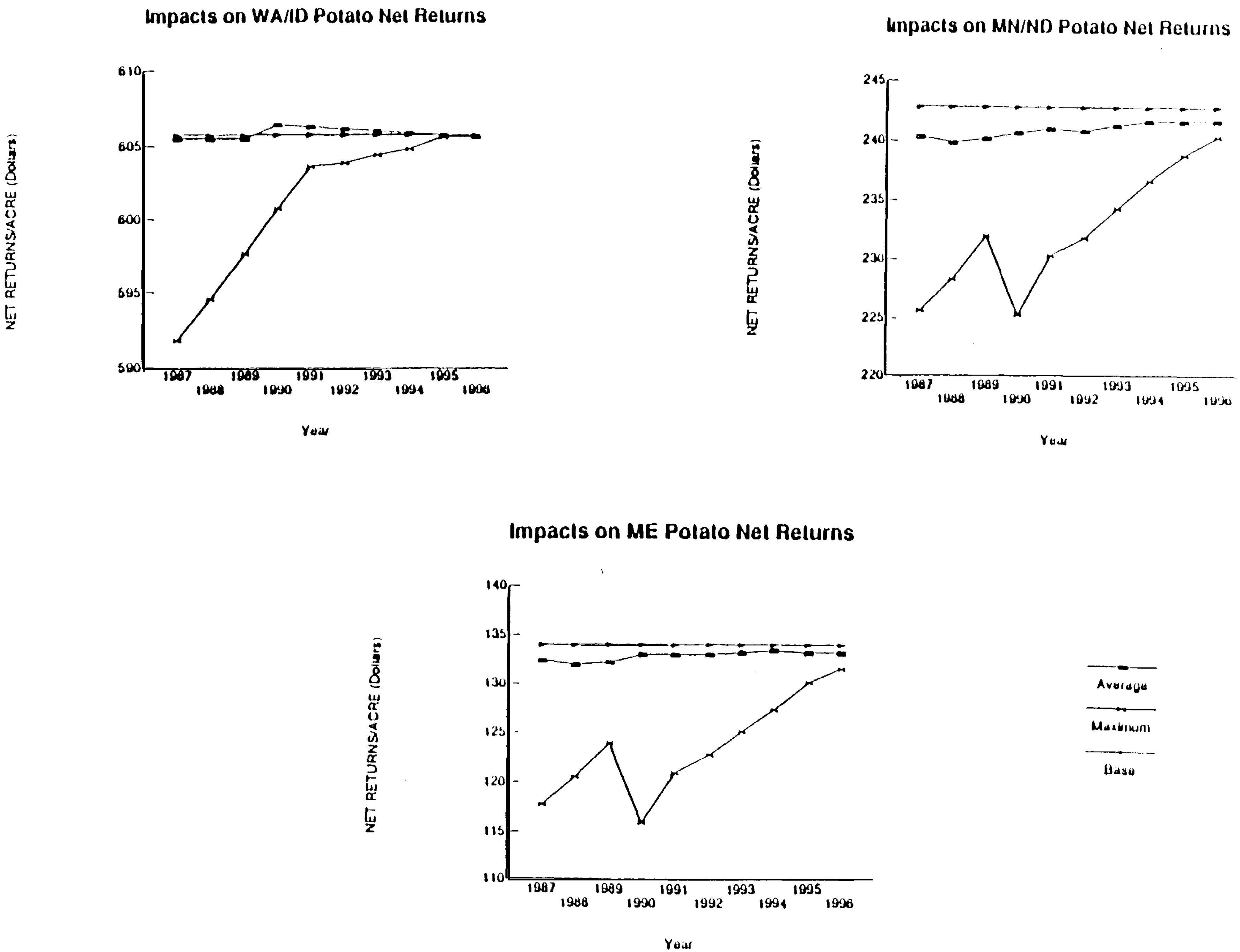
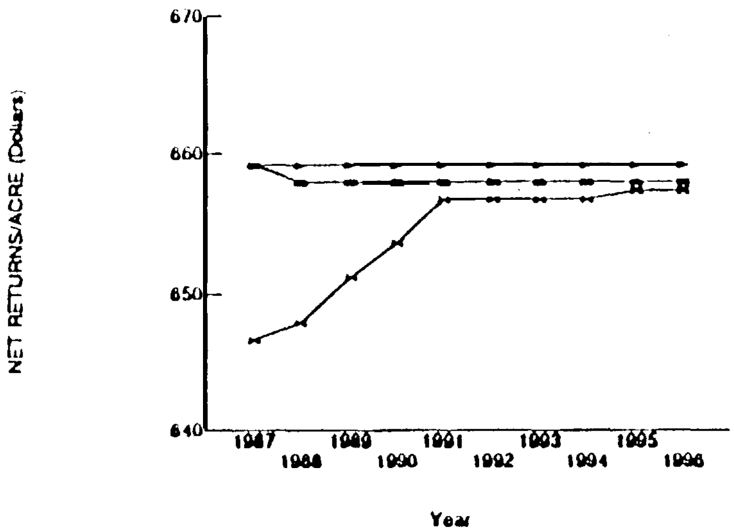
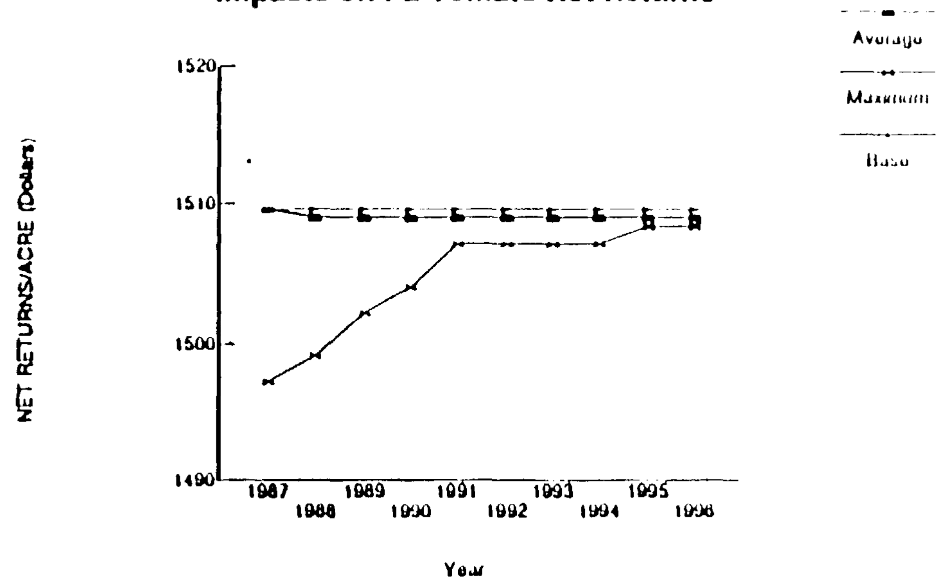


Figure E-2 Scenario regulatory impacts on potato net returns

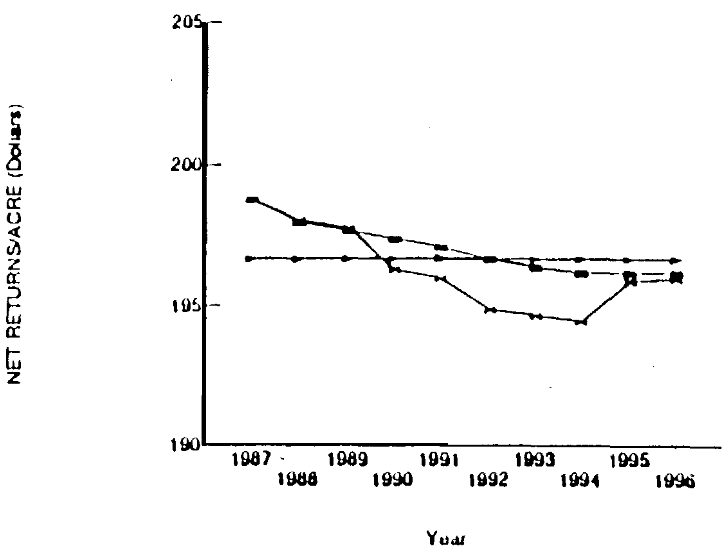
Impacts on CA Tomato Net Returns



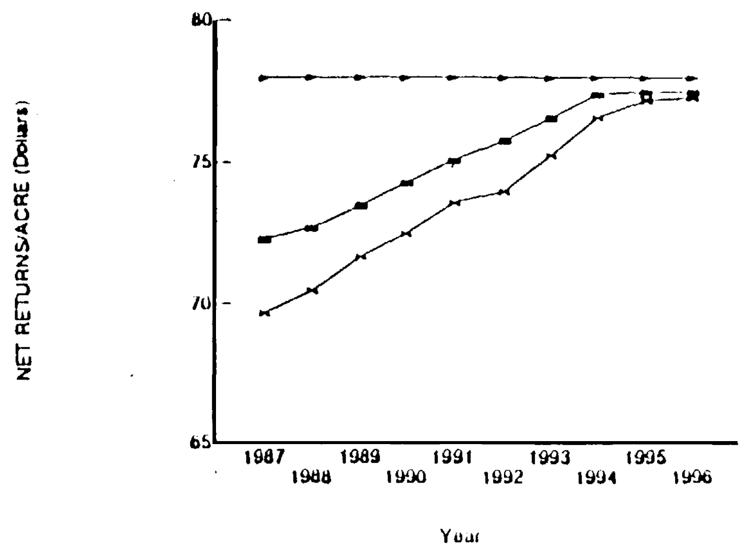
Impacts on FL Tomato Net Returns



Impacts on WI Pea Net Returns



Impacts on WA Pea Net Returns



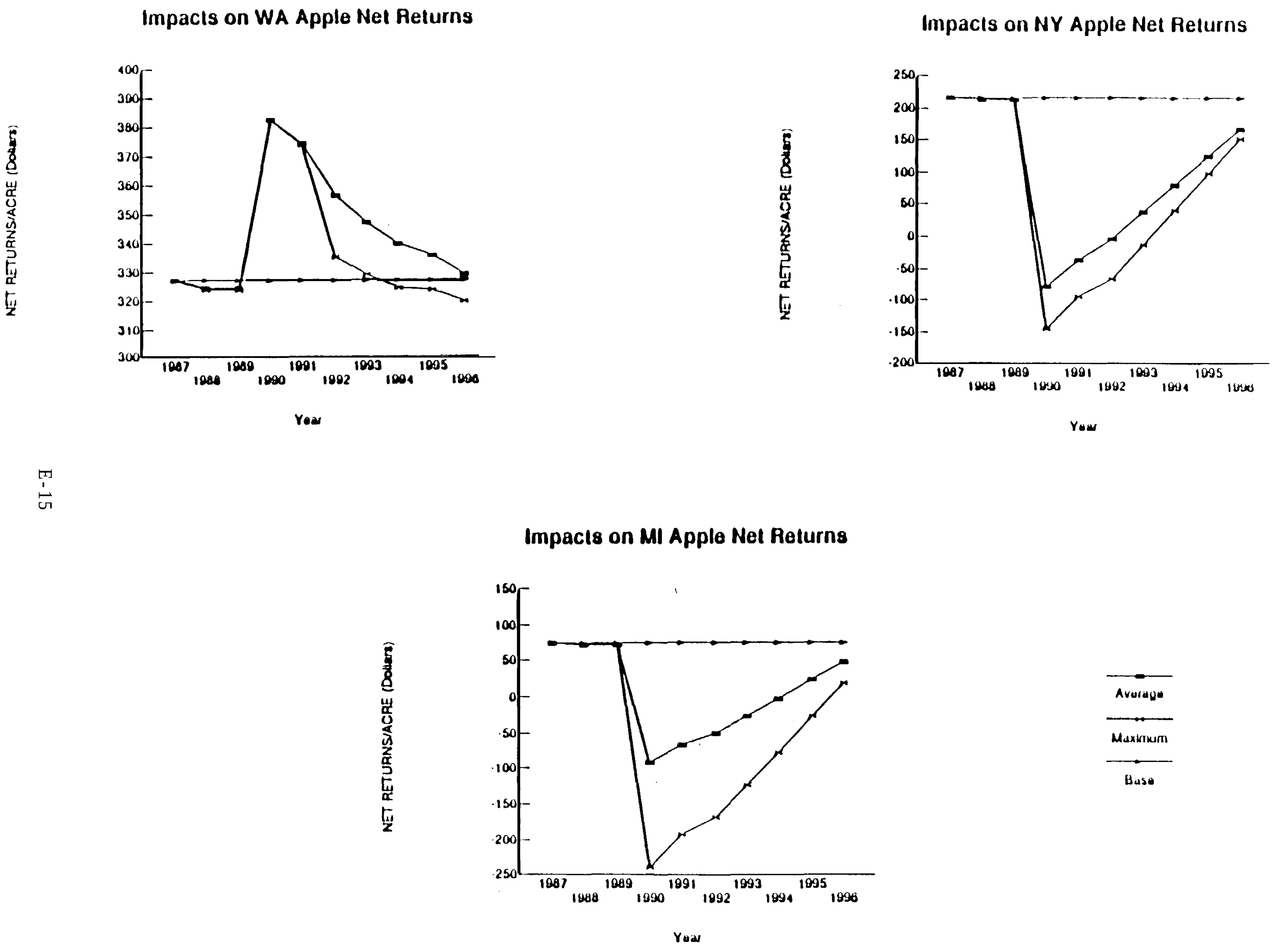
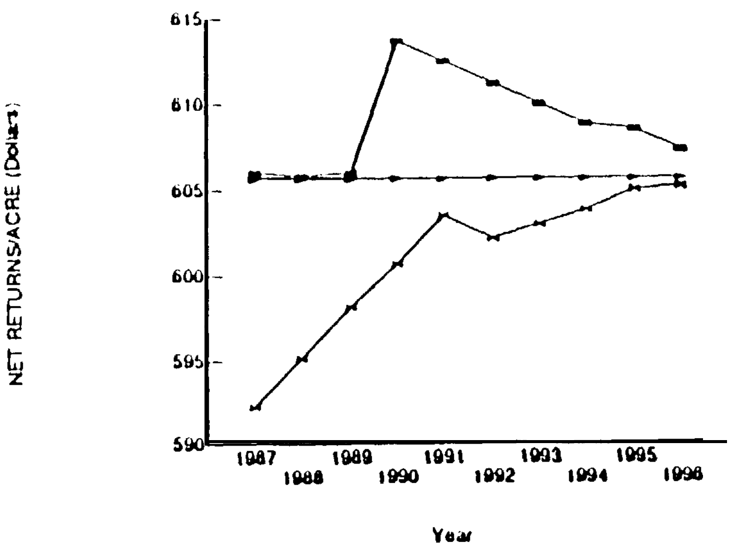
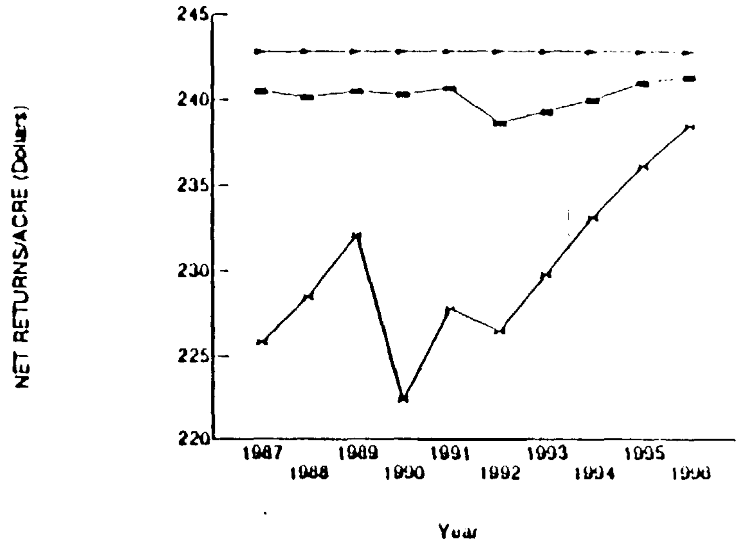


Figure E-4. Scenario 2, regulatory impacts on apple net returns

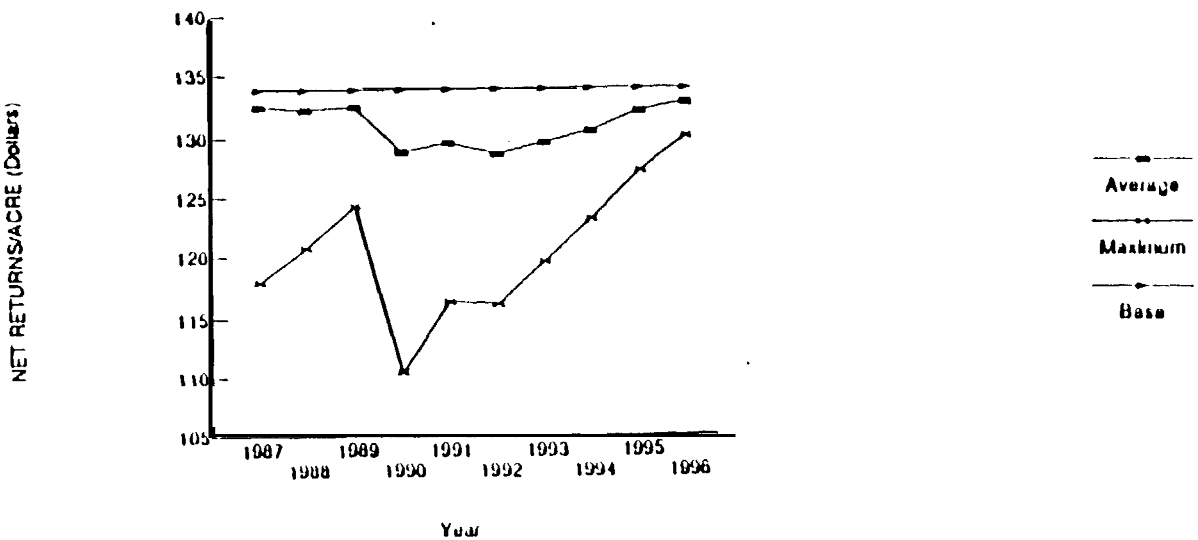
Impacts on WA/ID Potato Net Returns



Impacts on MN/ND Potato Net Returns



Impacts on ME Potato Net Returns



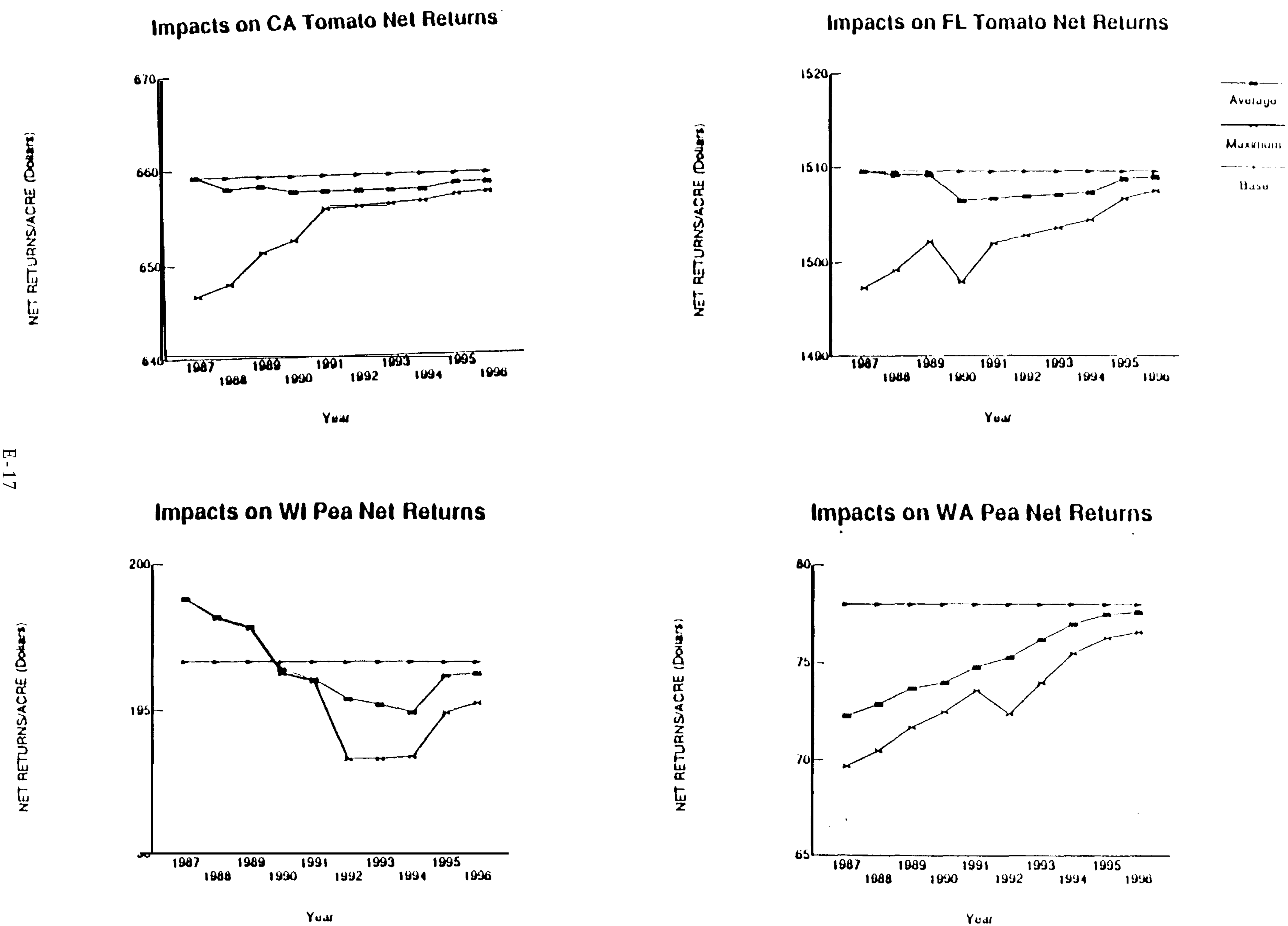
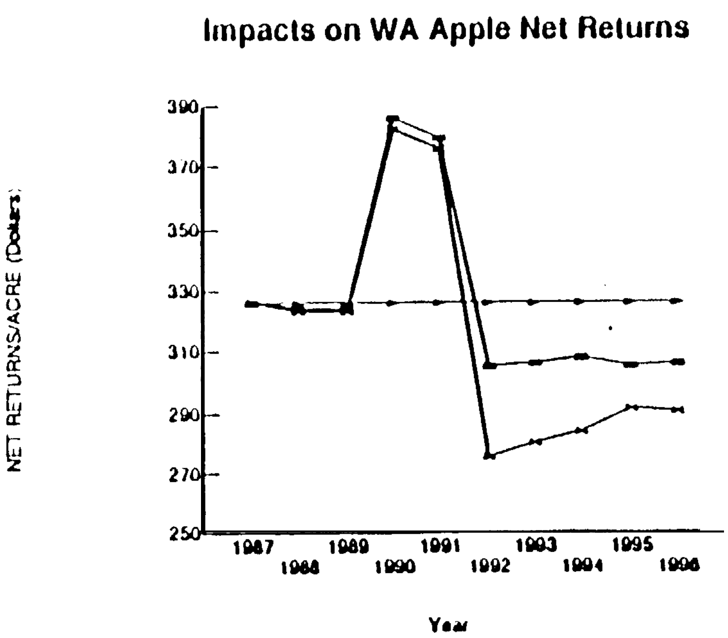
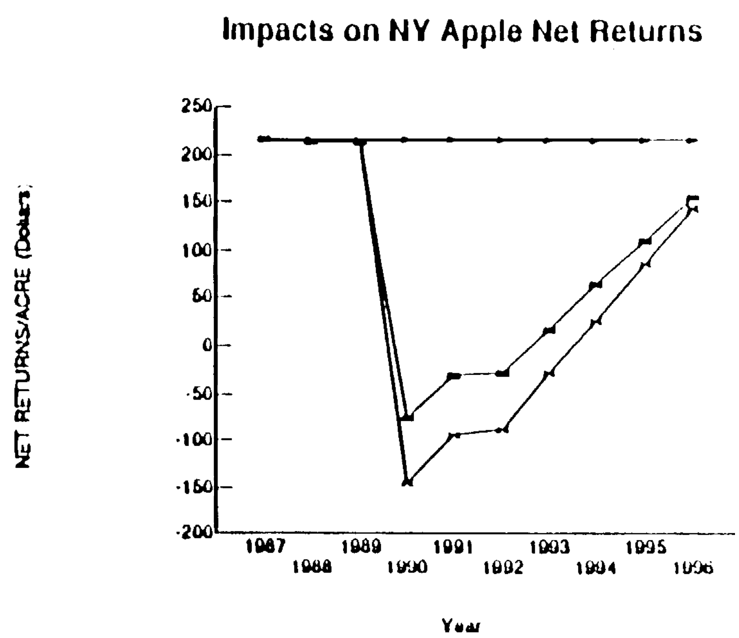


Figure E-6. Scenario 2, regulatory impacts on tomato and pea net retur





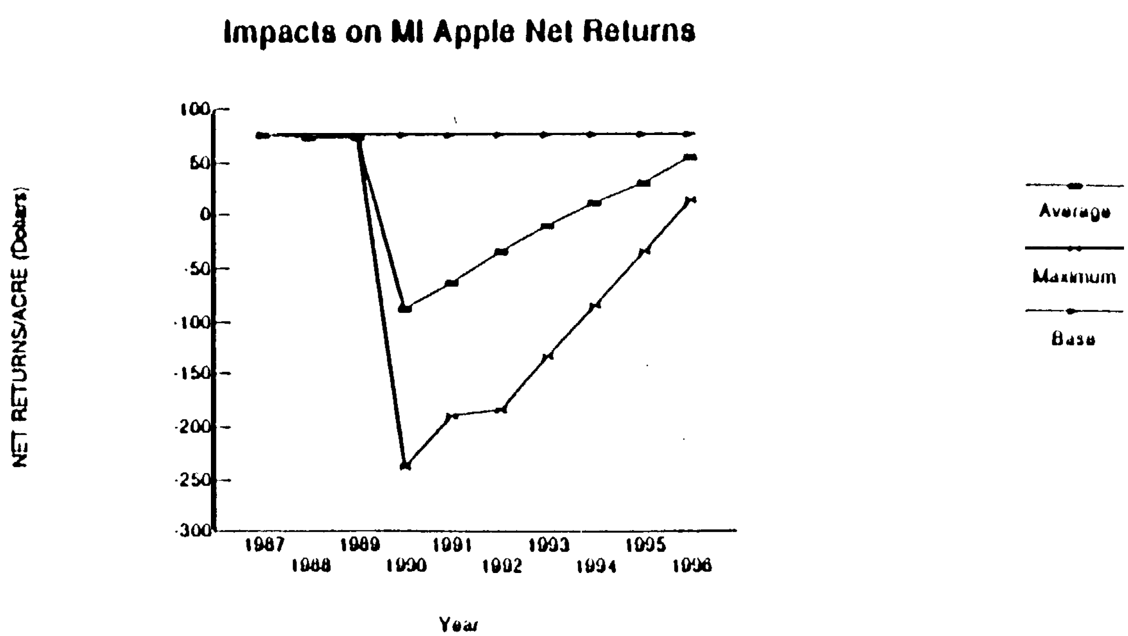


Figure E-7 3, regulatory impacts on apple net returns

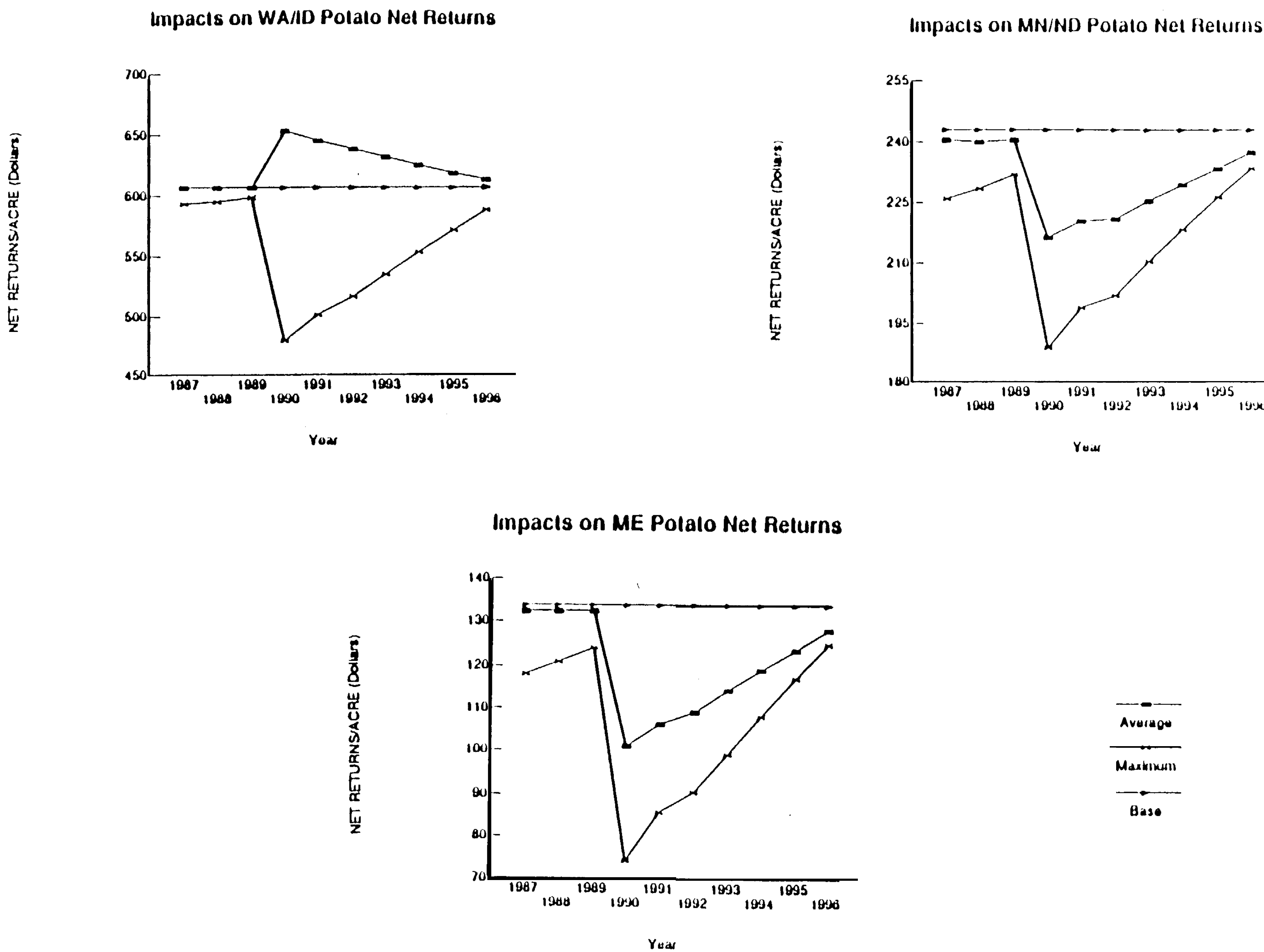


Figure E-8. Scenario 3, regulatory impacts on potato net returns

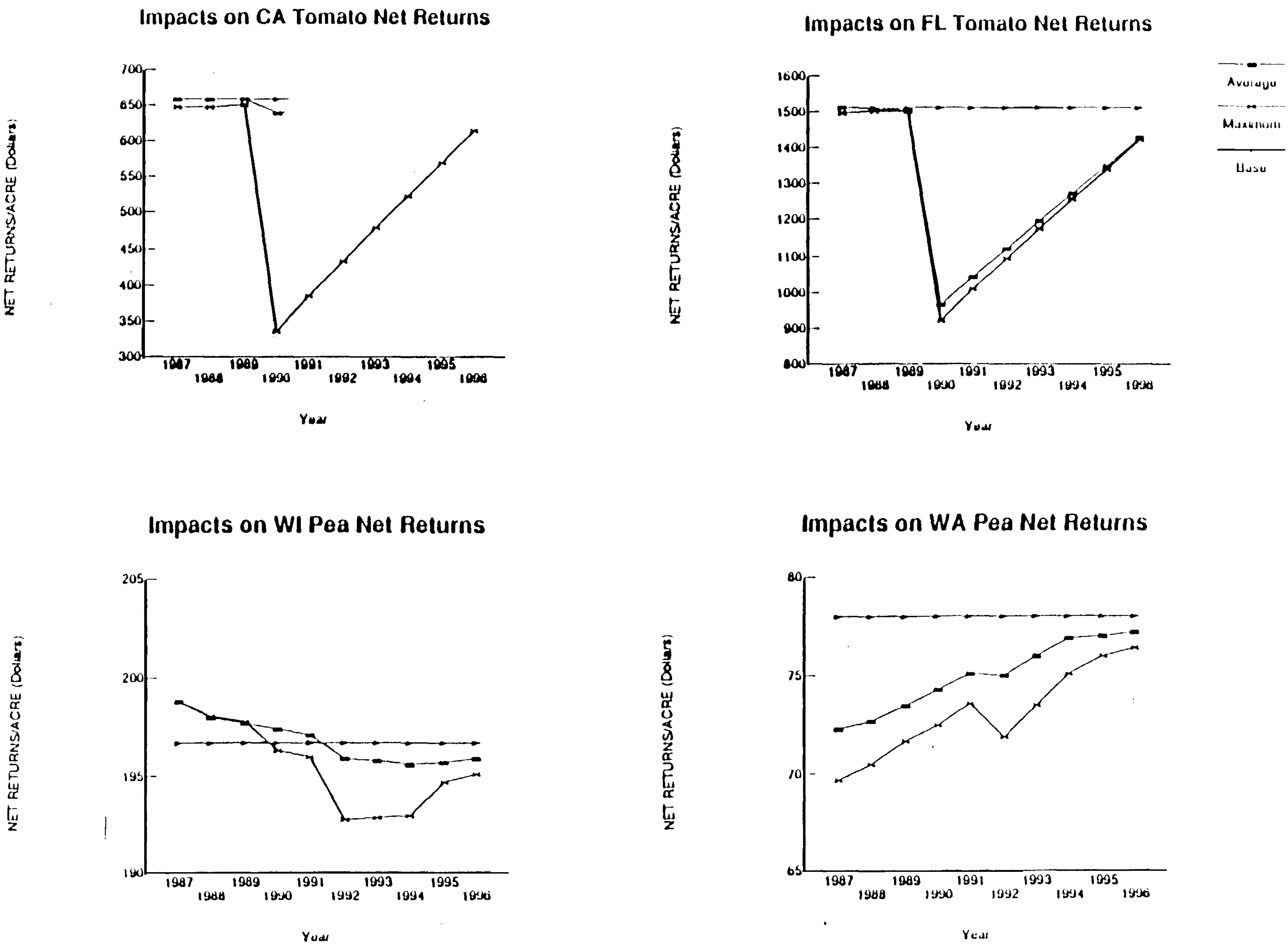


Figure E-9. Scenario 3, regulatory impacts on tomato and pea net returns

APPENDIX F

Data Problems and Assumptions

By

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Appendix F

Data Problems and Assumptions

The agricultural sector study relied on a wide range of information sources of varying quality. This section summarizes the data sources and briefly discusses the limitations of the data.

1.0 Basic Crop Production Information

Basic crop production data was obtained from annual publications of the USDA National Agricultural Statistics Service (NASS) where data were available. For apples and caneberries there was not a consistent data source. Production and price information for apples was obtained from USDA, while information on acres harvested was obtained from the Bureau of Census. Different estimation techniques were used in these two sources and they were collected in different time periods. However, apples are a relatively slow growing perennial crop, so differences in time frames of a few years are probably not particularly important. There were limited caneberry data available in statistical publications from some important states. The production data sources used in this study are listed below.

A. Crop Production, Annual Summary for relevant years, National Agricultural Statistics Board, USDA.

B. Vegetables, Annual Summary for relevant years, National Agricultural Statistics Board, USDA.

C. 1982 Census of Agriculture, Bureau of Census, USDC.

D. Non Citrus Fruits and Nuts, Annual Summary for relevant years, National Agricultural Statistics Board, USDA.

E. Various state annual reports of agricultural statistics for relevant years.

2.0 Time Frames for Actions

We attempted to project the year in which actions might take place and, for past actions, relied on historical information as to when actions actually occurred. Projections for future actions were based on an examination of likely dates for actions to take place.

For all pesticide specific actions we projected that impacts would dissipate evenly over a seven year period as users adjusted their practices and new pest control products became available.

There is some question regarding the accuracy of this assumption. Clearly, if new technologies exist to ameliorate the impacts of a regulatory action, they would tend to be registered (if necessary and they meet the criteria) and adopted within a seven year period. In addition, the cancellation of a pesticide would create some incentive to replace it. However, there is no certainty that such new technologies exist or if they do not currently exist, would be developed, registered, marketed, and adopted within a seven year time frame. The incentive to develop and market new technologies would tend to be greater for the major field crops, where large potential markets exist. There are also some data which suggest that new pesticides would be more expensive than older ones which have been cancelled.

3.0 Pesticide Usage Data

Quality of pesticide usage data vary widely. There are adequate regional (multi state) level usage data for most major field crops (corn, cotton, sorghum, wheat, and soybeans). Pesticide usage data for barley, oats, and hay are sporadic, with the most recent data being from the 1970's. Therefore, usage estimates developed by the registrants were used for these crops. In general, the usage data bases for major field crops are designed to be statistically reliable at the 10 percent level for the sample region. USDA has on occasion, collected statistically reliable state level data for selected major field crops in selected states.

Specialty crop pesticide usage data are highly erratic. USDA last collected pesticide usage data for tomatoes, green peas, apples, and potatoes in the 1970's. Latest USDA peanut pesticide usage data are for 1982 and there are no data for caneberries. State collected pesticide usage data were utilized when available. However, there are no regular periodic state usage surveys. California collects and reports all pesticide usage for restricted use materials and commercial applicators. This results in usage data which should be very reliable for restricted use materials; but are of questionable usefulness for unrestricted use materials.

The Pesticide Program has access to some proprietary pesticide usage estimates for major field crops and selected specialty crops. However, the reliability of these estimates is largely unknown. For major pesticides on major crops, these estimates agree with available data collected in statistically designed surveys. However, for minor pesticides and specialty crops, usage estimates obtained from proprietary sources are often inconsistent with available statistically designed surveys.

Analysis of the proposed pesticides in groundwater actions required projections of pesticide use at the county level. However, there are no public data collected to be statistically reliable at the county level. Data provided by a contractor was used to predict pesticide usage at the county level. However, this data base is composed of information drawn from available reports and expert opinion or local Cooperative Extension Service personnel and is not based on a statistically valid sample. The Federal government does not have data to check the reliability of any of these estimates.

4.0 Comparative Efficacy and Costs of Alternative Controls

Inputs developed and cleared by the program offices were used for past and near actions. The rigor of these analyses varied considerably. In some instances, potential yield impacts were not investigated and a zero yield loss was assumed. In other situations, rigorous analyses of the magnitude of possible yield losses were available.

In general, available pesticide crop trials are not designed to generate statistically reliable estimates of the differences in yields among substitute chemicals. The objective of the crop trials is to demonstrate that the pesticide provides some control of the pest and not to reveal how pesticides compare with each other.

For actions expected to take place further in the future (generally beyond about one year), various sources of information were employed. The following reports generated by, or for, and cleared by the program offices were used:

Preliminary Benefit Analysis of EDB

Preliminary Benefit Analysis of Toxaphene

Preliminary Benefit Analysis of EPN

Preliminary Benefit Analysis of 2,4,5-T

Preliminary Benefit Analysis of Silvex

Preliminary Benefit Analysis of Carbon Tetrachloride

Regulatory Impact Analysis: Worker Protection Standards for Agricultural Pesticides

Regulatory Impact Analysis in Support of Rulemaking Under Sections 302, 303 and 304 of Title III of the Superfund Amendments and Reauthorization Act of 1986

Regulatory Impact Analysis of Proposed Technical Standards for Underground Storage Tanks

Regulatory Impact Analysis of Proposed Financial Responsibility Requirements for Underground Storage Tanks Containing Petroleum

Preliminary Benefit Analysis of Dinocap

Preliminary Benefit Analysis of Chlordimeform

Preliminary Benefit Analysis of Ethyl Parathion

Preliminary Benefit Analysis of Aldicarb

Abbreviated Benefit Analysis of Dinoseb.

4.1 Corn and Soybeans

Publications from the USDA Commodity Assessment of Pesticide Use on Corn and Soybeans and Potential Bans of Corn and Soybean Pesticides, by Craig Osteen and Fred Kuchler USDA, ERS, Agricultural Economic Report Number 546 as well as some unpublished supporting commodity assessment data information (made available by the USDA) provided comparative efficacy for corn and soybeans. This provided a consistent data base which appears reasonable for the actions proposed for the future. The commodity assessment data base was constructed by obtaining expert opinion of estimates of product cost and yield effects due to losses of pesticides. The USDA has not updated this report and the estimates are somewhat dated. In some cases, the cost of alternatives provided in the Commodity Assessment was not appropriate for this analysis. In these cases the Commodity Assessment was supplemented with information from the Economic Analysis Branch (EAB) price files. Efficacy data for corn and soybeans is probably the most reliable of all crops considered in this analysis.

Concerns about groundwater contamination were assumed to result in the cancellation of both alachlor and the triazines in selected areas. In reality alachlor and the triazines are partial substitutes; however, the Commodity Assessment never considered the question of the loss of both alachlor and the triazines. In the absence of any information on how production costs and yields would change under the cancellation of both alachlor and the triazines, we used the commodity assessment data, which indicate the efficacy information associated with the cancellation of each one, assuming the other remains on the market. Logic indicates that the simple addition of impacts probably underestimated the impact of cancelling both, but the degree of underestimation is unknown.

4.2 Remaining Major Field Crops (Wheat, Cotton, Sorghum, Barley, Oats, Hay)

4.2.1 Wheat, Barley, Oats

There was only one significant future action that affected wheat. Yield change estimates developed for EPA by the registrants were used. There was no significant Agency review of these estimates (Benefits Estimates for Maneb, Pennwalt Corporation, December 1987 & Response of the Rohm and Baas Company to the Special Review for EBDC Fungicides, Rohm and Haas Company, October 1987).

4.2.2 Cotton

EPA policy actions assumed in this analysis have potentially significant affects on cotton production. Estimates of impacts were developed rather rapidly using judgments of EAB staff members. Possible actions are in areas where a number of alternative controls exist. Therefore, it is likely that the estimates developed are reasonable.

4.2.3 Sorghum

No efficacy data were available for sorghum. For herbicides it was assumed that the cost and percent yield changes would be the same as those for corn since the crops, pesticides, and pest spectra are similar. This could be a significant limitation since sorghum tends to be grown in drier and warmer areas than corn. The actual performance of the herbicides could be different under these conditions. The impacts of other actions were developed internally based on judgement. Other pesticides are of limited importance in the production of sorghum, therefore, our estimates are probably within reason even though not well documented.

4.2.4 Hay

Possible actions were very limited. Only a small portion of the acres planted are impacted (less than one percent).

4.3 Specialty Crops

4.3.1 Peanuts

Most information for impact estimates for alachlor and aldicarb (groundwater) were available from reports previously cleared by the program office (see above). We estimated portions of acres that would be affected based on knowledge of the soils where the crop is grown. Industry estimates of fungicide cost and yield impacts were used, although they had not been subject to internal review. Insecticide cost and yield effects were developed internally based on information on alternatives and possible target pests. Although we feel reasonably comfortable with estimates for the individual actions, we feel very uncomfortable with the simple addition as a means of aggregating yield impacts across chemicals. This problem, in addition to lack of information on supply elasticities for peanuts, prevented us from providing a complete analysis of the impact of EPA actions on peanut growers.

4.3.2 Apples

Cost and yield impact information provided by industry was utilized for fungicides. Cost information for other pesticides used on apples was estimated internally based on knowledge of registered materials and labeled target pests. Yield impacts were estimated internally based on limited information on yield impacts from selected pesticides.

4.3.3 Potatoes

Aldicarb (pesticide-in groundwater) information was available from an existing Agency study. Fungicide information was available from an industry report submitted to the Agency. Remaining impacts were estimated internally as they were for apples.

4.3.4 Green Peas and Tomatoes

Pesticide industry estimates were available for fungicides. Only limited information (primarily materials registered and target pests) was available to estimate cost and yield impacts associated with other future actions. We had some limited estimates from a contract publication (with no knowledge of how these estimates were obtained) on most common target pests and usage of various materials. Yield and cost impacts were estimated internally with little or no foundation, other than past experience on larger crops.

4.3.5 Caneberries

Virtually no information was available except for pesticide registrations and target pests on labels. This was the situation for most past actions as well as possible future actions. The following informational reports were used:

> Abbreviated Benefit Analysis of Dinoseb (Since the dinoseb action was still in litigation at the time inputs were developed for the study, estimates of impacts as developed for the regulatory action were used for this analysis).
>
> Preliminary Benefit Analysis of Aldicarb
>
> Preliminary Benefit Analysis of Alachlor
>
> Regulatory Impact Analysis: Registration fees under FIFRA

Regulatory Impact Analysis: Data requirements for Registering Pesticides

Benefit Estimates for Maneb, Pennwalt Corporation, December 1987

Response of the Rohm and Haas Company to the Special Review for EBDC Fungicides, Rohm and Haas Company, October 1987.

5.0 Elasticities

Price elasticities used for the major field crops were those contained within the simulation model (AGSIM). While the estimated elasticities may be subject to criticism, they were generated in a consistent manner within the same model. Price elasticities for the specialty crops were short-run farm level elasticities and were obtained from whatever reasonable sources were available. These estimates of supply and demand elasticities may have been estimated from different data bases using different techniques.

5.1 Apples

Obtained elasticities of supply from a USDA/ERS report "An Econometric Model of the U.S. Apple Market," June 1985. Elasticity of demand estimates from K. Huang, USDA/ERS, 1985.

5.2 Caneberries

Estimates of elasticities were not found.

5.3 Peanuts

Discussions with economists familiar with peanut production (both with USDA and in major peanut production areas) indicated that there are no reasonably reliable peanut elasticity of supply estimates available. Elasticities of demand are from K. Huang, USDA/ERS. However, these are questionable due to the nature of perceived demand for domestic peanuts produced under quota and additional peanuts (peanuts for export and oil).

5.4 Peas, Potatoes and Tomatoes

Elasticities of demand were obtained from K. Huang, USDA/ERS, 1985. Elasticities of supply for peas were obtained from Ascari and Cummings, International Economic Review, 1977. Elasticity of supply for potatoes was obtained from unpublished work by G. Zepp, USDA/ERS, 1987. Elasticity of supply for tomatoes was obtained from Churn and Just, Giannini Monograph, 1978.

APPENDIX G

Cumulative Probability Cost Distribution

By

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Appendix G

Cumulative Probability Cost Distribution

Since we are simultaneously examining the impact of several EPA policies, a fundamental issue that had to be determined was: how do we define an "impacted" farmer? For example, Illinois corn soybean farmers may be affected by the cancellation of several different pesticides, may incur insurance costs if they have an underground storage tank that meets certain criteria, and may incur an expense to rebuild their tractor engine if all lead is banned from gasoline and they have a leaded gasoline tractor. How many of these potential costs do we assume that the "impacted" farmer incurs? For each producer we examine two alternative sets of impacts:

* A Maximum Impact Case: In this case it is assumed that the producer is affected by every regulation that may possibly affect a producer of that type.

* An Average Impact Case: In this case it is assumed, that the producer experiences the average impact of producers-of that type - e.g., if 10% of all-producers of a given type experienced a cost of $1,000, we would use a cost of $100 ($1,000 x 0.10) for the average impact case.

Examining these two cases, however, only provides two snapshots of possible impacts without providing the full picture of how cost and yield impacts are likely to be distributed across producers. To provide more insight into the likely distribution of these initial cost and yield impacts, we constructed a cumulative probability cost curve for each representative farm in average financial position. The following example demonstrates what these cumulative probability cost curves reveal.

Suppose a given farmer may be affected by three possible regulations, each having the following associated cost and probability of affecting a given producer:

Regulation	Cost	Probability of Impact	Probability of No Impact
A	$100	.30	.70
B	$200	.20	.80
C	$300	.10	.90

Provided the probabilities of incurring the costs of the three regulations are independent, the possible set of outcomes and associated costs and probabilities may be defined as:

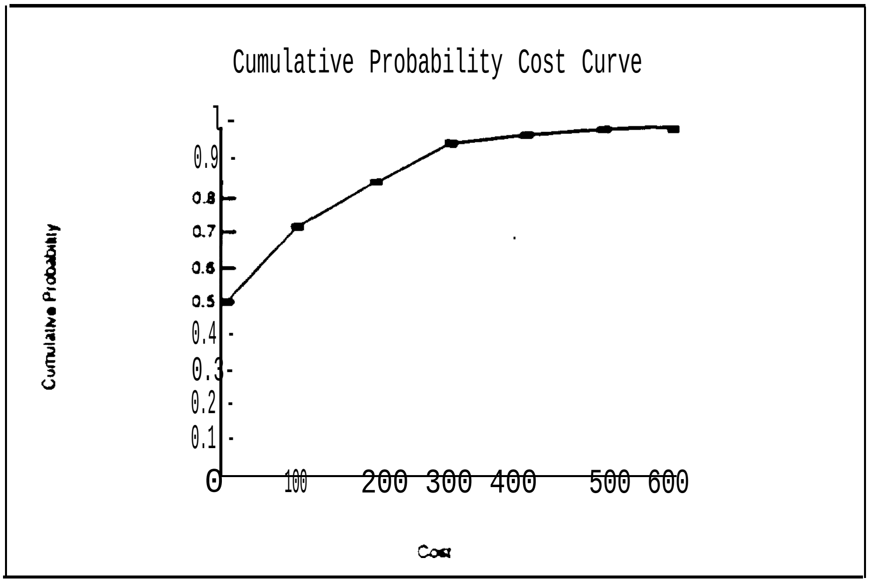
Regulations Affected by:	Cost	Probability 1/
A	$100	.216
B	$200	.126
C	$300	.056
NONE		.504
A,B	$300	.054
B,C	$500	.014
A,C	$400	.024
ALL	$600	.006

1/ Note the probability of being impacted by Regulation A = P(A) x P(NB) x P(NC), where P(A) = the probability of being affected by regulation A, and P(NB), P(NC) = the probability of not being affected by B and C, respectively.

By ranking these possible outcomes in order of cost, and adding up the associated probabilities, we can arrive at the following cumulative probabilities:

Regulations Affected by:	Cost	Cumulative Probability
NONE	$0	.504
A	$100	.720
B	$200	.846
C	$300	.902
A,B	$300	.956
A,C	$400	.980
B,C	$500	.994
ALL	$600	1.00

Then, plotting the cost on the x-axis and the cumulative probability on the y-axis, we can use this information to generate the following cumulative probability cost curve:



This cost curve indicates the probability of incurring a cost less than or equal to a given level. For example, it indicates that any given farmer has a probability of .846 of incurring a cost that is less than or equal to $200.

To shed insight into the probability that the farms examined in this report would actually incur any given level of cost, we generated a cumulative probability cost curve for each of the representative farms in average financial position. In the above example, all of the costs were assumed to be independent. In reality, however, this may not be the case. For example, farmers who use a certain type of pesticide on their corn may very likely be using the same pesticide on their soybeans, if the pesticide is used on a certain pest that is found on both corn and soybeans. In generating the cumulative probability cost curve for each representative farm, we tried to account for the correlation among different costs. The assumptions we used for each representative farm are outlined below:

Illinois corn soybean farm assumptions:

1. If a farmer is using any chemical, then he incurs Farm Worker Safety Costs.
2. If a farmer is using alachlor on his soybeans, then he is using alachlor on his corn.
3. If a farmer is using a corn rootworm insecticide on his corn, then he is using a triazine on his corn.
4. If a farmer is using alachlor on his corn, then he is using a triazine on his corn.

Mississippi cotton soybean farm assumptions:

1. If a farmer is using any chemical, then he incurs Farm Worker Safety Costs.
2. If a farmer is using dinoseb on his soybeans, then he is using dinoseb on his corn.

Kansas wheat cattle farm assumptions:

1. If a farmer is using any chemical, then he incurs Farm Worker Safety Costs.
2. If a farmer is using alachlor on his soybeans, then he is using alachlor on his corn.
3. If a farmer is using a triazine on his corn, then he is using a triazine on his sorghum.
4. If a farmer is using alachlor on his corn, then he is using a triazine on his corn.

Incorporating these assumptions into the method described in the above example, we generated a cumulative probability cost curve for each representative farm in each scenario (Figures G-l-through G-5). Any given point on the curve may be interpreted as the

ILLINOIS CORN SOYBEAN FARM: SCENARIO 1

AVERAGE FINANCIAL POSITION

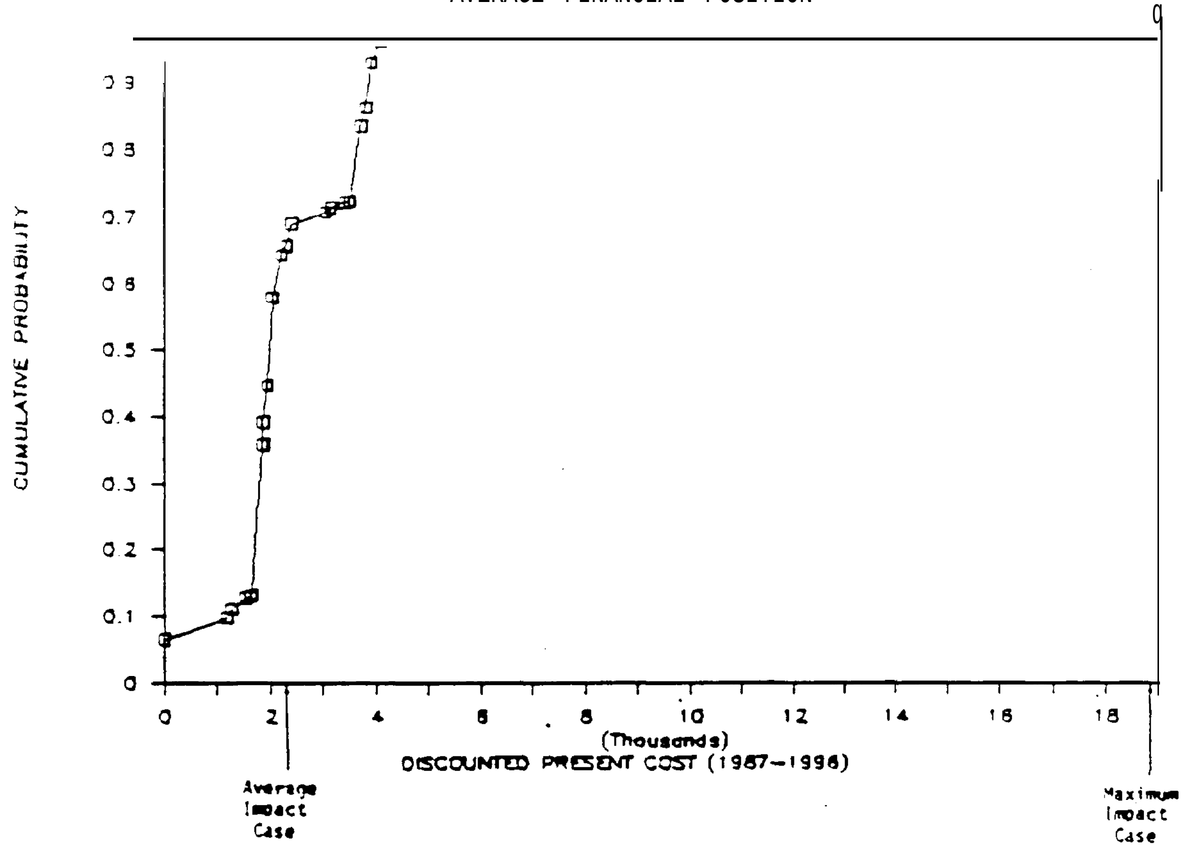


Figure G-la. Scenario 1, cumulative probability cost curve for the representative Illinois corn soybean farm in average financial condition

ILLINOIS CORN SOYBEAN FARM: SCENARIO 2

AVERAGE FINANCIAL POSITION

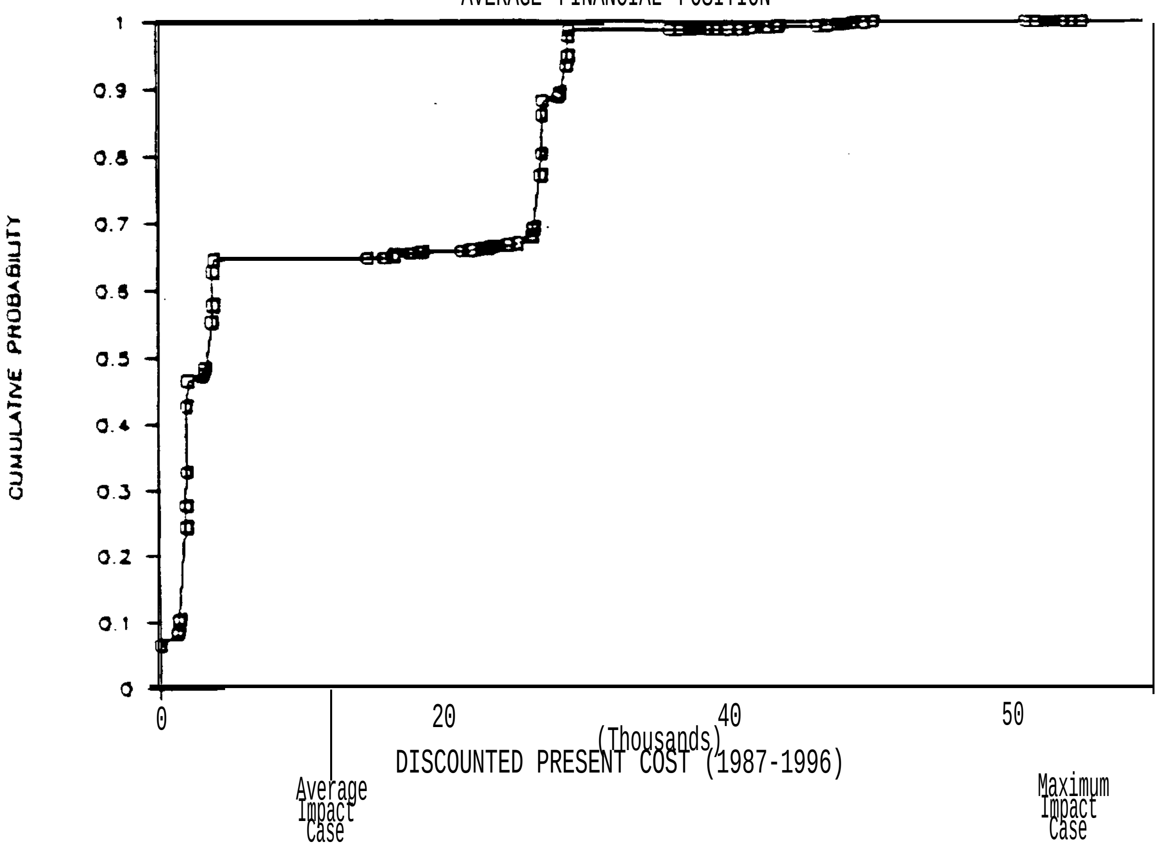


Figure G-lb. Scenario 2, cumulative probability cost curve for the representative Illinois corn soybean farm in average financial condition

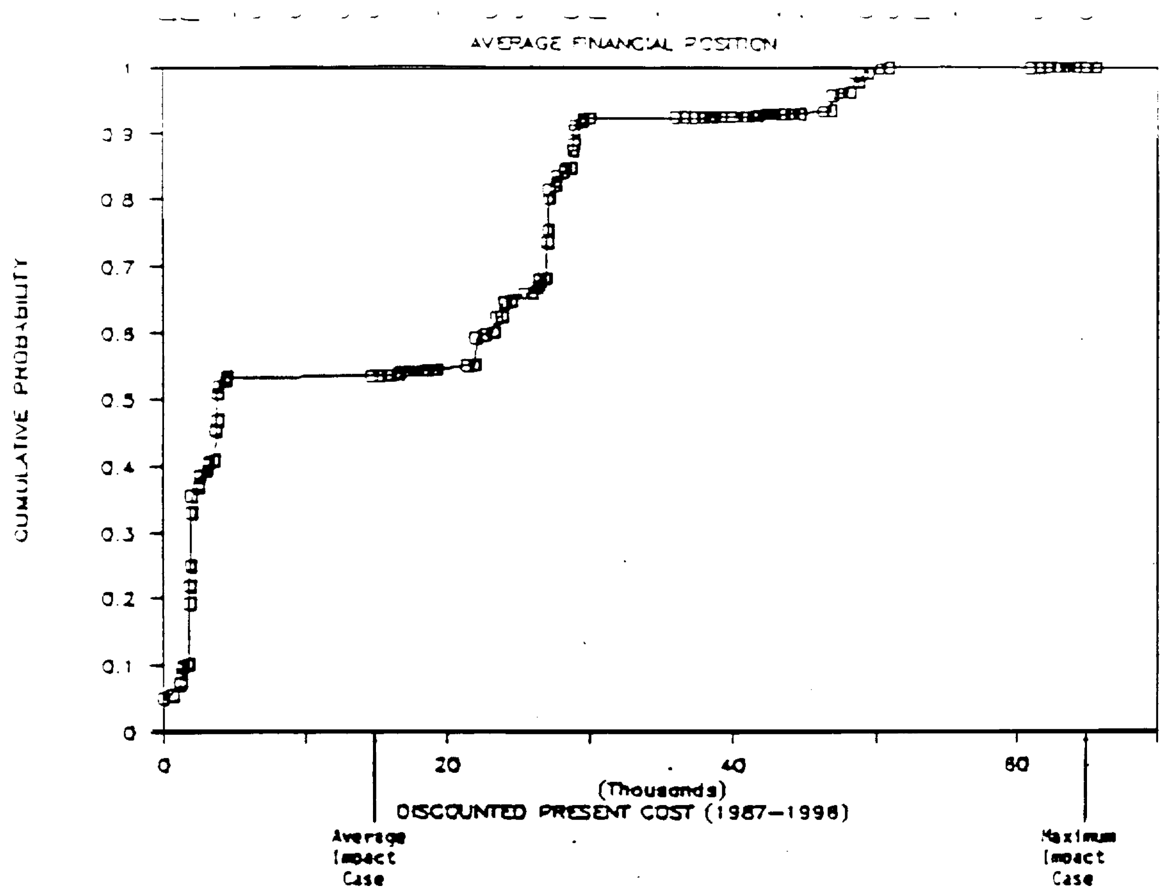


Figure G-2a. Scenario 3, cumulative probability cost curve for the representative Illinois corn soybean farm in average financial condition

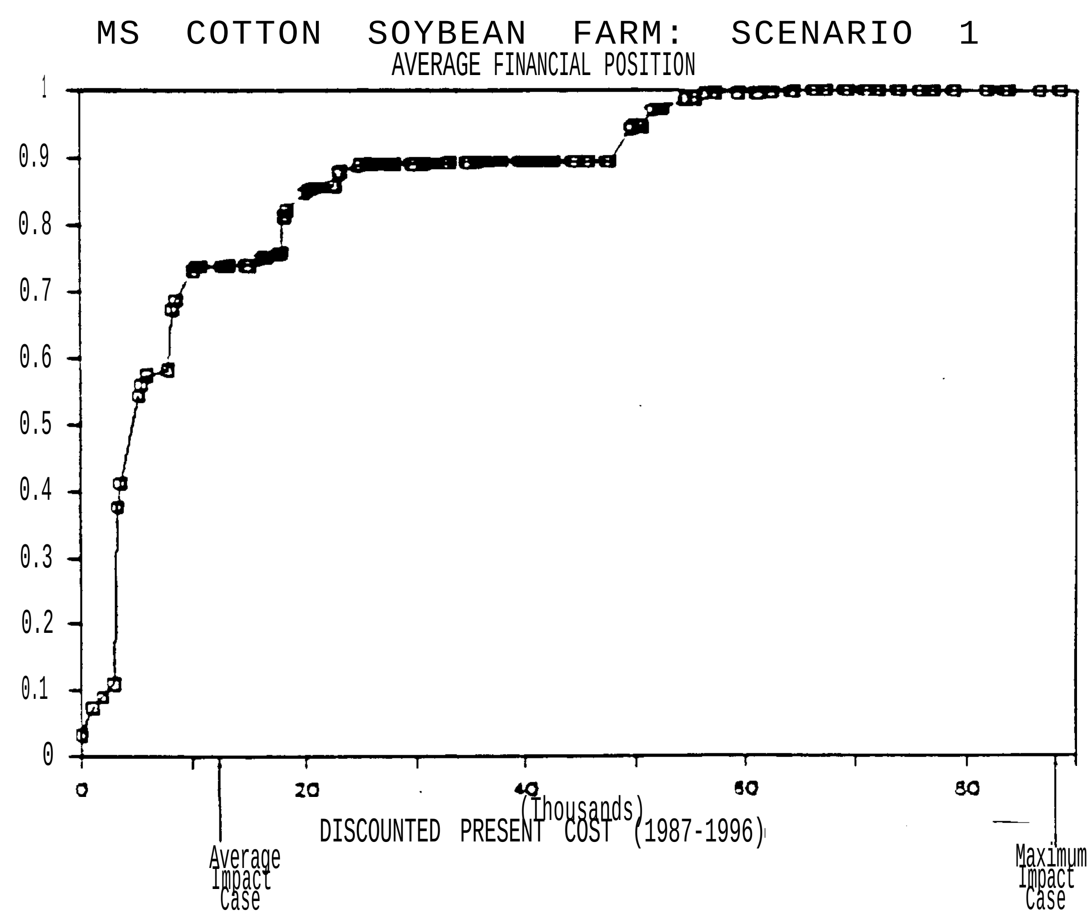


Figure G-2b. Scenario 1, cumulative probability cost curve for the representative Mississippi cotton soybean farm in average financial condition

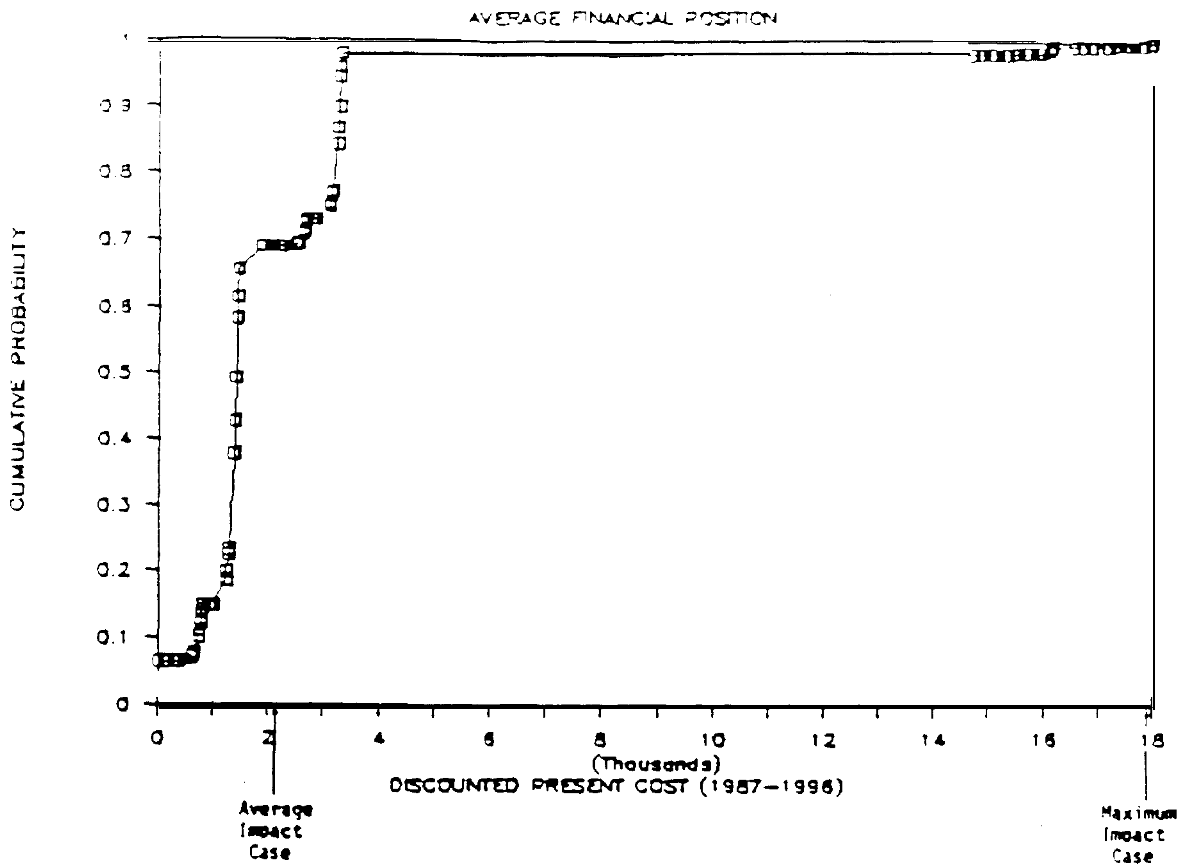


Figure G-La. Scenario 1, cumulative probability cost curve for the representative Kansas wheat cattle farm in average financial condition

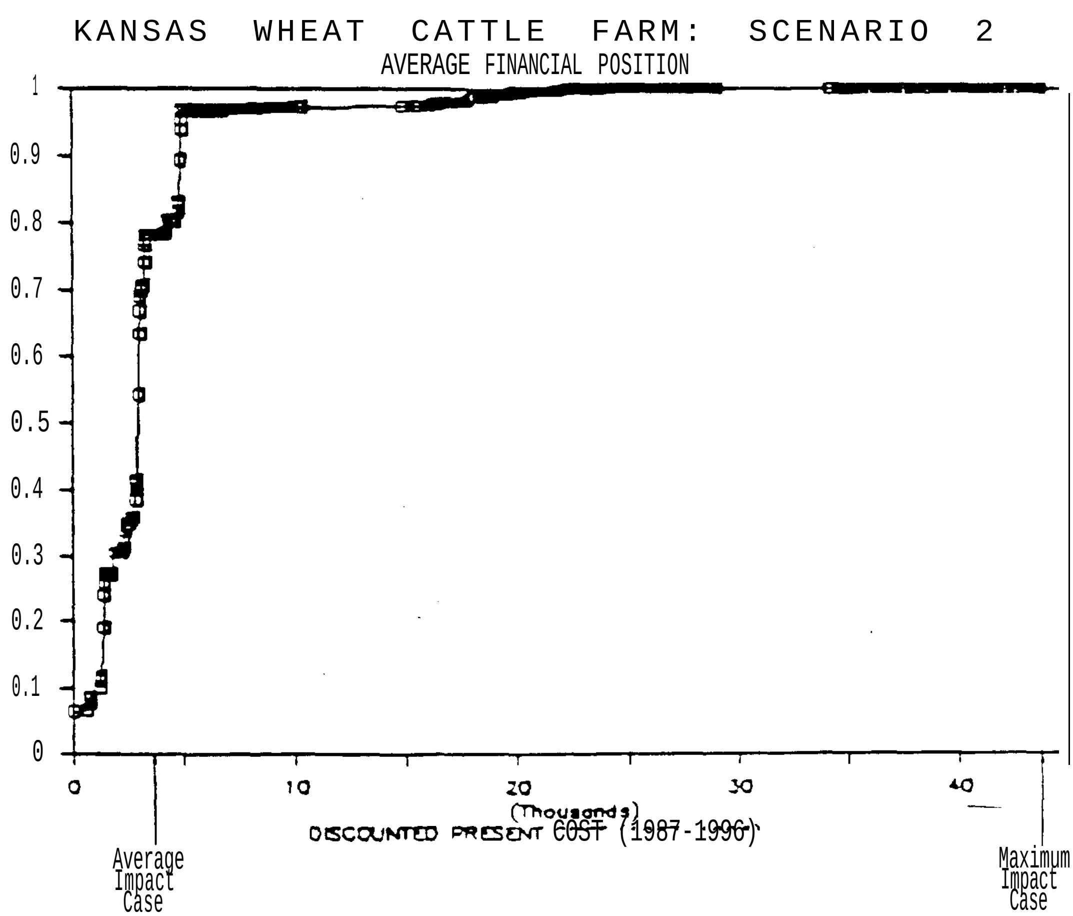


Figure G-4b. Scenario 2, cumulative probability COSt curve for the representative Kansas wheat cattle farm in average financial condition

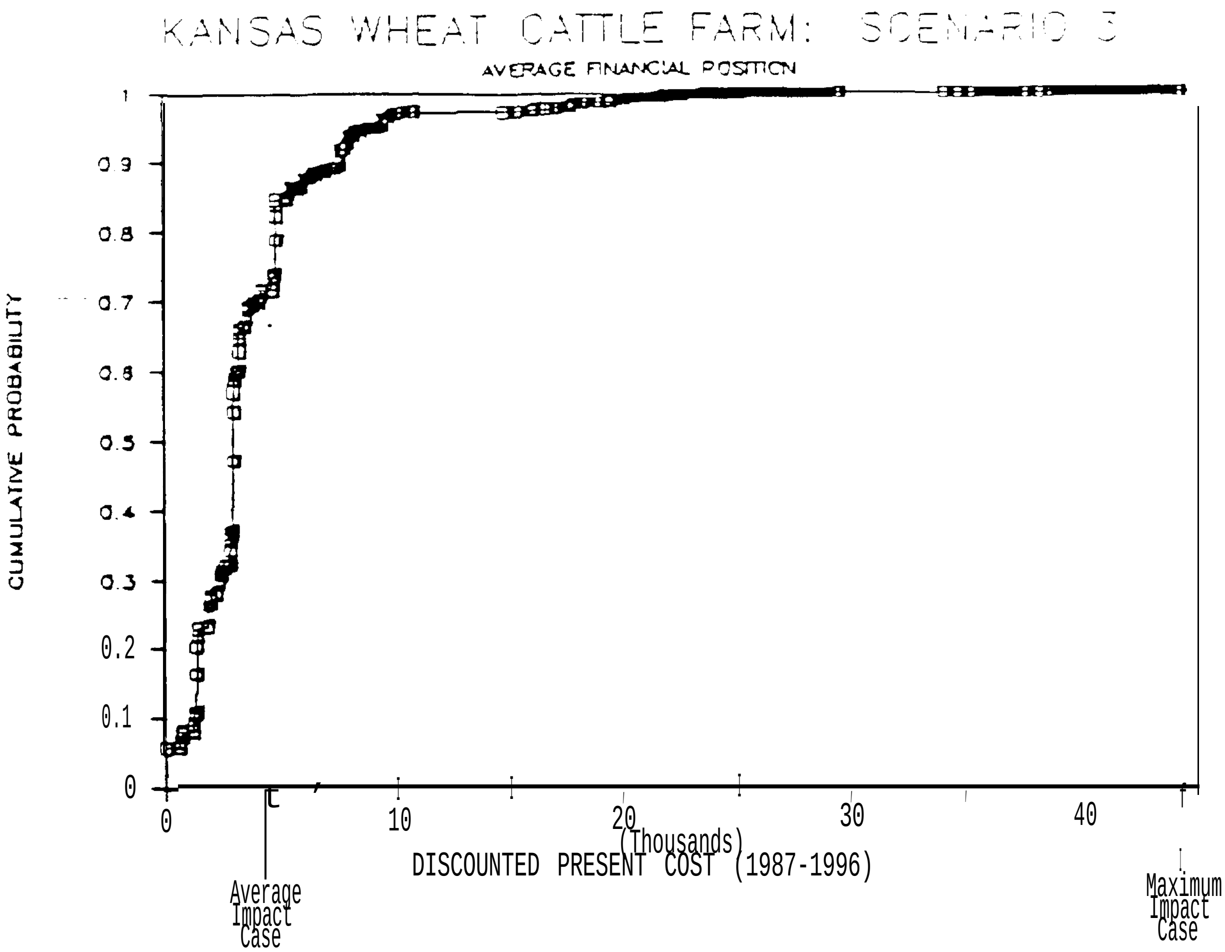


Figure G-5a. Scenario 3, cumulative probability cost curve for the representative Kansas wheat cattle farm in average financial condition probability that the representative farm will incur a cost equal to or less than a given level. For example, the curve in Figure G-la indicates that the representative Illinois corn soybean farm in Scenario 1 has a .50 probability of incurring a discounted present value of cost and yield impacts (1987-1996) of less than or equal to $2,000. The discounted present value of cost and yield impacts corresponding to the average and maximum impact cases are indicated on each curve.

If all Illinois corn soybean farms had the same number of acres of each crop as the representative farm, Figure G-la could be interpreted as the percent of farms likely to incur cost and yield impacts less than or equal to a given level. Since farms will vary in the number of crop acres that they plant, their present discounted value of impacts under any particular combination of regulations will vary from the representative farm. (Recall that the representative farm does not truly represent all farms but is only a composite of farms of a given type.) These curves, therefore, are only meant to provide some insight into the distribution of cost and yield impacts for farms of a given type but do not represent accurate cost and yield impacts for any particular farm (other than the average farm), or the true distribution of impacts across farms.

APPENDIX H

Recommendations for Acquiring Better Pesticide Usage Data

By

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Appendix H

Recommendations for Acquiring Better Pesticide Usage Data

In this agricultural sector study, the lack of current and reliable pesticide usage data has limited the ability to accurately assess the economic impact of EPA actions, particularly on the specialty crops. The quality of the usage data used in the report is described in Appendix F. To summarize, data for the major crops were usually adequate only at the regional level. For small-area crops, the data were old and/or of unknown statistical validity. For no crop was information available nationwide at the county level which is the minimum level of disaggregation needed for measuring the impact of ground water regulatory actions. The gaps identified in Appendix F could affect the study results because the measurement of economic impacts of EPA actions depends on the cost and yield effects of pesticide cancellation which in turn depend on usage data.

The agricultural sector study is only one example of the many EPA analyses that depend on basic pesticide data for accurate estimation of economic and other effects of pesticide regulation. Because this study is an excellent illustration of the difficulty the data limitations present, it is an opportunity to discuss those limitations, their consequences for economic and risk analyses of pesticide use, and what can be done to improve the situation.

As seen in the agricultural sector study, two types of basic pesticide data are fundamental to assessing a pesticide's economic importance: performance and usage. A current project in the Office of Pesticide Programs directly addresses the incompleteness of the performance data by strengthening data requirements placed on pesticide manufacturers. For that reason, the discussion here is limited to usage data, defined roughly as the amount a particular pesticide and its alternatives are used on a crop, how many acres are treated with each pesticide, in which locations, at what rate, and by what methods. For the sake of brevity, the focus is on agricultural pesticide use, although data problems exist with nonagricultural use as well.

1.0 Why Pesticide Usage Data are Important

The agricultural sector study is just one of several recent special analyses relying on pesticide usage data. Some of the special studies could be of far-reaching importance for future pesticide use, for example, preparation for the Agency's Endangered Species Program and targeting of water wells for the national groundwater monitoring program. For risk/benefit analyses on individual pesticides and for other regular pesticide assessments (e.g., exemptions for local use), usage data and performance data form the foundation upon which scientists and economists build their quantitative estimates of a pesticide's importance.

Without complete information, often the case with small area crops, analysts must rely on educated guesses, adding uncertainty to their final conclusions. In the recent case of the herbicide dinoseb, usage information on alternatives was not readily available and analysts had inadequate time to gather it.- This lack of data contributed to a successful legal challenge by growers of some small crops, causing EPA to exempt those crops from the suspension decision already made. Furthermore, usage data are an integral part of exposure assessments, which in turn play a key role in deciding whether a pesticide is placed in Special Review.

2.0 Current State of Usage Data

The agricultural pesticide usage data currently available are very uneven in quality and coverage. For the major crops such as corn, soybeans, cotton, and wheat, current survey data are available from USDA and private sources and are likely to be collected periodically in the foreseeable future. Information on major crops falls short of OPP's needs because it often excludes minor producing areas and are often not disaggregated to a small enough geographic level. Considerably greater problems occur with small-area crops, for example, there has been no publicly-available survey of pesticide use on citrus since 1977. For the specialty crops studied in this report as well as the whole spectrum of fruits, vegetables, and other crops, usage data are rarely what they need to be: current, reliable, disaggregated at least to the state level, and publicly available.

3.0 Recommendations for Acquiring Better Data

The Benefits and Use Division (BUD) of the Office of Pesticide Programs has made a concerted effort to upgrade its usage data, but is often met with budgetary constraints. BUD recently estimated that it would cost $3 million to acquire adequate survey usage data on crops and nonagricultural sites of importance to OPP. That expenditure would be needed every three or five years.

However, the Office of Pesticide Programs is not the only organization needing pesticide usage data, and the list is growing because of heightened concern about pesticide health and environmental effects, for example groundwater contamination. Other organizations which recently used pesticide usage data are:

* Department of Agriculture,
* EPA Office of Drinking Water, Non-Point Source Branch,
* EPA Office of Ground Water Protection,
* individual registrants,
* Food and Drug Administration,
* National Agricultural Chemicals Association,

* state environmental, water quality, and public health programs, and
* U.S. Geological Service, Water Resources Division.

For some of the options that follow, a cost-sharing arrangement between EPA and other interested organizations could make the data acquisition far more affordable.

Below are possible options for generating better pesticide usage data. Each has different costs and benefits.

1. Conduct a set of jointly-funded periodic surveys of pesticide users

   Each set would cover certain sites, such as major crops, small area crops, crops in certain regions, pesticide-intensive crops in areas of groundwater vulnerability, or nonagricultural sites. A different group of sponsoring organizations would fund each set. Fees would be charged to non-sponsoring users.

2. Set up cost-sharing between EPA and states to conduct surveys

   This is a more limited version of option #l. In-order to receive EPA funds, states would have to design the surveys to meet certain specifications so the data. would fit EPA's needs. This might be the most efficient approach for small crops.

3. "Socialize" private data collection services
   These services currently poll farmers nationwide on pesticide usage. EPA and-other interested parties could contract to completely fund the data collection, in order to be able to control the survey methods and site coverage; and to ensure the data is public.

4. Attach questions to existing USDA surveys currently used for other purposes

   This is already being done to a limited extent; the new questions would be much more detailed.

5. Attach questions to the U.S. Census of Agriculture

   The Census currently asks farmers questions on all crops as well as usage of pesticide in broad categories. To be useful for most EPA analyses, additional questions would be added that are detailed at the active ingredient level.

6. Require data from registrants

Registrants are required to generate pesticide toxicity and performance data to support pesticide registrations. If usage data were also required, the cost to the government would be lower than with other options, though there could be problems with confidentiality.

7. A combination of the above

Existing USDA surveys cover only a subset of the crops relevant to EPA. Pesticide usage questions, could be attached to those surveys while data on remaining crops could be collected jointly by a consortium as in #l and #3.

An interagency committee composed of EPA, USDA, FDA, and DOI, meets on occasion to share pesticide usage data. To date, there has been no joint funding of data. Working through the committee, the OPP Benefits and Use Division and the OPPE Office of Policy Analysis have begun an initiative to acquire better data.

4.0 Summary

There is a clear need for more detailed, precise estimates of pesticide usage, both agricultural and non-agricultural. Recent renewed interest in pesticide-related environmental and health problems has increased the number of organizations needing such information. Because there are many hundreds of different pesticidal active ingredients and hundreds of different crops and nonagricultural sites across the country, acquiring high quality information on a regular basis is expensive. Yet without it, the accuracy of economic valuation of pesticides is uncertain. If such accuracy is deemed important enough, some increased effort will be needed to acquire the necessary data.

There are several ways to generate better usage data. Detailed questions could be attached to existing surveys designed for other purposes, EPA could require the data from registrants, or a consortium of interested private, federal, and state organizations could be formed to share the costs of new surveys. Since there is a wide variety of use sites, a different arrangement might be made for different types of sites.

Each approach would differ from a cost-benefit standpoint. To the extent EPA can pool resources with other users of pesticide data, costs can be lowered. The benefit of better data will be greater efficiency in the assessments of pesticide use, a higher quality of analysis, and subsequently, more informed decisions on pesticide regulation.