

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 impacts 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:

$$(1) \quad P_0 = MC_0$$

$$(2) \quad dMC = \frac{P_0(dY/Y) + (dC/Y_0)}{1 - dY/Y_0}$$

$$(3) \quad dP/P_0 = (e_s/(e_s e_D))(dMC/MC)$$

$$(4) \quad dQ/Q = (e_D e_s / (e_s - e_D)) (dMC/MC)$$

where:

P_0 = commodity baseline price, farm level

MC_0 = 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_0 = 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

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:

$$(5) \quad dR = P_i Q_i - P_o Q_o$$

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

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

The change in costs for the acreage remaining in production is

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

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

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

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

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

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-1). 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)		
<u>Rish Potatoes</u>					
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.	600	170.3 cwt.
ME	4.12 cwt.	98	24,926,000 cwt.	600	254.4 cwt.
<u>Green Peas</u>					
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
<u>Apples</u>					
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
<u>Peanuts</u>					
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
<u>Quotas</u>					
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
<u>Caneberries (Raspberries)</u>					
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.
<u>Tomatoes</u>					
Processing	72.40/ton	225.3	5,944,000 tons	1,200	26.6 tons
CA	75.68/ton	280.4	6,981,000 tons	---	24.9 tons
U.S.					
Fresh	559.70/ton	45.4	660,000 tons	500	14.6 tons
FL	522.00/ton	123.7	1,385,000 tons	---	11.2 tons
U.S.					

* - 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-1 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 production, 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

<u>Demand Elasticities 1/</u>	
Potatoes	-.3688
Apples	-.2015
Tomatoes (fresh)	- .5584
Tomatoes (processing)	-.3811
Other fresh vegetables (peas)	-.2102

<u>Supply Elasticities</u>	
	<u>Short-run</u>
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

Year	Change in variable cost from base year (\$)					Change in yield from base year						
	Apples	Potatoes	Tomatoes		Peas	Peanuts	Apples	Potatoes	Tomatoes		Peas	Peanuts
			Fresh	Proc.					Fresh	Proc.		
<u>Scenario 1</u>												
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	.000
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
<u>Scenario 2</u>												
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	6.97	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.
<u>Scenario 3</u>												
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	.010
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	.048	0	.050	0	0	.253
1991	3.45	8.70	-10.33	6.02	2.26	22.21	.041	0	.168	0	0	.211
1992	18.32	12.44	-7.48	6.14	2.06	22.12	.034	0	.140	0	0	.279
1993	16.58	10.26	-4.64	6.26	1.53	17.97	.027	0	.112	0	0	.223
1994	14.84	8.08	-1.79	6.38	.99	13.82	.021	0	.084	0	0	.168
1995	13.10	6.51	1.05	6.50	.95	9.77	.014	0	.056	0	0	.122
1996	11.36	4.94	3.90	6.62	.90	5.71	.007	0	.028	0	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

Year	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
	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

Year	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
	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	-1,605,324	-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

Year	Percent change from Base Year 1983		Change in welfare from Base Year 1983		
	Production	Price	Consumer Surplus	Producer S u r p l u s	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

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	-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	N e t
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 1-10 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-1) 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-1) and were used 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-1) 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-1
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:

	<u>Average Financial Position</u>	<u>Vulnerable Financial Position</u>
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:

	<u>Average Financial Position</u>	<u>Vulnerable Financial Position</u>
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:

	<u>Average Financial Position</u>	<u>Vulnerable Financial Position</u>
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:

	<u>Average Financial Position</u>	<u>Vulnerable Financial Position</u>
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 \$2.00/acre cost, we would assume a \$1.00/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

<u>Scenario</u>	<u>Action</u>	<u>Crop</u>	<u>Cost 2/</u>	<u>Yield(%)</u>	<u>Acres(%)3/</u>
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)

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

Fixed Costs:

<u>Scenario</u>	<u>Action</u>	<u>Impact</u>
1-3	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.
1-3	Enclosed Cabs	Cost of enclosing cab = \$2,500. Assumed the 1/3 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.
1-3	SARA Title III, Section 302-304	cost = \$50/covered farm. Assumed 1/3 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

<u>Scenario</u>	<u>Action</u>	<u>Crop</u>	<u>Cost</u>	<u>2/</u>	<u>Yield(%)</u>	<u>Acres(%)3/</u>
1-3	Dinoseb Cancellation	cotton	5.00	-1.5	24.1	
		soybeans	16.00	0	10.5	
1-3	Toxaphene cancellation	soybeans	6.8	0	1.2	
1-3	Chlorodimeform - cancellation of yield enhancement	cotton	3.88	0	24	
1-3	Alachlor-restricted use	soybeans	.50	0	10	
1-3	Farm Worker safety	cotton	.44	0	95	
		soybeans	.65	0	85	
1-2	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)

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

Fixed Costs:

<u>Scenario</u>	<u>Action</u>	<u>Impact</u>
1-3	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.
1-3	Enclosed Cabs	Cost of Enclosing Cab = \$2,500. Assumed that 1/3 of all cabs must be enclosed.
1-3	SARA Title III, Sections 302-304	cost = \$50/covered farm. Assumed 1/3 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

<u>Scenario</u>	<u>Action</u>	<u>Crop</u>	<u>Cost 2/</u>	<u>Yield(%)</u>	<u>Acres(%)3/</u>
1-3	Alachlor-Restricted Use	corn	.50	0	37.1
		soybeans	.50	0	19
1-3	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:cyanazine	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)

<u>Scenario</u>	<u>Action</u>	<u>Crop</u>	<u>Cost</u>	<u>2/</u>	<u>Yield(%)</u>	<u>Acres(%)</u> 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:

<u>Scenario</u>	<u>Action</u>	<u>Impact</u>
1-3	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.
1-3	Enclosed Cabs	Cost of Enclosing cab = \$2,500. Assumed 1/3 of all cabs must be enclosed.
1-3	SARA Title III: Sections 302-304	cost = \$50/covered farms. Assumed 1/3 of all farms are covered.
3	Lead Ban	Assumed impacted farm incurred \$1,000 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

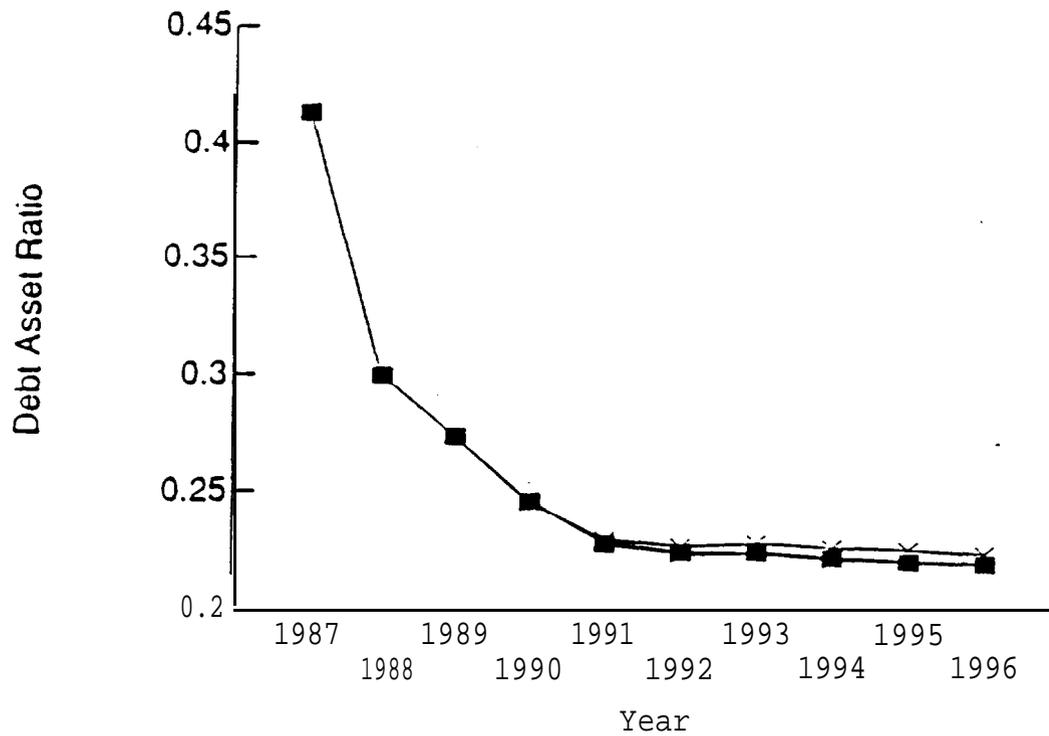
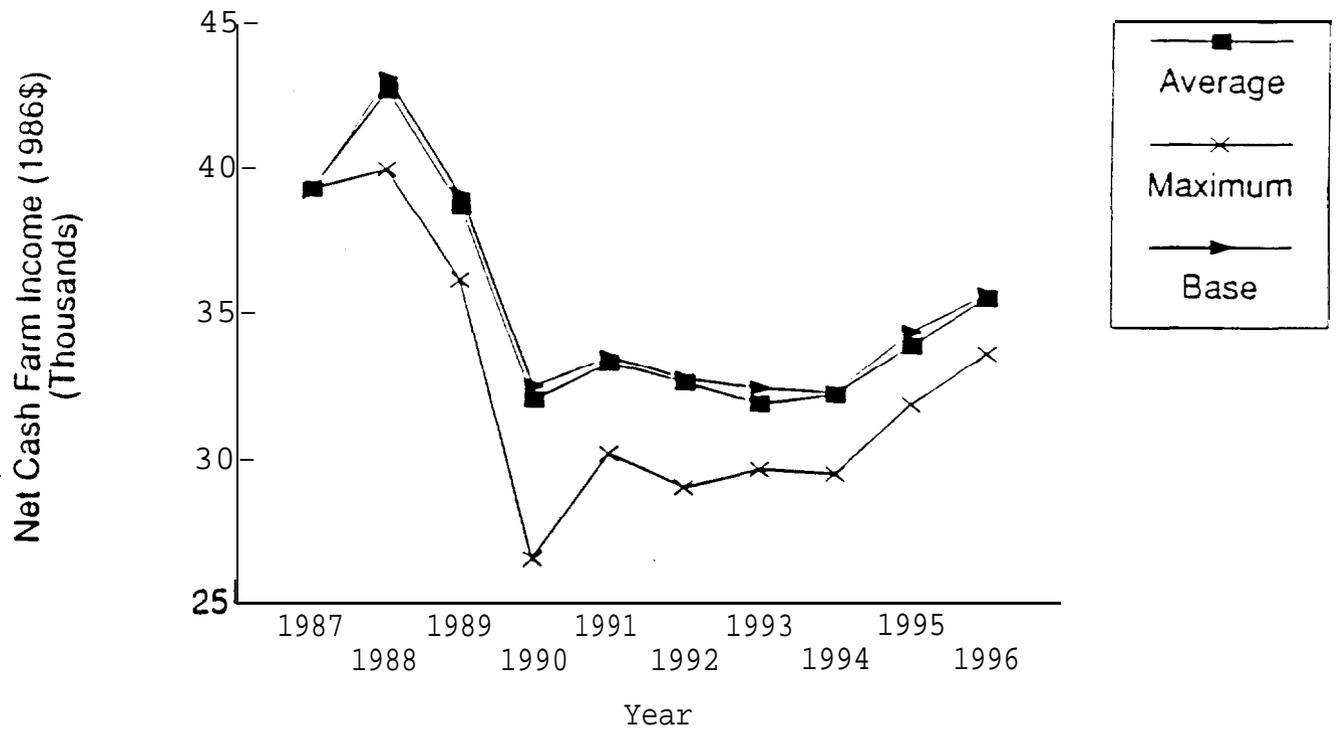


Figure D-1. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in average financial condition: Scenario 1

Illinois Corn Soybean Farm: Scenario 1

Vulnerable Financial Condition

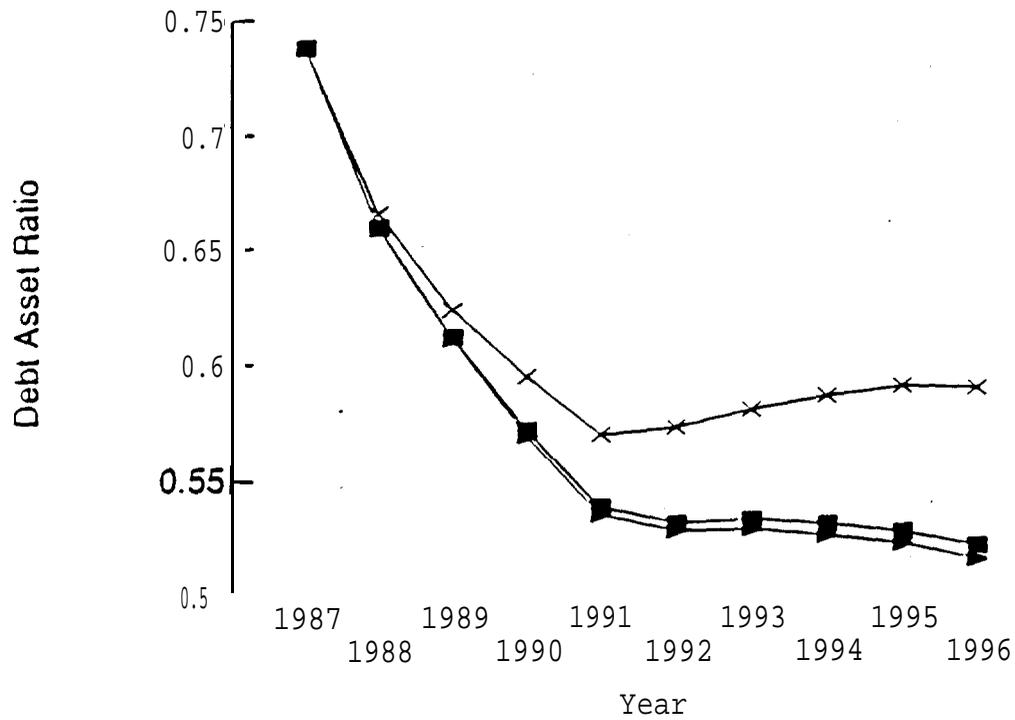
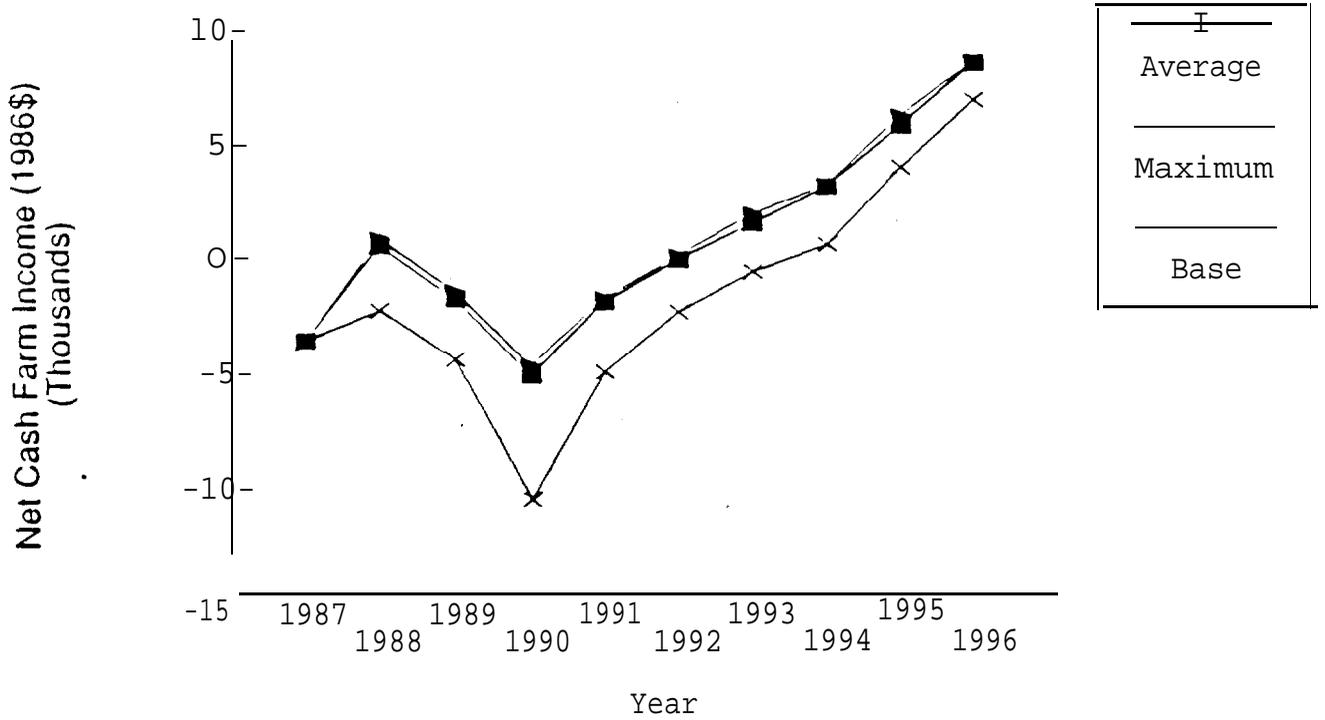


Figure D-Z. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in vulnerable financial condition: Scenario 1

Illinois Corn Soybean Farm: Scenario 2

Average Financial Condition

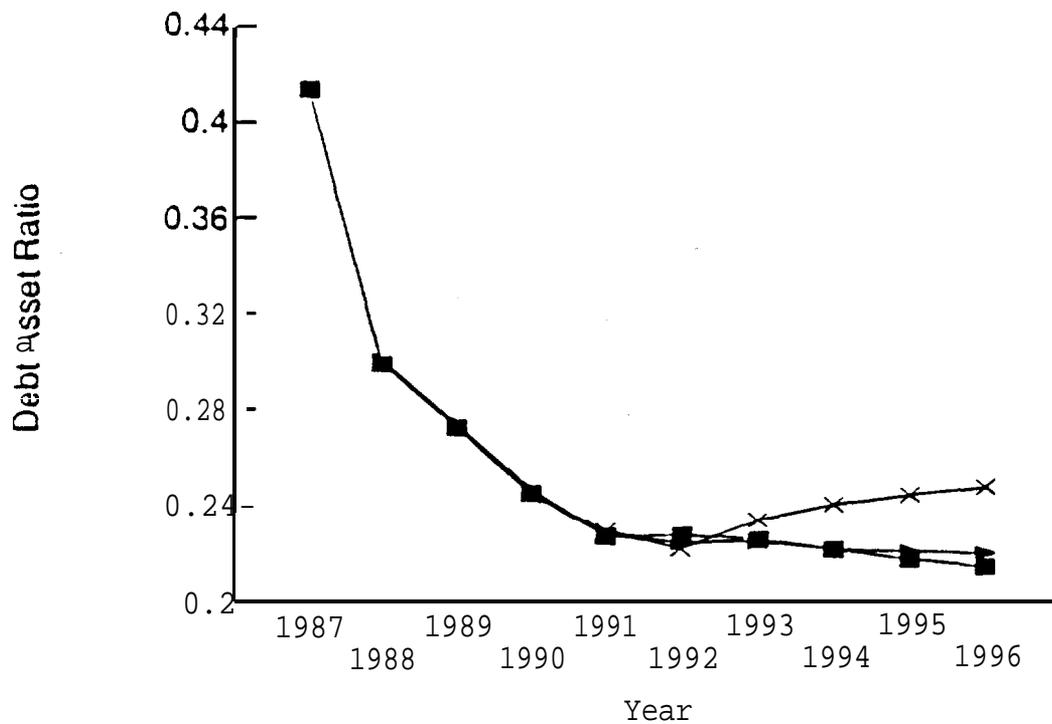
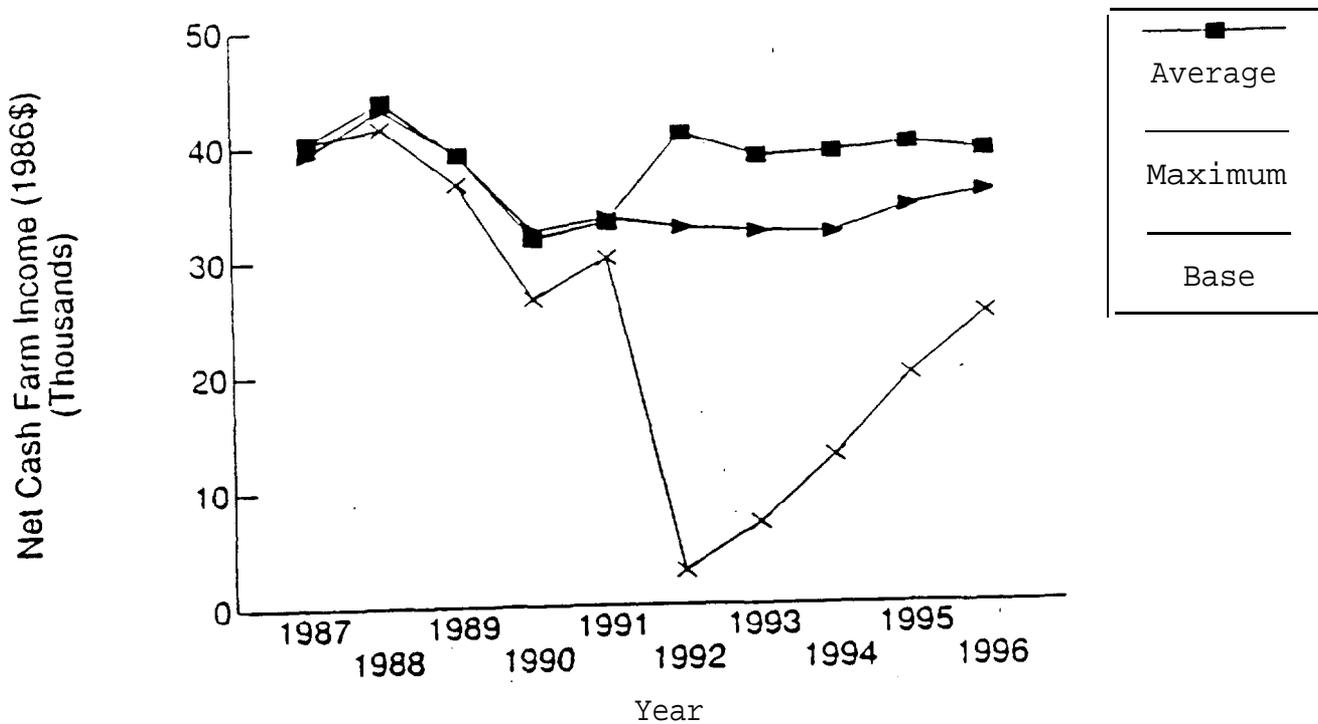


Figure D-3. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in average financial condition: Scenario 2

Illinois Corn Soybean Farm: Scenario 2

Vulnerable Financial Condition

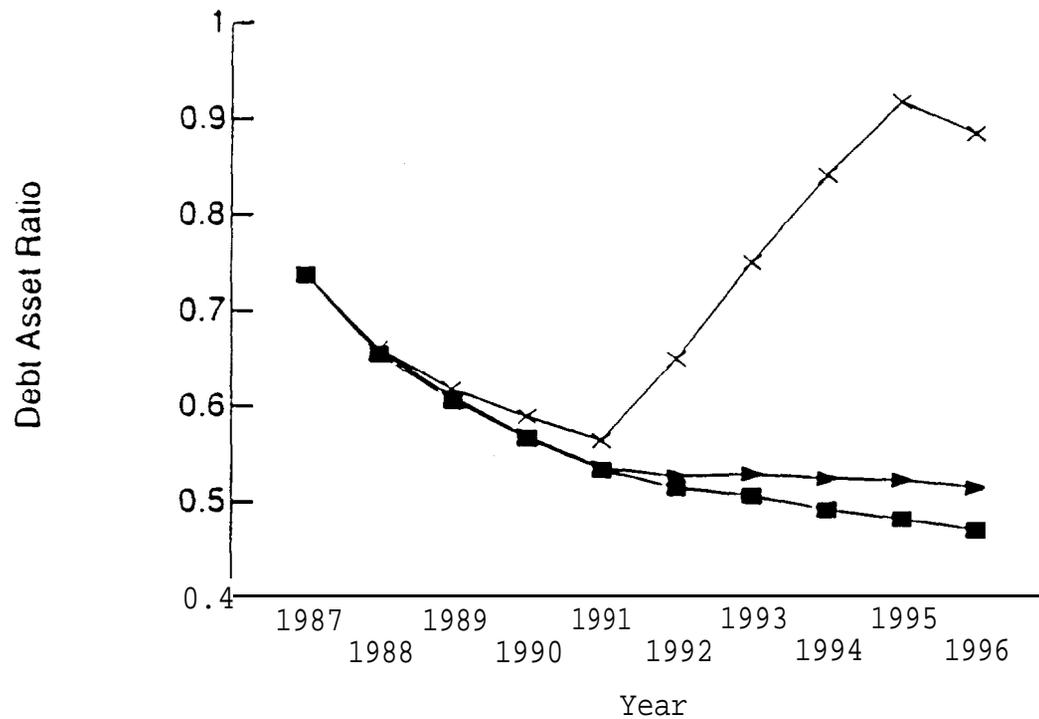
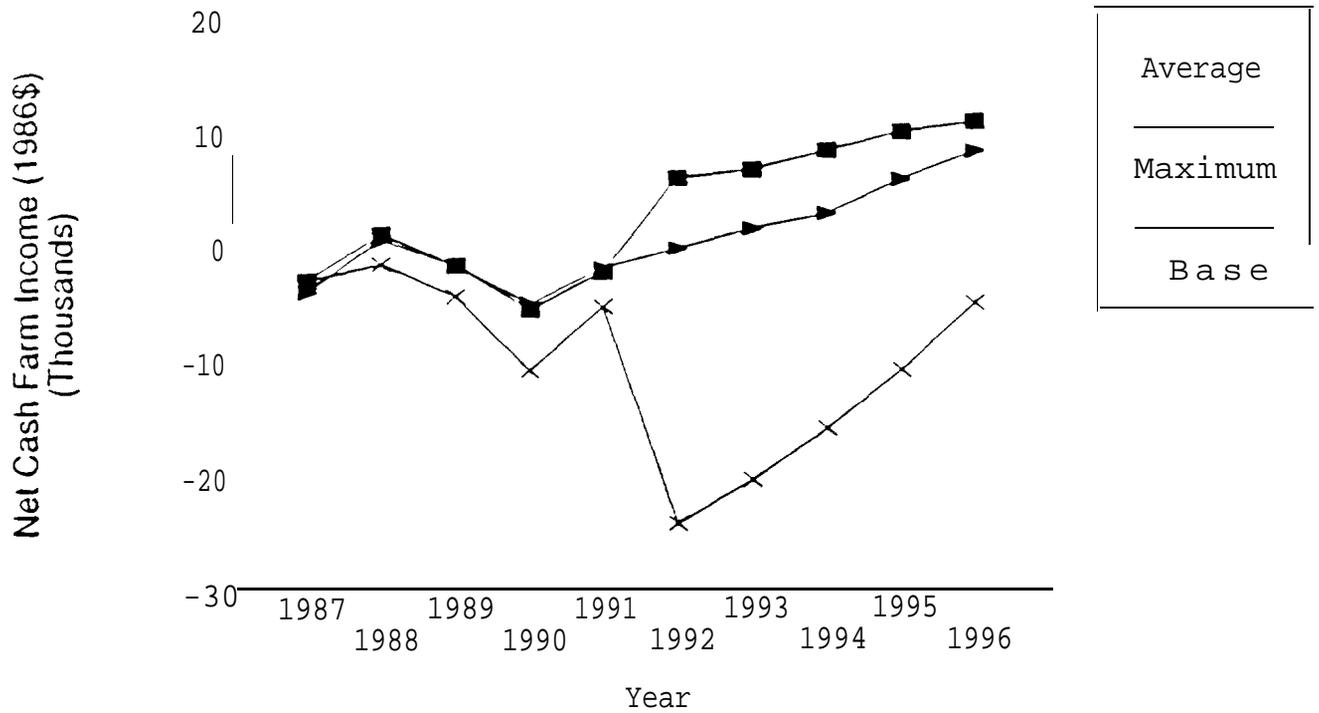


Figure D-4. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in vulnerable financial condition: Scenario 2

Illinois Corn Soybean Farm: Scenario 3

Average Financial Condition

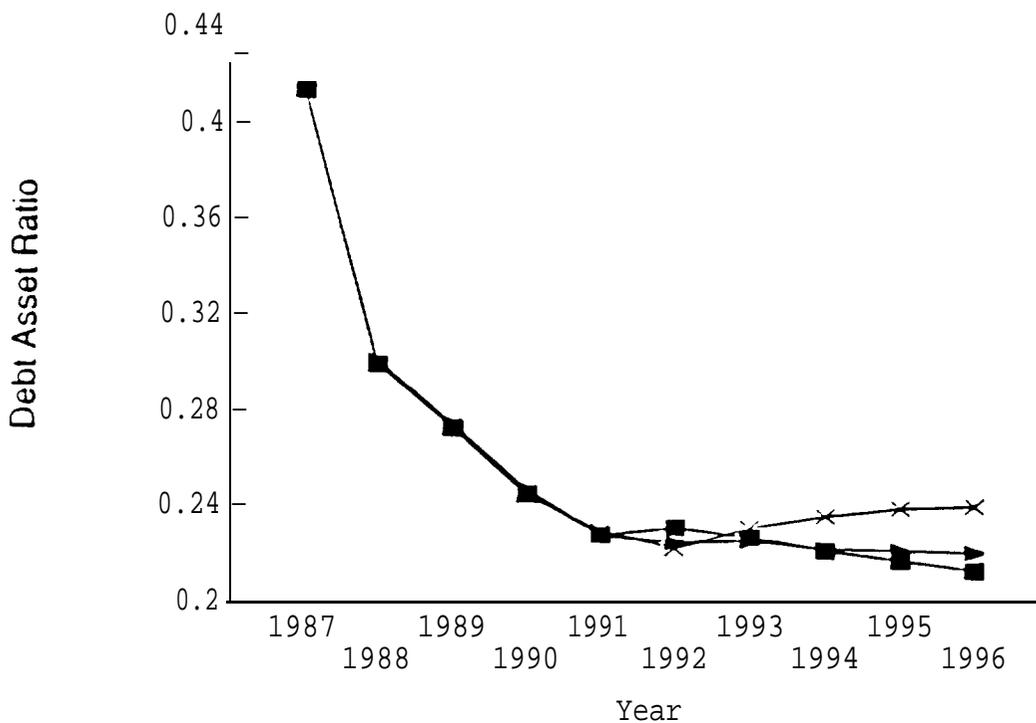
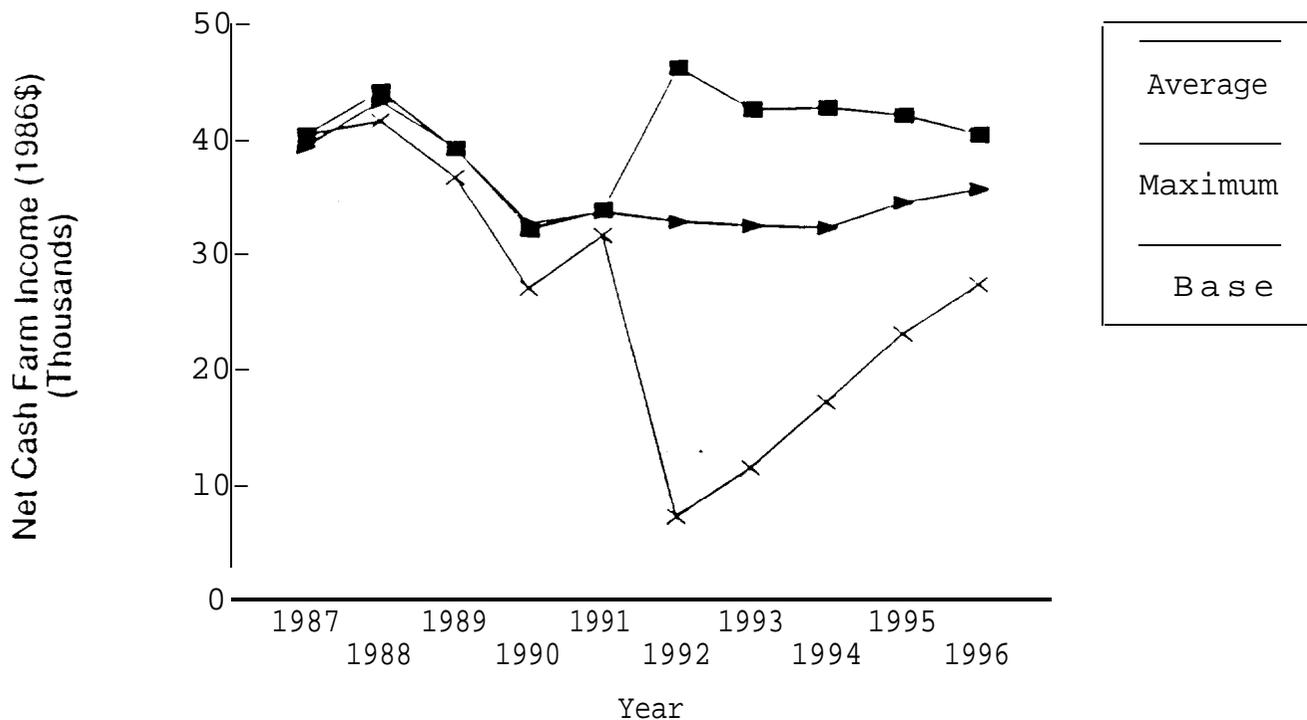


Figure D-S. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in average financial condition: Scenario 3

Illinois Corn Soybean Farm: Scenario 3

Vulnerable Financial Condition

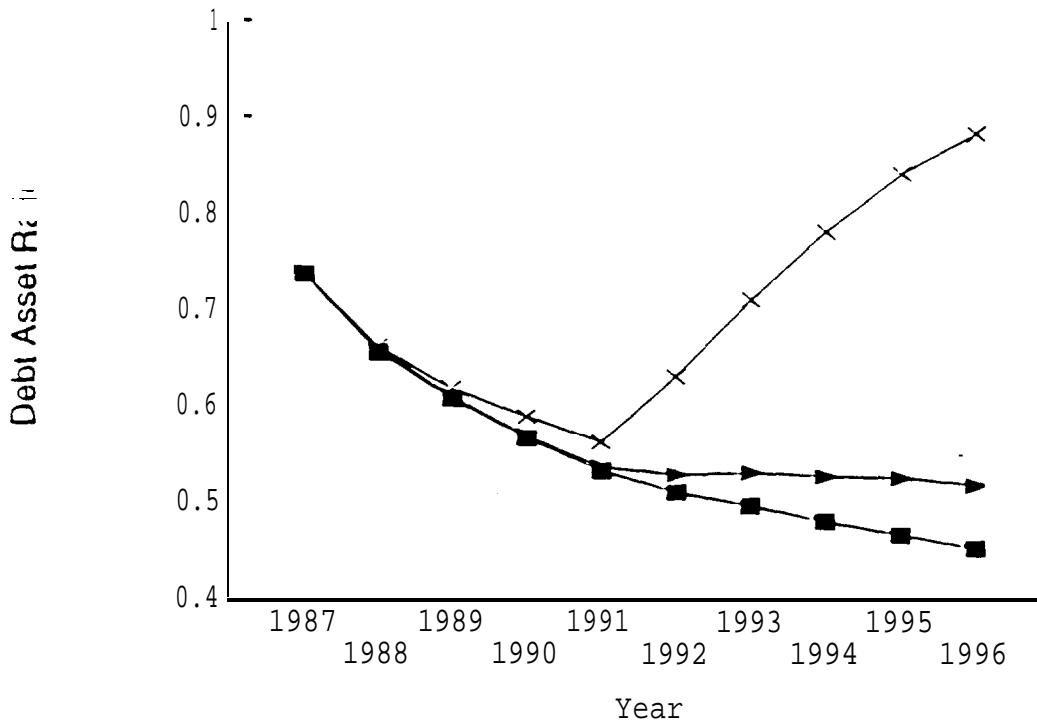
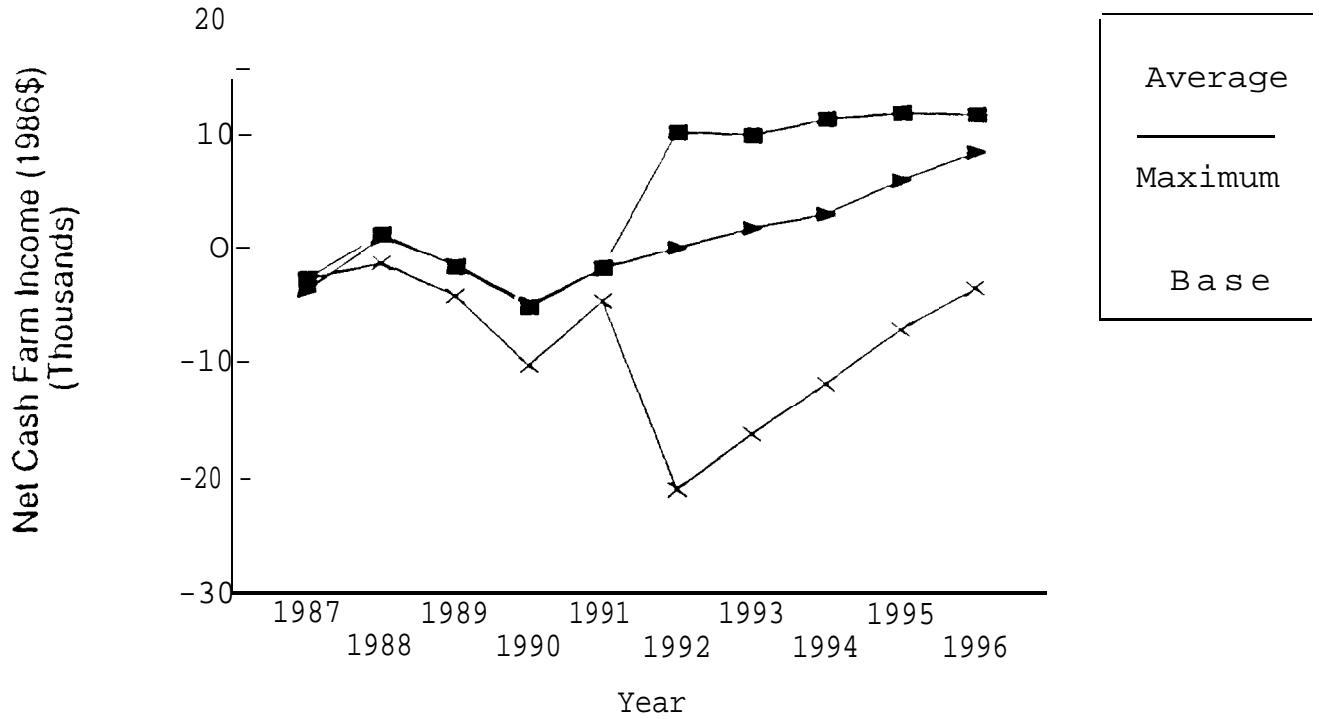


Figure D-6. EPA impacts on net cash farm income and debt asset ratio for a representative Illinois corn soybean farm in vulnerable financial condition: Scenario 3

MS Cotton Soybean Farm: Scenario 1

Average Financial Condition

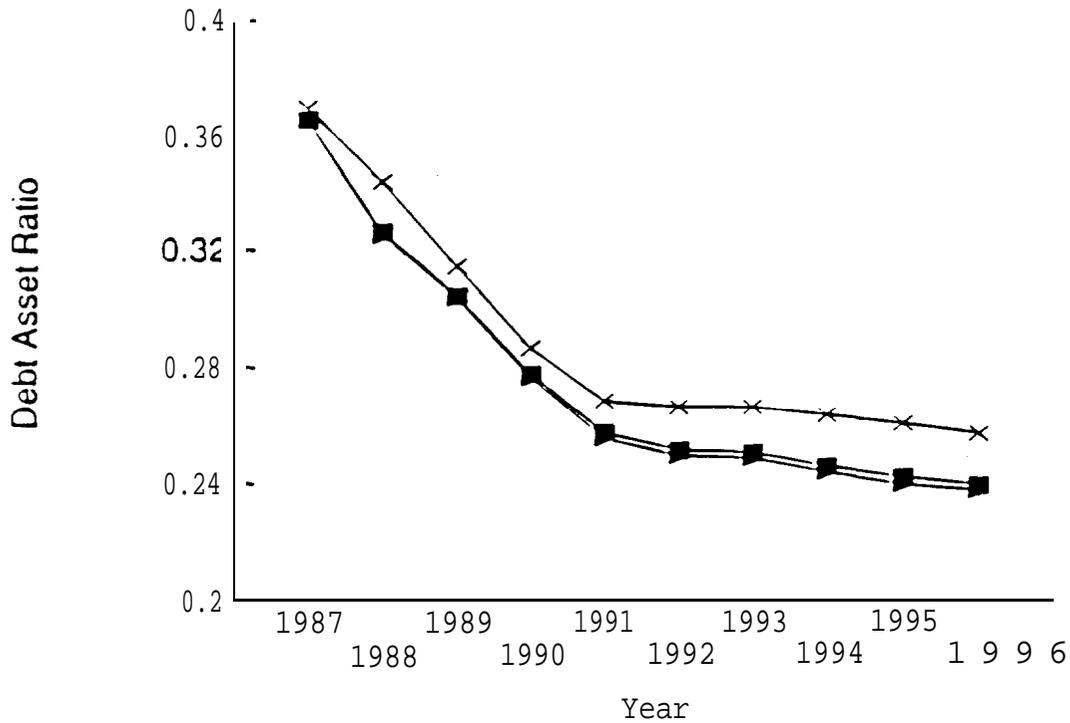
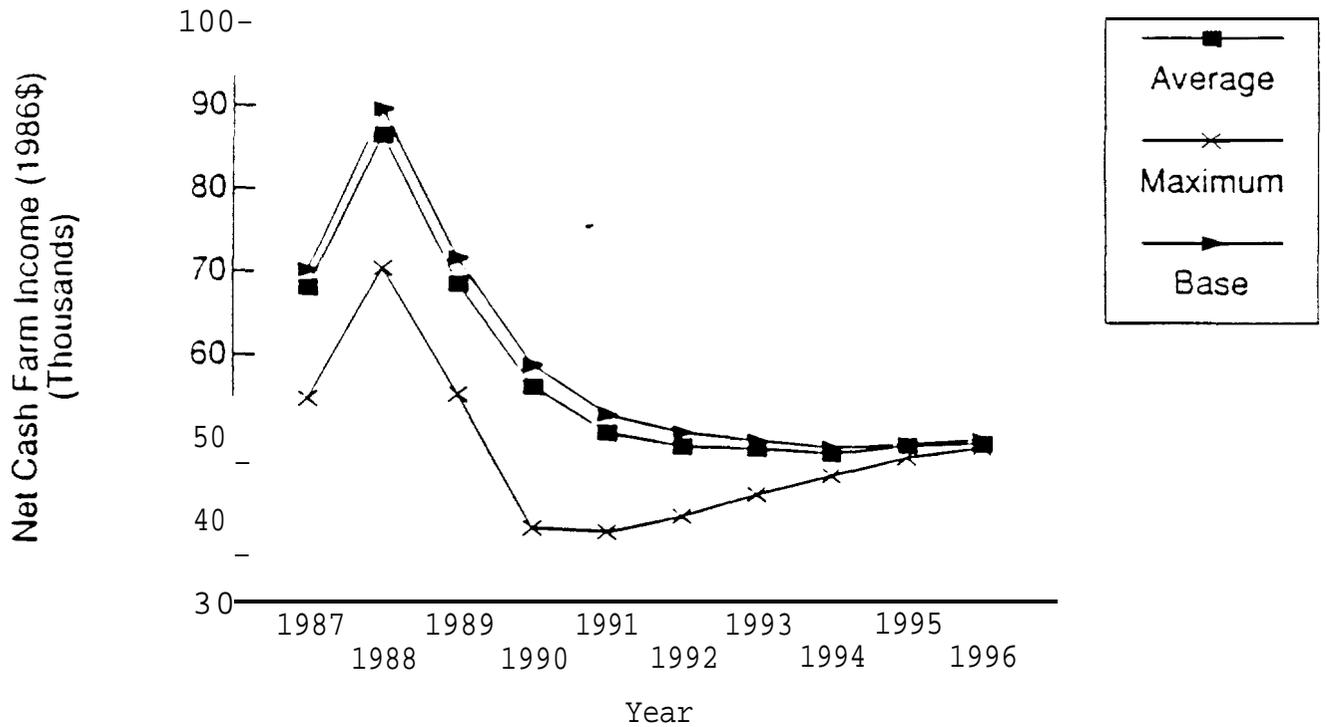


Figure D-7. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in average financial condition: Scenario 1

MS Cotton Soybean Farm: Scenario 1

Vulnerable Financial Condition

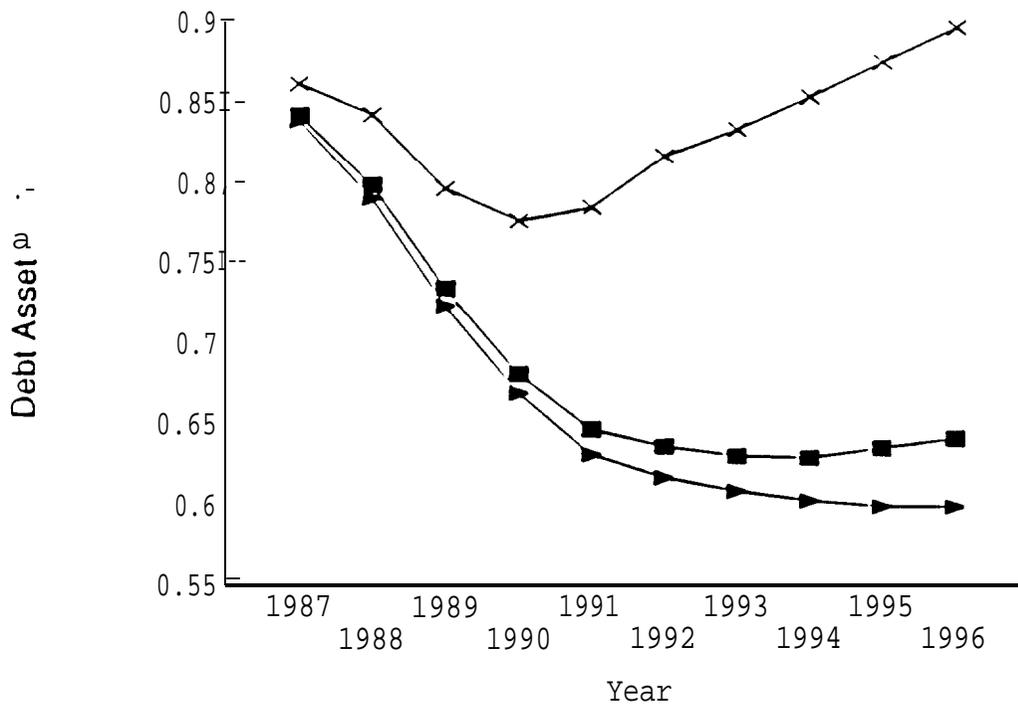
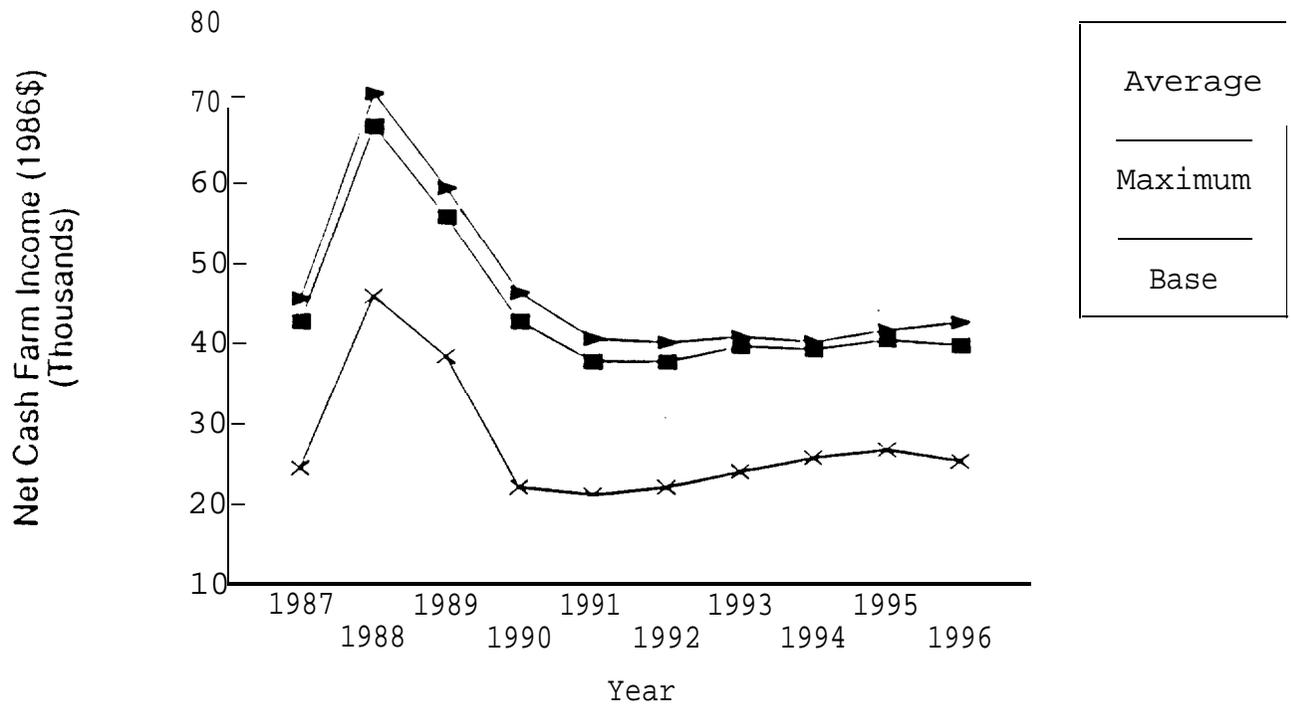


Figure D-8. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in vulnerable financial condition: Scenario 1

MS Cotton Soybean Farm: Scenario 2

Average Financial Condition

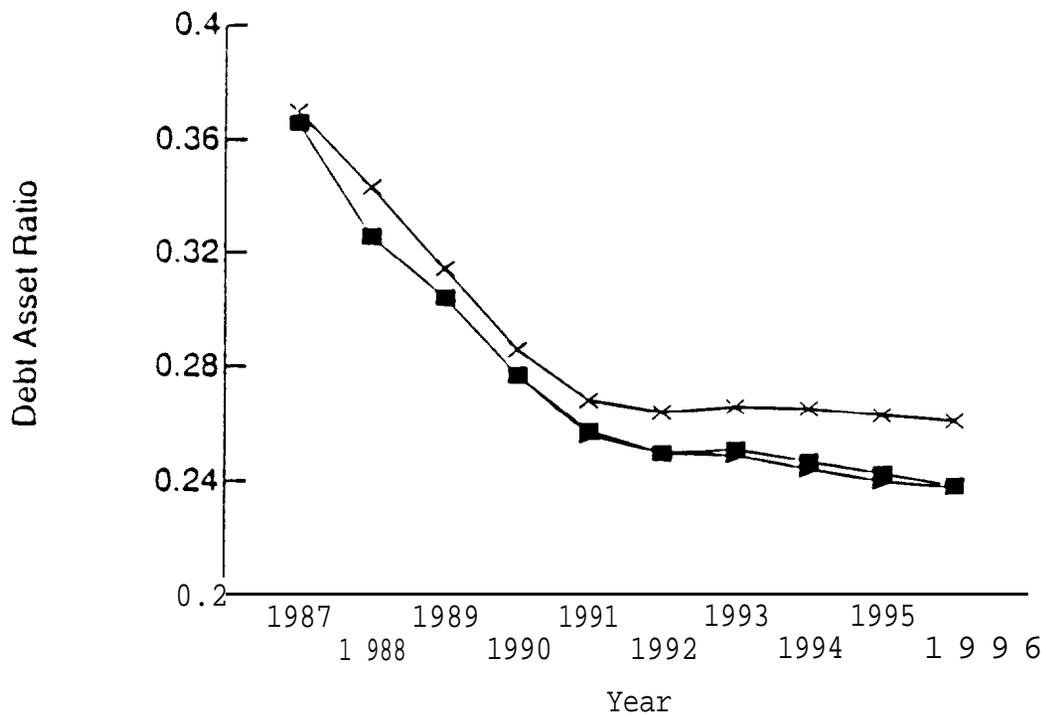
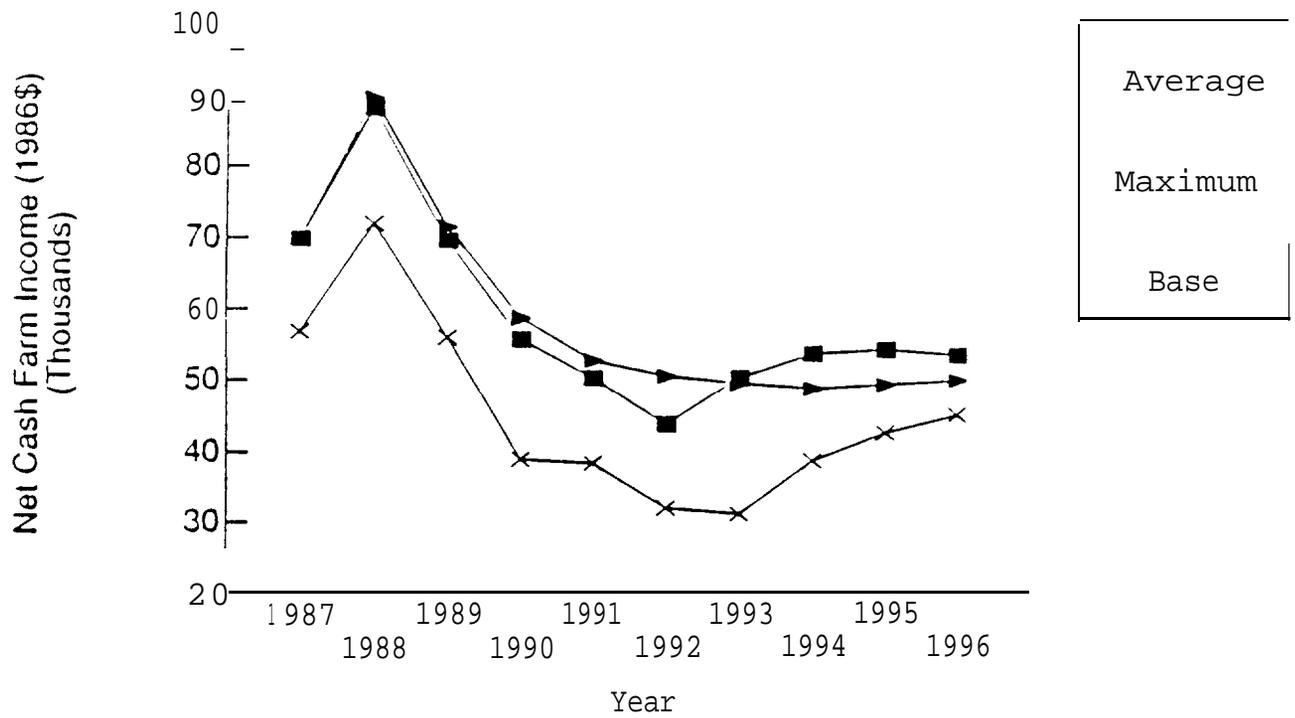


Figure D-9. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in average financial condition: Scenario 2

MS Cotton Soybean Farm: Scenario 2

Vulnerable Financial Condition

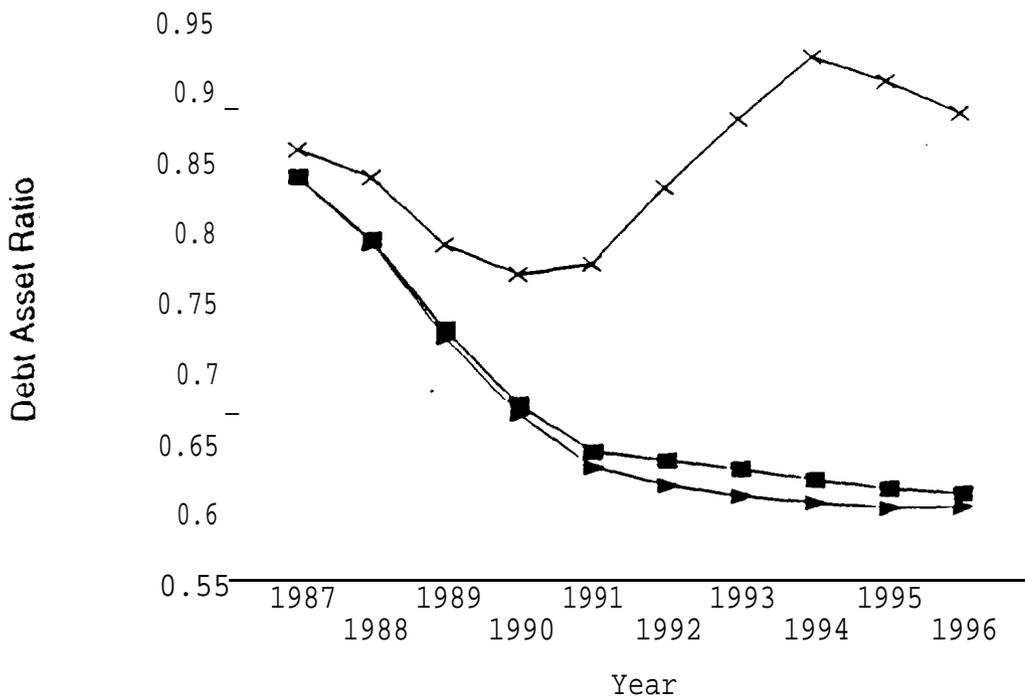
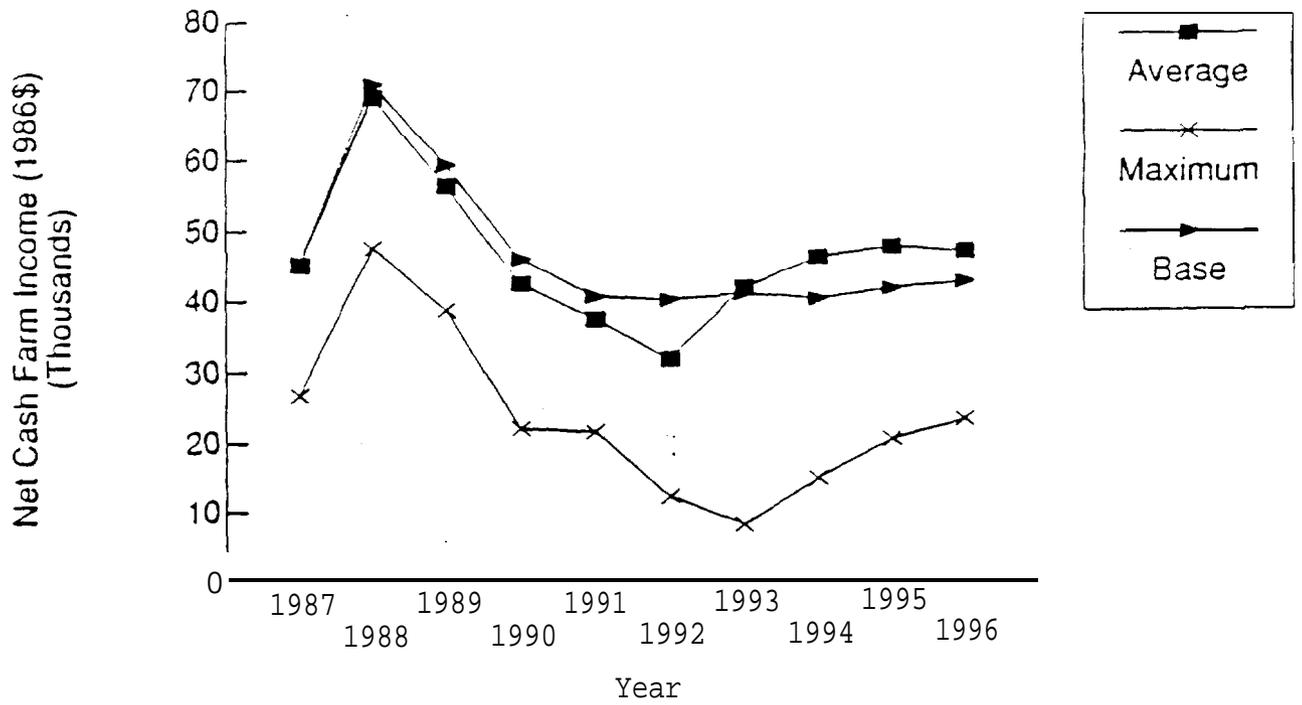


Figure D-10. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in vulnerable financial condition: Scenario 2

MS Cotton Soybean Farm: Scenario 3

Average Financial Condition

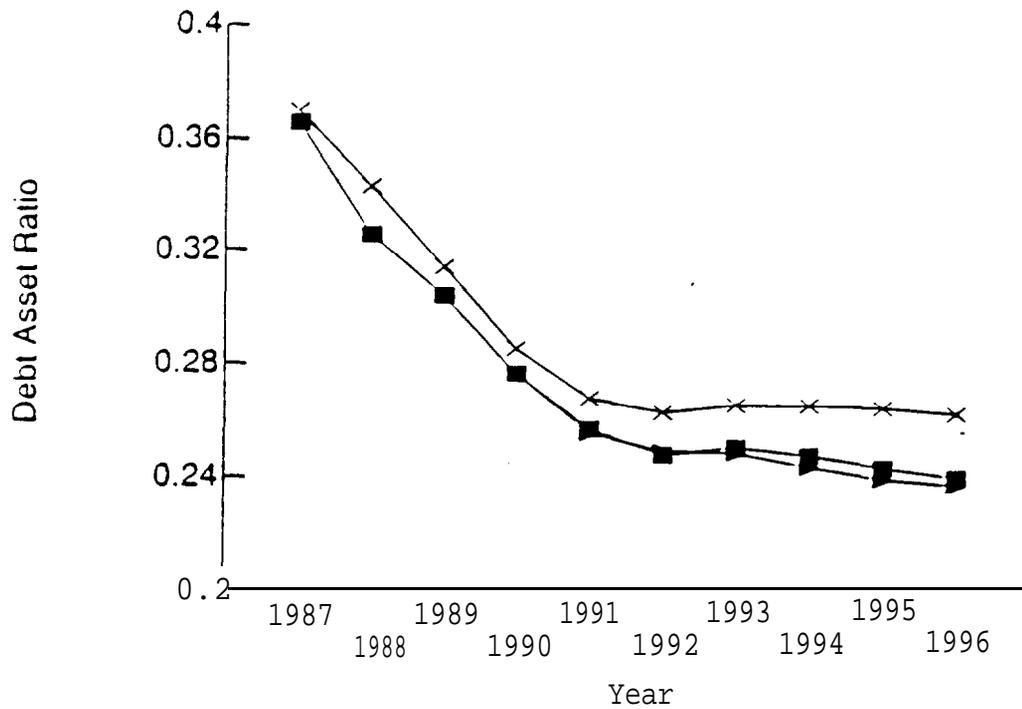
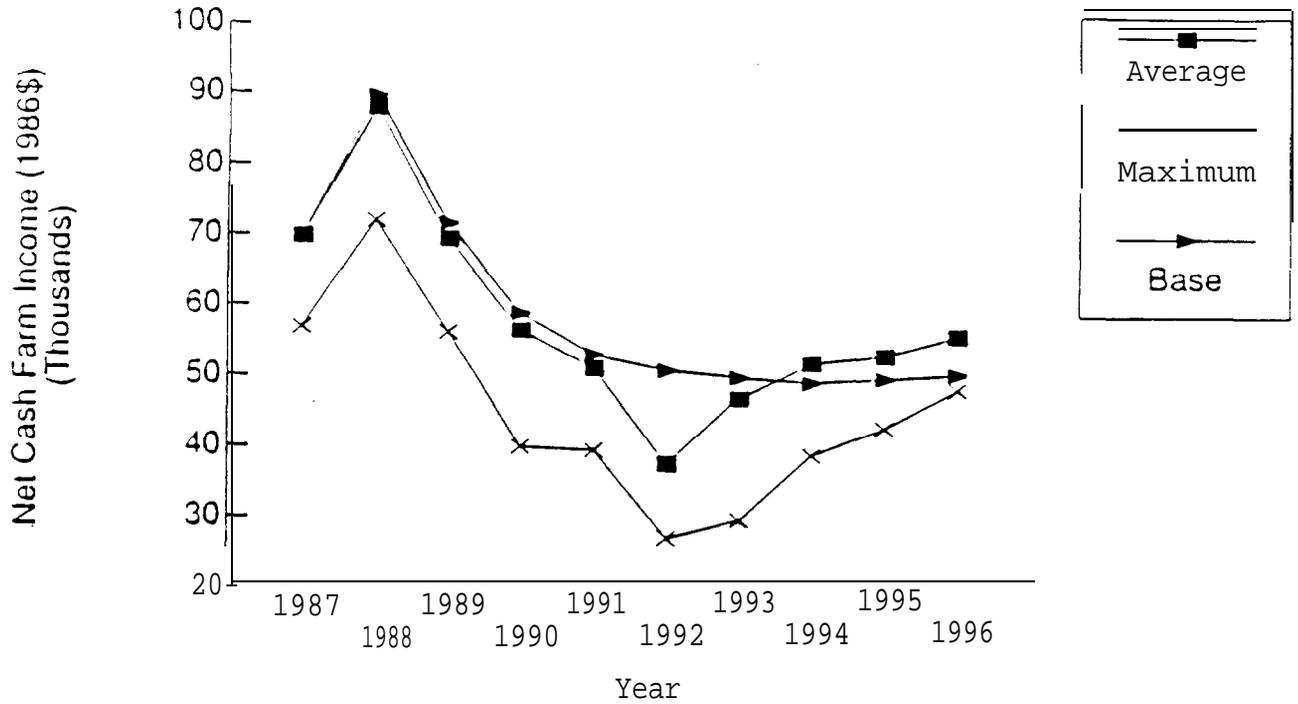


Figure D-11. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in average financial condition: Scenario 3

MS Cotton Soybean Farm: Scenario 3

Vulnerable Financial Condition

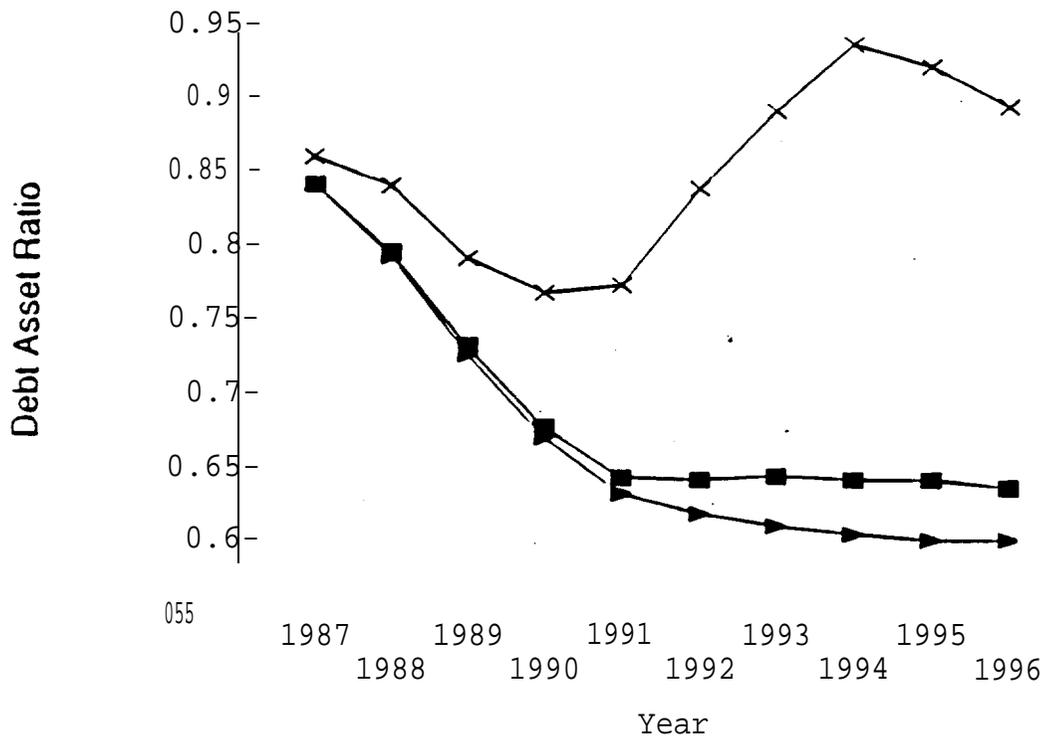
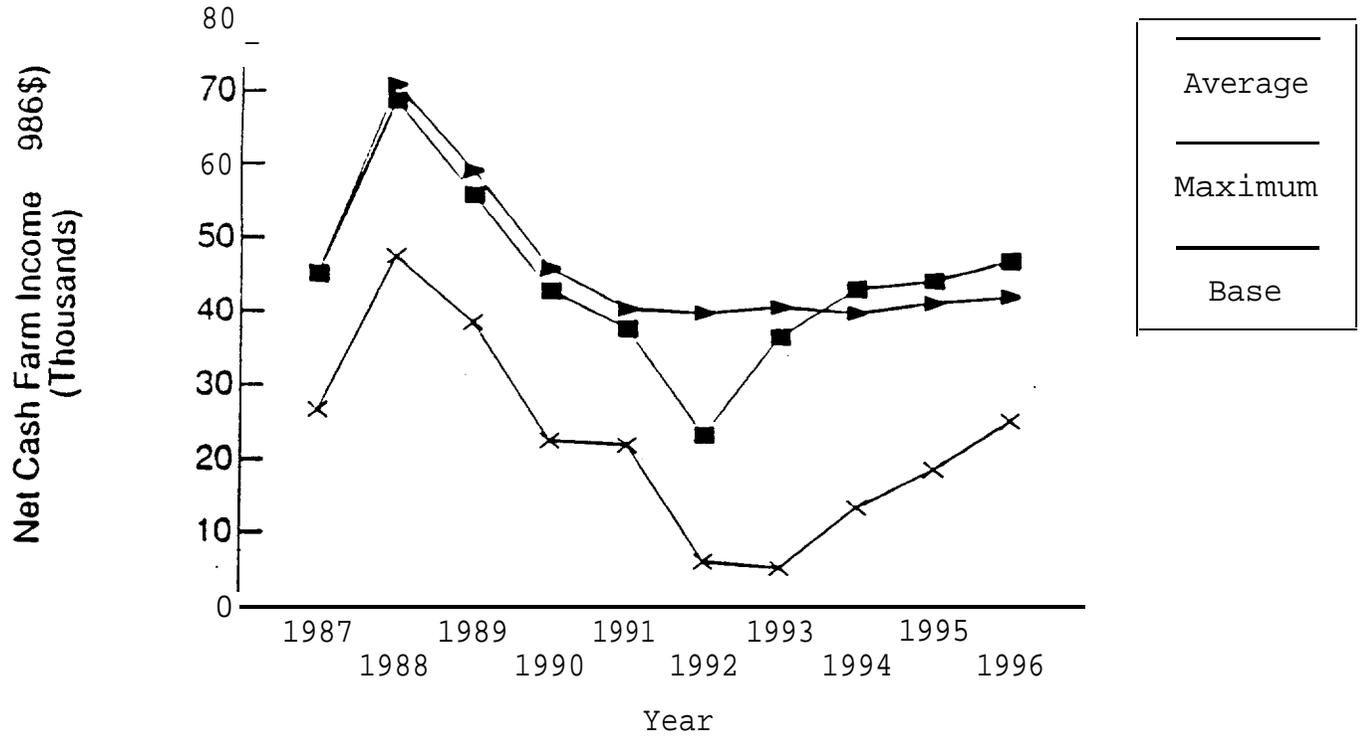


Figure D-12. EPA impacts on net cash farm income and debt asset ratio for a representative Mississippi cotton soybean farm in vulnerable financial condition: Scenario 3

Kansas Wheat Cattle Farm: Scenario 1

Average Financial Condition

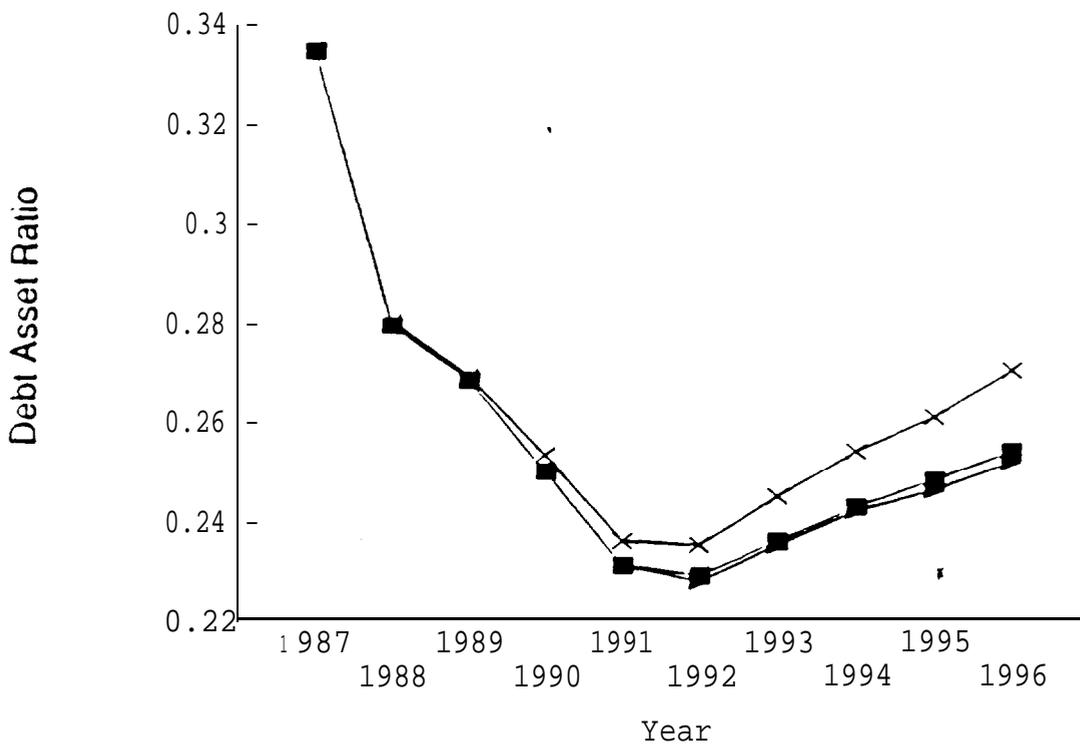
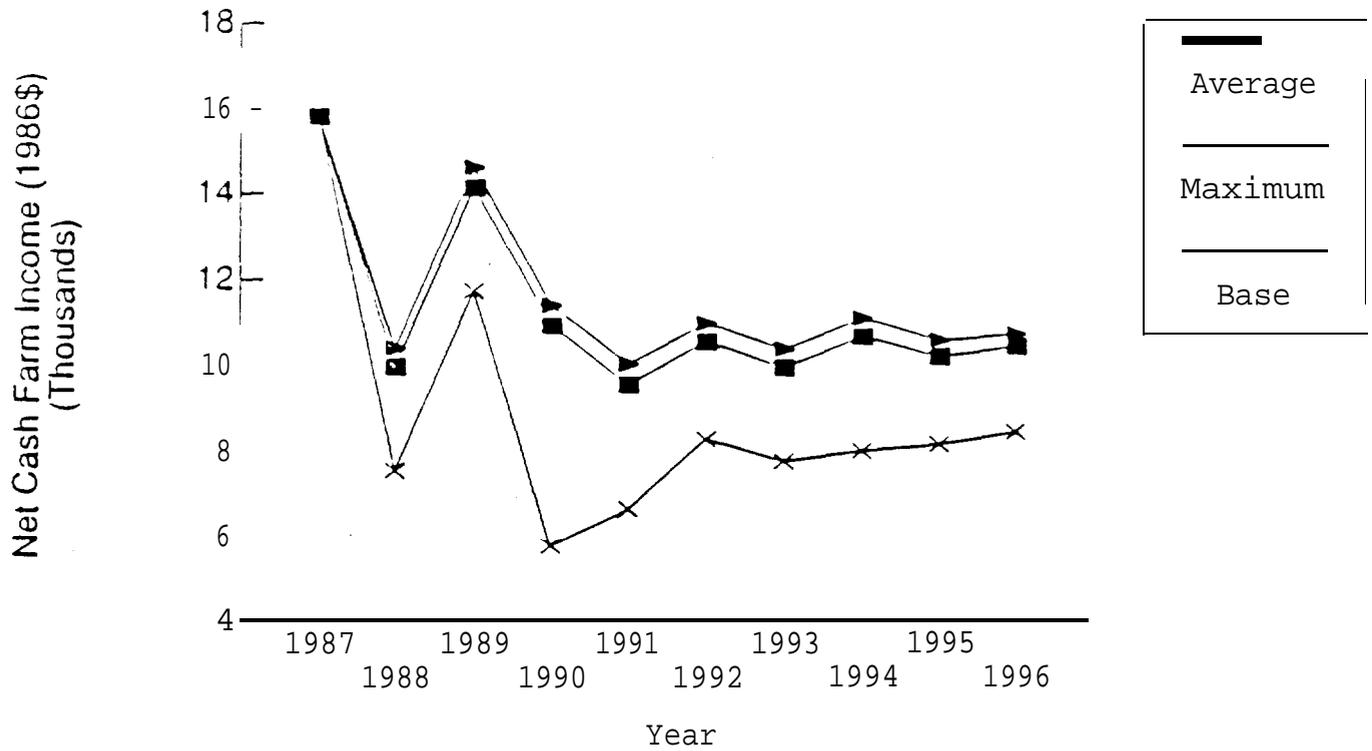


Figure D-13. EPA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in average financial condition: Scenario 1

Kansas Wheat Cattle Farm: Scenario 1

Vulnerable Financial Condition

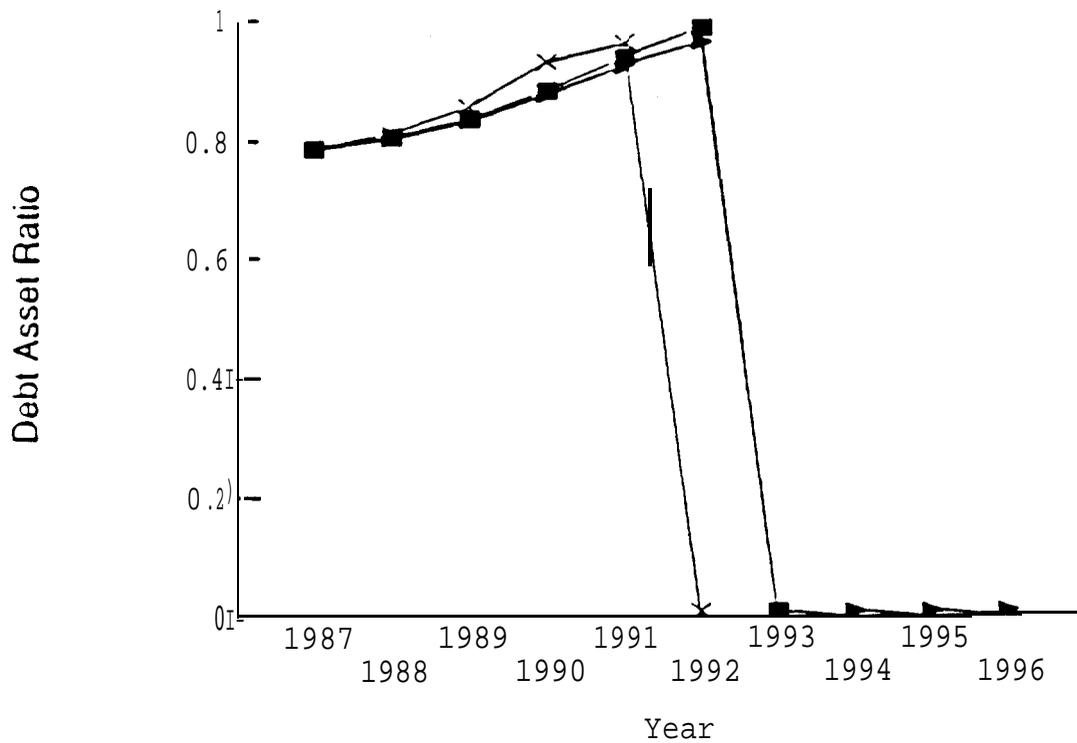
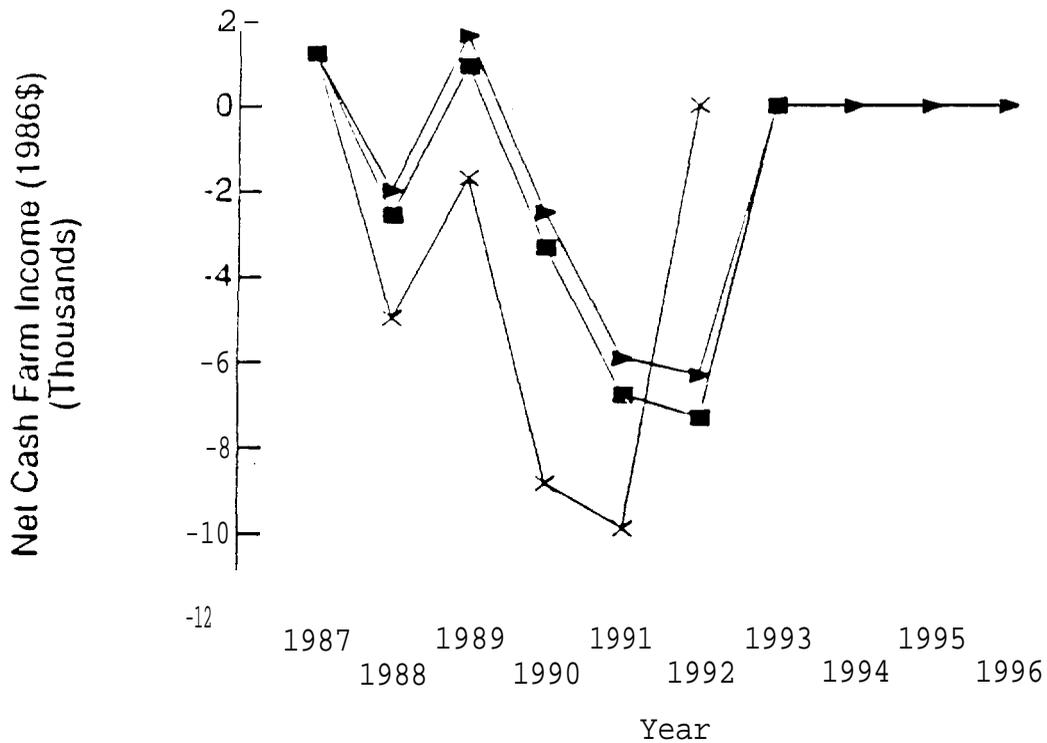


Figure D-14. EPA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in vulnerable financial condition: Scenario 1

Kansas Wheat Cattle Farm: Scenario 2

Average Financial Condition

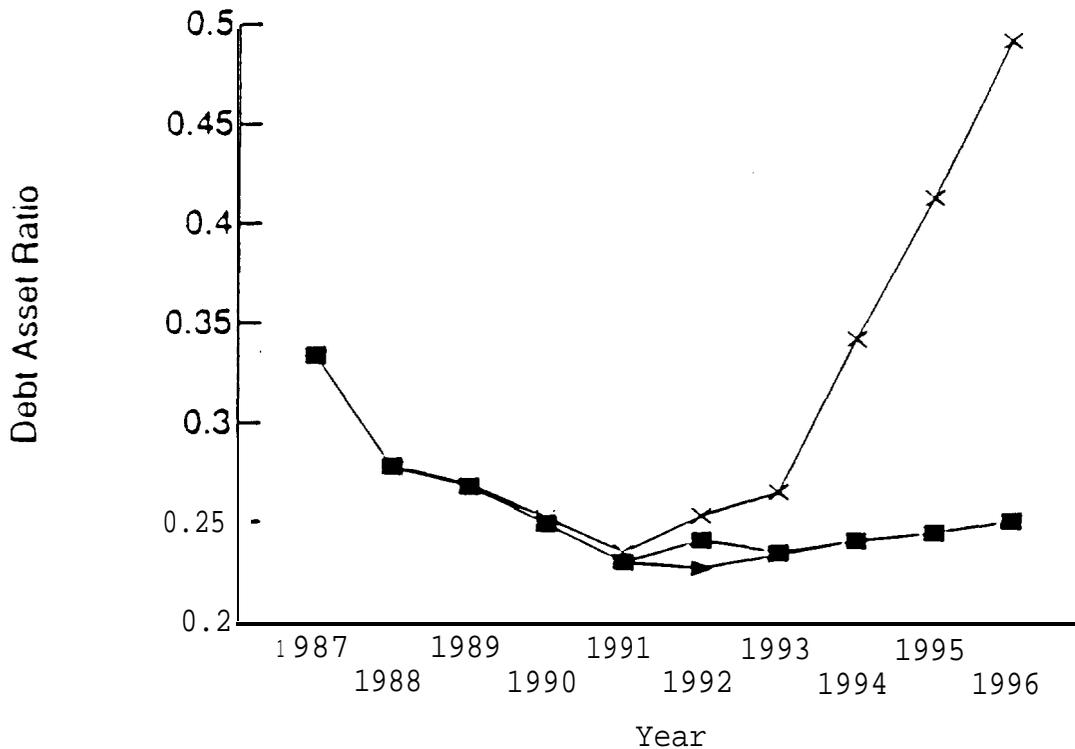
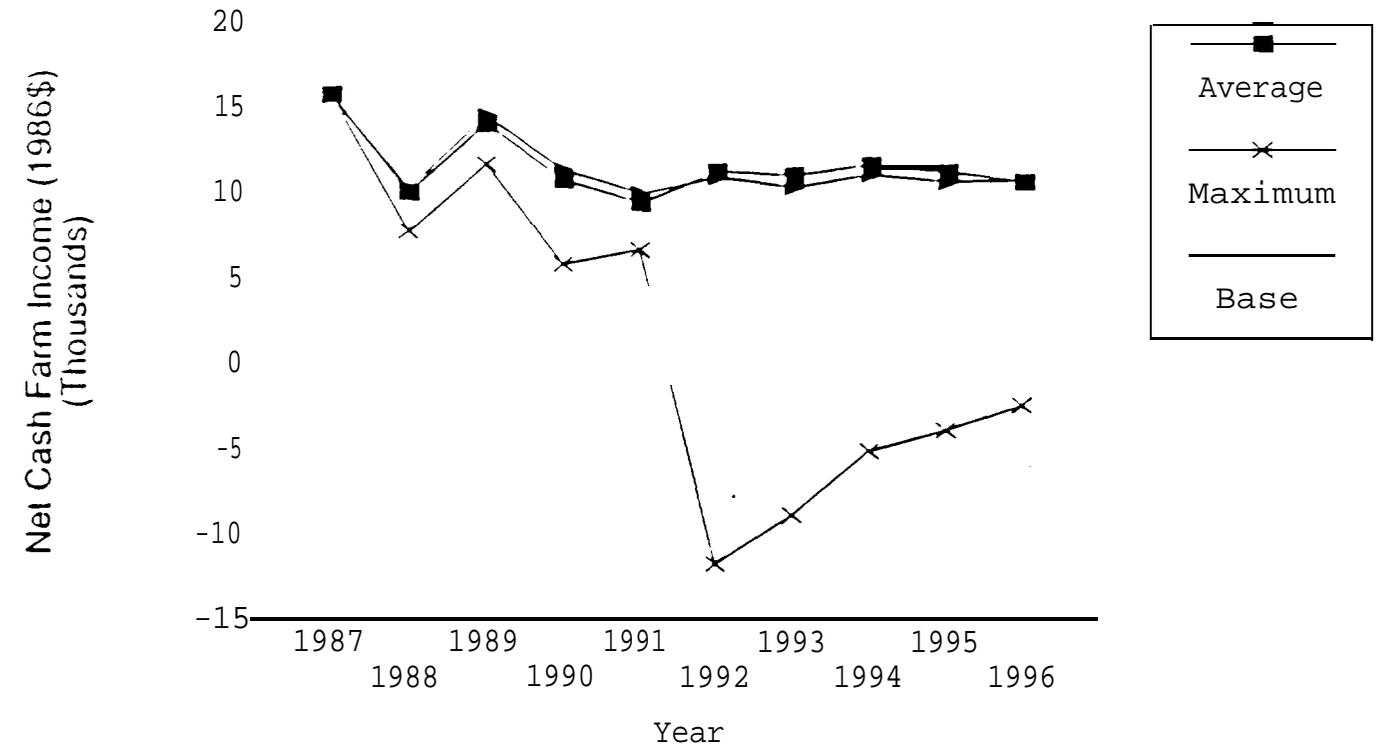


Figure D-15. EPA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in average financial condition: Scenario 2

Kansas Wheat Cattle Farm: Scenario 2

Vulnerable Financial Condition

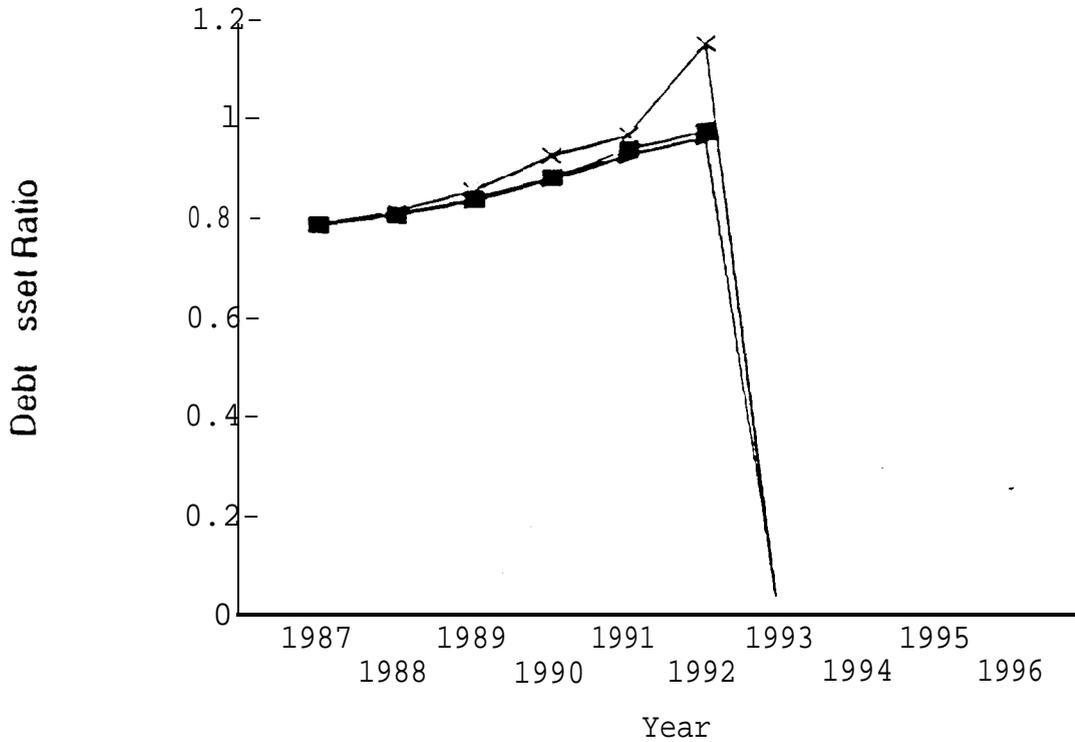
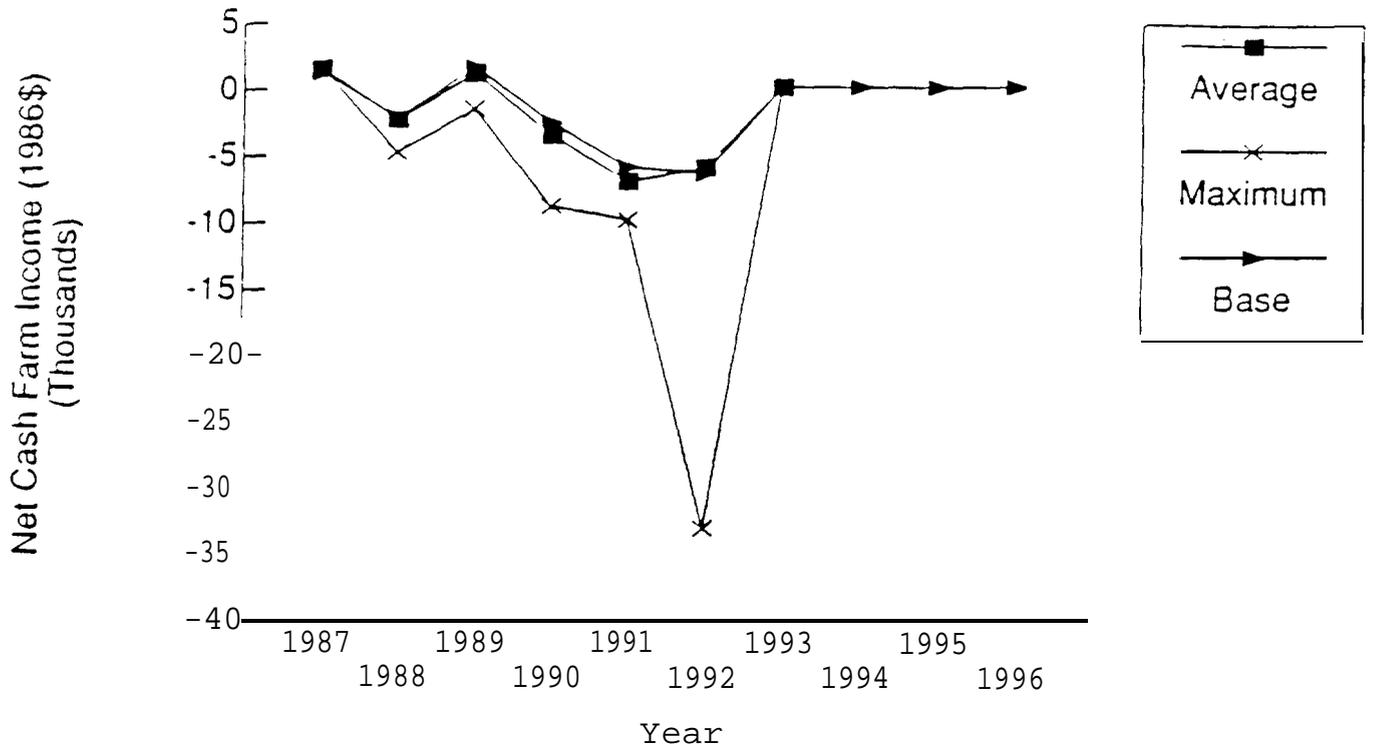


Figure D-16. WA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in vulnerable financial condition: Scenario 2

Kansas Wheat Cattle Farm: Scenario 3

Average Financial Condition

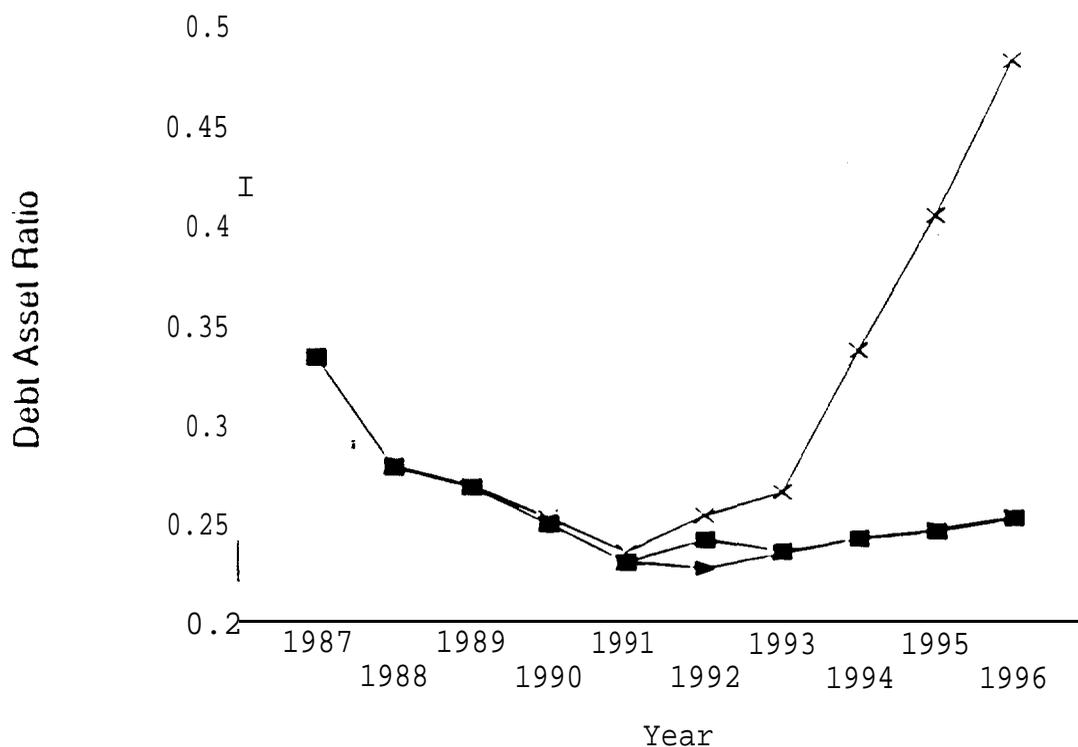
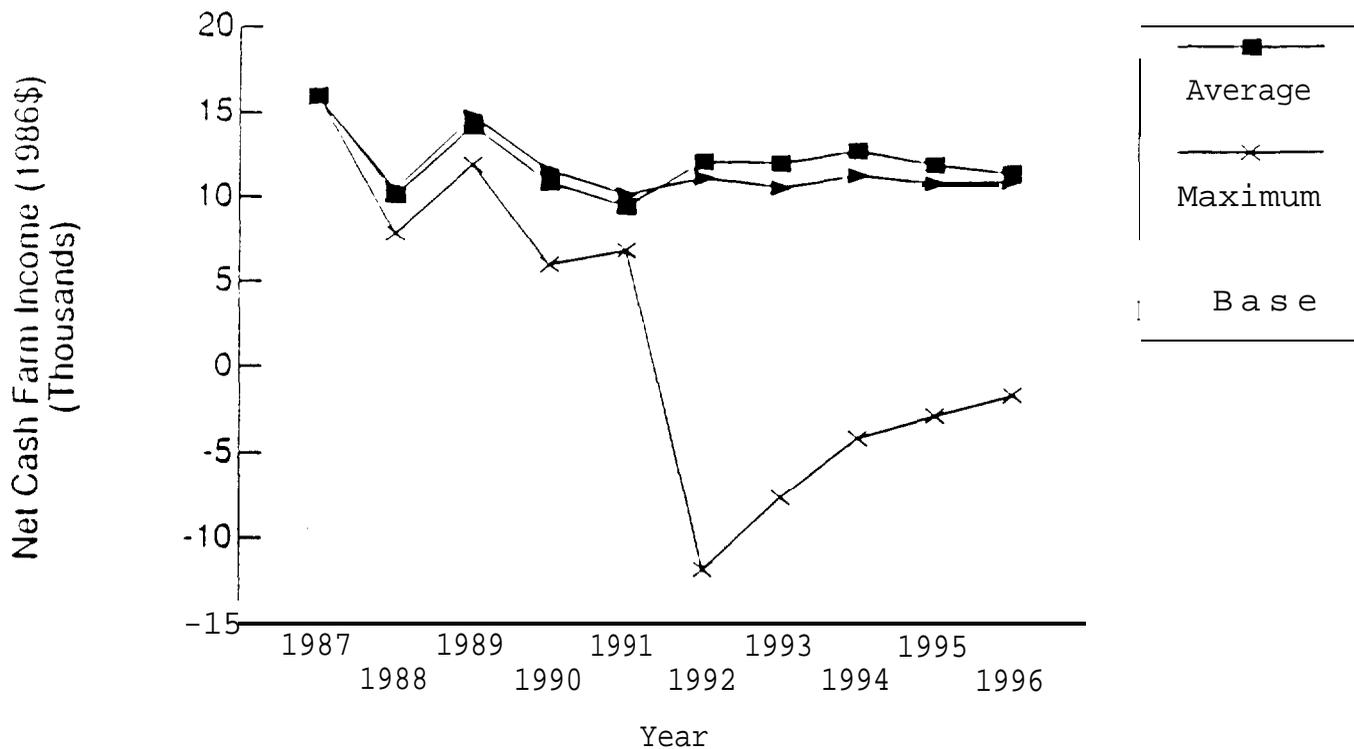


Figure D-17. EPA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in average financial condition: Scenario 3

Kansas Wheat Cattle Farm: Scenario 3

Vulnerable Financial Condition

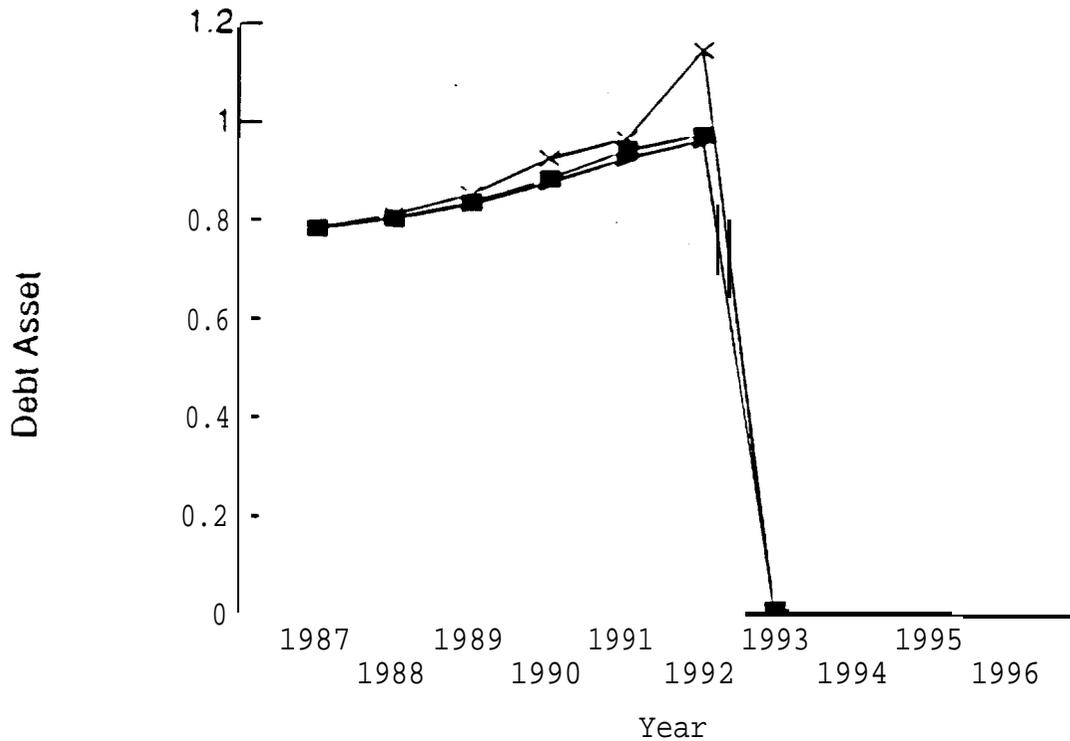
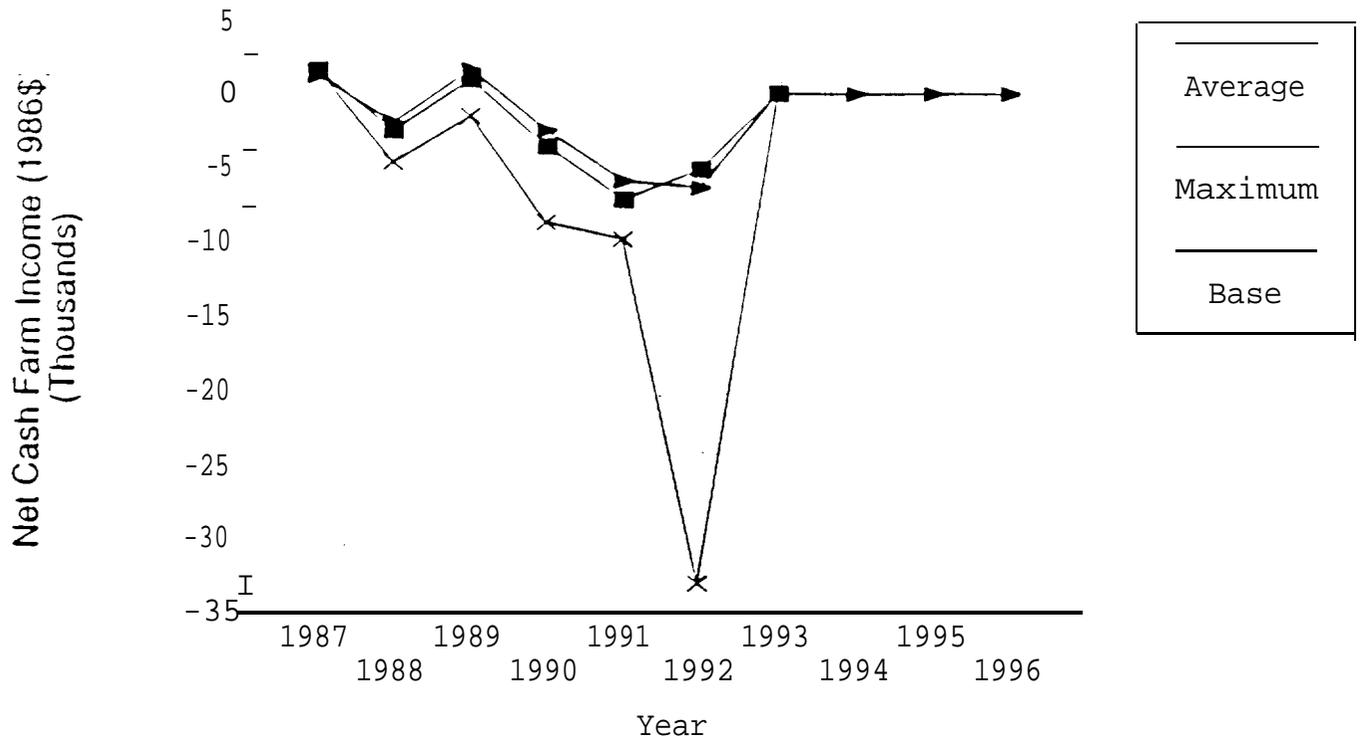


Figure D-18. EPA impacts on net cash farm income and debt asset ratio for a representative Kansas wheat cattle farm in vulnerable financial condition: Scenario 3