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Abstract
A better understanding of the relationship between a state's agricultural sector and the national agricultural economy increases the ability of agricultural interest groups to anticipate and understand policy developments. This paper develops and documents a state-level model of the Iowa agricultural sector. The model is used to evaluate the future performance of the Iowa agricultural economy, given a specific set of assumptions about the general economy, agricultural policies, the weather, and technology change. When the model is used to analyze the implications of the Dunkel text on agriculture, the increase in Iowa net farm income is found to be proportionally higher then the increase in U.S. net farm income, because Iowa's agricultural economy is concentrated in commodities that benefit from the Dunkel text.

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Agriculture, Policy, Models and assessment tools

Disciplines
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ABSTRACT

A better understanding of the relationship between a state's agricultural sector and the national agricultural economy increases the ability of agricultural interest groups to anticipate and understand policy developments. This paper develops and documents a state-level model of the Iowa agricultural sector. The model is used to evaluate the future performance of the Iowa agricultural economy, given a specific set of assumptions about the general economy, agricultural policies, the weather, and technological change. When the model is used to analyze the implications of the Dunkel text on agriculture, the increase in Iowa net farm income is found to be proportionally higher than the increase in U.S. net farm income, because Iowa's agricultural economy is concentrated in commodities that benefit from the Dunkel text.

A STATE-LEVEL AGRICULTURAL SECTOR POLICY MODEL: BASELINE AND IMPLICATIONS OF THE DUNKEL TEXT ON AGRICULTURE FOR IOWA

Understanding the implication of trends, issues, and agricultural policy implications is important to a wide audience of farm and agribusiness-related groups. Because of regional commodity specialization and diversities in production conditions, and the relative importance of different issues, various policy-related issues affect the regions of the country differently. The political effectiveness of regional interest groups with a stake in the development of agricultural policy also contributes to regional differences in policy impacts. At the state level, new initiatives such as beginning farmer programs, alternative cropping schemes, and value-added agricultural processing programs may also create regional diversity of policy outcomes.

These regional differences in agriculture and agricultural policy concerns have increased interest in understanding the implications of policy issues for a particular state's economy. Although interest usually peaks when a new farm bill is being debated, interim issues such as the General Agreement on Tariffs and Trade (GATT) negotiations and the North American Free Trade Agreement (NAFTA) also concern agricultural constituencies and may affect individual state economies differently. Both GATT and NAFTA have the potential to affect international trade for particular commodities differently, resulting in variant impacts to state economies and producer groups within those states. A better understanding of the relationship between a state's agricultural sector and the national agricultural economy increases the ability of agricultural interest groups to anticipate and understand policy developments.

This paper develops and documents a state-level model of the agricultural sector for Iowa. Results from the model are used to evaluate the expected performance of the Iowa agricultural sector under provisions of the Food, Agricultural, Conservation and Trade Act of 1990 (FACTA-90) and the Omnibus Budget Reconciliation Act of 1990 (OBRA-90). The framework provided by the analysis of GATT for the United States is then used to analyze implications for Iowa agriculture of the proposed changes to agriculture and agricultural trade made by Arthur Dunkel in the Uruguay Round of GATT negotiations.

Method of Analysis

The basic strategy of this analysis is to link the state agricultural sector to national commodity markets to determine state-level commodity production and prices. Farm production cost estimates are based on the cropping pattern and livestock mix within the state along with national-level macroeconomic factors. This approach is based on the assumption that one state's production of these commodities does not significantly affect outcomes at the national level, but that there may be different cropping patterns and degrees of specialization that will result in different costs of production by state.

The analysis begins at the national level, where major U.S. crop and livestock markets are modeled using the agricultural policy model of the Food and Agricultural Policy Research Institute (FAPRI). The FAPRI model determines the production, domestic use, trade, stocks, and prices of major crop and livestock products. For beef, pork, chicken, turkey, dairy, feed grains, wheat, soybeans, rice, and sugar, structural econometric equations are used to develop estimates for the United States and other major trading countries. Structural econometric equations are also utilized to determine results for the U.S. cotton and hay sectors. A set of satellite models combine the commodity price and quantity results with the program assumptions to provide estimates of U.S. government costs, farm receipts, production costs, and net income (see Devadoss et al. 1989).

The Iowa Agricultural Model

Since the national-level models consider the interaction among commodities, the state-level models are linked recursively to the national model. The Iowa agricultural model consists of five components representing the markets for the five major Iowa commodities: corn, soybeans, beef, pork, and dairy. Each component links Iowa production, price, marketing, and cash receipts from marketings to the U.S. crops and livestock sectors in the FAPRI agricultural model. Production expenses in Iowa are not directly linked to U.S. levels because of regional specialization and differences in production practices in Iowa versus the rest of the United States. Equations are estimated for individual variable production expense categories and total fixed expenses based on levels of crop and livestock production activities in Iowa. Iowa farm income is derived by linking the components of cash receipts and payments from government agricultural programs with estimates of production expenses.

The linkages to the U.S. agricultural sectors allow evaluation of agricultural policy impacts on the Iowa farm economy. Since there is simultaneous price determination in the U.S. markets, a change in one component affects all other components. For example, both the demand for and the supply of feed grains affect other feed crops and have an impact on the livestock sector. As each component in the Iowa model is linked to its respective component in the U.S. agricultural economy, the model allows adjustment in all sectors, if any of the policies inherent in the model are changed. Specifically, for the crops sector, corn and soybean acreage and prices are directly linked to U.S. acreage and prices. Production depends on acreage, and marketings on production. Cash receipts are the product of prices and marketings. Therefore, a policy affecting acreage ultimately would affect cash receipts in the crops sector and farm income. Since the crops and livestock sectors affect each other, this same acreage impact would also affect the Iowa farm economy through the Iowa livestock sector.

The structure for estimating costs of production includes national as well as state-level variables. Total expenses are determined by production levels and production intensities for individual commodities at the state level that affect input quantities purchased and by macro variables, such as interest and inflation rates, that affect price levels.

Theoretical Specification of the Model

The theoretical specification of the Iowa agricultural model is presented in Table 1. Since prices and production of both crops and livestock in Iowa are assumed not to substantially influence levels in the U.S. market, these relationships are recursive and OLS estimation techniques are appropriate. Area planted equations for both corn and soybeans are estimated as a function of U.S. area and U.S. area squared. Each of the squared terms is expected to have a negative sign, because the potential cultivated land base in Iowa is more fixed than the national base in corn and soybeans and substantial expansion of Iowa's area is not feasible. The pork production equation also includes a squared U.S. production term because the data indicate that pork production is more subject to existing capacity restrictions than is production elsewhere. The cattle production equation includes trend variables to capture the continuing shift of cattle production out of Iowa and into other regions of the United States, particularly into Kansas and Nebraska. The milk production equation includes a shift variable beginning in 1983, when a diversion program and high feed costs resulted in a permanent reduction in Iowa milk production relative to that in the rest of the United States. There was a similar diversion program in 1986 but it was coupled with favorable feed costs and it did not have a substantial effect on production. Other estimated equations on the supply side of the Iowa agricultural model are estimated as functions of national-level variables.

Table 1. Theoretical specification of the Iowa agricultural model

Corn Supply

Area planted = f(U.S. corn area, U.S. corn area squared)
Area harvested = f(Iowa planted area, proportion of U.S. harvested to planted area)
Yield = f(U.S. yield, trend)
Production = Area harvested * Yield
Market price = f(U.S. farm price)
Value of production = Production * Market price

Soybean Supply

Area planted = f(U.S. soybean area, U.S. soybean area squared)
Area harvested = f(Iowa planted area)
Yield = f(U.S. yield)
Production = Area harvested * Yield
Market price = f(U.S. farm price)
Value of production = Production * Market price

Hog Supply

Production = f(U.S. pork production, U.S. pork production squared)
Market price = f(U.S. barrow/gilt price)
Value of production = Production * Market price

Cattle Supply

Production = f(U.S. beef production, trend from 1982-84, trend)
Market price = f(Omaha steer price)
Value of production = Production * Market price

Milk Supply

Production = f(Lagged Iowa milk production, U.S. milk production, trend, shift beginning in 1983)
Market price = f(U.S. all milk price)
Value of production = Production * Market price

Table 1. Continued

Production Expenses

Total production expenses = Feed expenses + Livestock expenses + Seed expenses + Fertilizer expenses + Fuel, oil expenses + Labor expenses + Real estate interest expenses + Non-real estate interest expenses + Capital consumption expenses + Other expenses
Total cash expenses = Total production expenses – Capital consumption expenses – Difference between total actual and calculated cash expenses
Feed expenses = f(Iowa corn price, Decatur soybean meal price)
Livestock expenses = f(Iowa cattle production, KC feeder price)
Seed expenses = f(Wholesale price index, total Iowa planted area)
Fertilizer expenses = f(Fertilizer price index, Iowa corn area)
Pesticide expenses = f(Wholesale price index, fuel price index, total Iowa planted area)
Fuel, oil expenses = f(Fuel price index, total Iowa planted area, trend)
Labor expenses = f(Wage price index, Iowa cattle production, total Iowa planted area)
Real estate interest expenses = f(Lagged real estate interest expenses, Moody's AAA rate, gross farm income)
Non-real estate interest expenses = f(Lagged non-real estate interest expenses, short run interest rate, sum of livestock, feed, seed, fertilizer, pesticide, and fuel and oil expenses)
Capital consumption expenses = f(Moody's AAA rate, total Iowa planted area, Iowa hog production)
Other expenses = f(Wholesale price index)
Difference between total calculated and actual cash expenses = f(Wholesale price index)

Farm Income

Gross farm income = Crop receipts + Livestock receipts + Other income + Government payments + Value of inventory adjustment
Net farm income = Gross farm income – Total production expenses
Total cash income = Crop receipts + Livestock receipts + Other cash expenses + Government payments
Net cash income = Total cash income – Total cash expenses
Crop receipts = f(Value of production of corn and soybeans)
Livestock receipts = f(Value of production of beef, pork and dairy)
Other cash income = f(Wholesale price index, lagged other cash income)
Other noncash income = f(Moody's AAA rate, total cash receipts)
Government payments = Deficiency payments + Diversion payments + Disaster payments + Conservation payments

The production expense equations include individual components that allow the expense measures to be aggregated into estimates of fixed and variable as well as cash and noncash expenses. Total production expenses for the Iowa agricultural sector are calculated as the sum of components. Total cash expenses exclude capital consumption expenditures and a portion of the other expense category capturing other noncash expenses. Since a large proportion of Iowa hog production is farrow-to-finish (more than 65 percent in 1991), livestock purchases are estimated solely as a function of Iowa cattle production and the Kansas City feeder price. Each of the expense equations for seed, fertilizer, pesticides, fuel and oil, and labor includes national-level macro variables and total acreage terms with the exception of fertilizer expenses, which exclude soybean acreage, which is not a fertilizer-intensive crop. Iowa cattle production is used as a proxy for the amount of labor required to produce an animal unit in the labor expense equation.

Both the real estate and non-real estate interest equations include long and short term interest rate terms, respectively, and lagged dependent terms. The real estate interest expense equation also includes gross farm income as a proxy for the value of farm land. The equation for non-real estate interest rate expenses contains a variable summing all other production expenses likely to be purchased with loans. The capital consumption expense equation includes a long-term interest variable, total planted area as a proxy for machinery demand, and hog production, the most capital-intensive livestock industry. The variable containing other expenses includes rent to nonoperator landlords, property taxes, electricity, and other miscellaneous expenses, and is estimated as a function of the wholesale price index.

The results of the production expense equations, as well as crop, livestock, and dairy receipts and government payments are then used to derive aggregate measures of farm income for Iowa. For purposes of estimating crop and livestock marketings, 100 percent of both soybean production and milk production is assumed to be marketed. The endogenous marketings from crops variable is redefined to exclude the value of soybean production, and is estimated as a function of the value of corn production. It also includes a trend variable to account for the increasing proportion of corn production that is marketed, given ongoing structural changes in Iowa agriculture which have led to increased specialization. Similarly, the livestock marketings variable is redefined to exclude the value of milk production, and is estimated as a function of the value of production of both beef and pork. Other cash income includes rent received, custom work, and other miscellaneous cash income, and is estimated as a function of a lagged dependent variable and the wholesale price index. Other noncash income, primarily capturing the dwelling value, is estimated as a function of a long-term interest rate and total cash receipts, a proxy for the value of land. Government payments are calculated as a sum of deficiency payments, diversion program payments, disaster payments, and conservation payments.

Statistical Results

Annual data to estimate the crops, livestock, and dairy sectors of the model were obtained from *Agricultural Statistics* for 1961-90. Data for the production expense and farm income sectors were obtained for the same period from *Economic Indicators of the Farm Sector: State Financial Summary*. A complete list of the variable names and their definitions and sources is provided in Table A.1.

The equations and statistical results for the agricultural production and prices of Iowa crops are presented in Table A.2. For each estimated equation, t-statistics are presented in parentheses below the parameter estimates. Where appropriate, elasticities evaluated at the mean of the variables are reported in brackets. Also reported for each estimated equation are the estimation period, the R-squared, the adjusted R-squared, the standard error of the estimates, the Durbin-Watson statistic, and the mean of the dependent variable. For equations containing a lagged dependent variable, the H-statistic is reported rather than the Durbin-Watson statistic.

Similarly, the equations and statistical results of the production and prices of Iowa livestock and dairy are presented in Table A.3. Table A.4 summarizes the equations and results of production expense components of the Iowa model. The results of the receipts and production expense equations are then used to derive measures of farm income for Iowa, which are presented in Table A.5.

The statistical results for all sectors of the Iowa model indicate that a high percentage of variation is explained by the equations in the model. Most of the individual coefficients are significant at the 10 percent level. These results suggest that the set of equations in the Iowa agricultural model adequately captures the interrelationships of the Iowa agricultural sector for the time period being studied.

Baseline Results for Iowa

The equations estimated in the previous section provide the basis for projecting indicators of performance for the agricultural sector to the year 2000/01 for crops and 2001 for livestock, dairy, and farm income. A Lotus-123 spreadsheet is used to link sectors in this model of the Iowa agricultural economy and provide the simulation. Tables 2 and 3 summarize the results of the 10-year Iowa agricultural outlook, which is grounded on a series of assumptions about the general economy, agricultural policies, the weather, and technological change. Actual data are reflected in the tables through 1991/92 for the crops sectors, and through 1991 for the livestock, dairy, and income sectors. The Iowa outlook uses results from FAPRI's January 1992 U.S. agricultural outlook and macroeconomic projections from the WEFA Group. (See FAPRI 1992a for details). Current agricultural policies are assumed to continue indefinitely in the baseline to provide a benchmark from which to evaluate the implications of changes in these policies. Average weather conditions and historical rates of technological change are assumed to prevail during the projection period.

Several factors are expected to influence the reliability of these results over the long term. Obvious factors such as weather variability, locally and global, could change the production and price results that drive the state-level model. Sudden changes in world food demand or another oil price shock would cause deviation from the baseline and necessitate recalculating the outlook.

A policy-related uncertainty includes determining the disposition of acres enrolled into the Conservation Reserve Program (CRP). The baseline assumes that CRP contracts are not extended when they expire, beginning in 1996/97, since extending the contracts would require implementing some new policy measure. It is also assumed that some of the corn acreage due to return to production is immediately enrolled in the 0-92 program, and some of the soybean area enrolled in the CRP is permanently removed from production. When these acres do come back into production, commodity market conditions could influence their use in row crops versus pasture land. It is important to recognize the potential variability in this baseline that these and other assumptions will likely cause.

Crops Sector Baseline

Table 2 summarizes the results of the 10-year projections for Iowa crops and livestock. Shifting of planted acreage from corn to soybeans occurred in Iowa in 1991/92, both as a result of the flexible acreage provisions of the 1990 Farm Bill and wet planting conditions in early spring. As a result, Iowa corn planted acreage fell slightly, despite the lower ARP rate, and soybean acreage increased. Assuming average weather conditions in Iowa, corn acreage is projected in the baseline to increase in 1992/93 as a result of stronger expected market prices and the reduced ARP rate. Conversely, soybean acreage is projected to fall to just over 8 million acres. Acreage data released after the baseline was prepared indicate that these projections closely resemble actual planting of both crops in 1992/93. Corn area planted was reported at 13.4 million acres and soybean area planted was 8.1 million acres. With assumed ARP rates for corn of between 5 percent and 7.5

Table 2. Results of the 10-year projections on Iowa crops, livestock, and dairy

	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01
CORN														
Area Planted (mil. a.)	10.40	11.30	12.60	12.80	12.50	13.08	12.51	12.57	12.77	12.83	12.77	12.75	12.78	12.78
Area Harvested (mil. a.)	10.15	10.70	12.25	12.40	12.20	12.76	12.26	12.35	12.57	12.66	12.67	12.70	12.77	12.81
Yield (bu./a.)	130.0	84.0	118.0	126.0	117.0	125.2	126.5	127.5	127.9	128.7	129.4	129.9	130.3	131.0
Production (mil. bu.)	1,320	899	1,446	1,562	1,427	1,598	1,551	1,574	1,607	1,630	1,640	1,649	1,664	1,678
Market Price ($/bu.)	1.89	2.45	2.29	2.21	2.35	2.13	2.19	2.23	2.32	2.27	2.17	2.14	2.14	2.23
Value of Prod. (mil. $)	2,494	2,202	3,310	3,453	3,354	3,397	3,403	3,516	3,732	3,703	3,551	3,522	3,554	3,748
SOYBEANS														
Area Planted (mil. a.)	7.95	8.15	8.30	8.00	8.70	8.03	8.24	8.26	8.24	8.29	8.48	8.47	8.45	8.49
Area Harvested (mil. a.)	7.90	8.10	8.28	7.90	8.65	7.99	8.19	8.21	8.19	8.24	8.42	8.42	8.40	8.43
Yield (bu./a.)	43.5	31.0	39.0	41.5	40.5	41.9	42.0	42.4	42.9	43.2	43.3	43.7	44.2	44.5
Production (mil. bu.)	343.7	251.1	322.9	327.9	350.3	334.6	344.0	348.3	351.3	356.3	364.8	368.1	370.9	375.2
Market Price ($/bu.)	5.97	7.33	5.62	5.63	5.45	5.79	5.64	5.65	5.90	5.93	5.46	5.29	5.39	5.69
Value of Prod. (mil. $)	2,052	1,841	1,815	1,846	1,909	1,938	1,941	1,968	2,075	2,114	1,992	1,948	2,001	2,134

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
HOGS														
Production (mil. lb.)	5,507	5,544	5,394	5,863	5,958	5,949	5,870	5,833	5,928	5,964	5,962	5,903	5,849	5,891
Price ($/cwt)	43.20	43.20	54.70	50.50	42.81	46.59	53.43	57.96	53.08	48.77	51.80	56.64	60.91	57.97
Value of Prod. (mil. $)	2,379	2,395	2,951	2,961	2,551	2,771	3,137	3,381	3,146	2,909	3,088	3,344	3,563	3,415
CATTLE														
Production (mil. lb.)	2,058	2,078	1,899	1,931	1,937	1,951	1,960	1,971	1,973	1,955	1,929	1,900	1,879	1,876
Price ($/cwt)	67.30	70.60	75.90	72.30	71.35	70.23	68.97	66.95	67.86	71.80	75.45	81.41	85.73	83.94
Value of Prod. (mil. $)	1,385	1,467	1,442	1,396	1,382	1,370	1,352	1,320	1,339	1,403	1,455	1,547	1,611	1,575
MILK														
Production (mil. lb.)	4,040	4,202	4,330	4,151	4,114	4,144	4,182	4,216	4,250	4,287	4,346	4,412	4,460	4,487
Price ($/cwt)	11.80	13.20	13.30	11.59	11.67	11.87	12.01	12.20	12.35	12.40	12.31	12.38	12.62	12.94
Value of Prod. (mil. $)	477	555	576	481	480	492	502	514	525	532	535	546	563	581

percent after 1992/93, and stable market prices, corn planted area in Iowa is projected to remain between 12.5 and 12.8 million acres through 2000/01. Iowa soybean acreage is projected to expand through the mid- to late 1990s in response to both price strength and the return of CRP land into production as contracts expire after 1995/96.

Corn prices are projected to remain in the $2.15 to $2.30 per bushel range throughout the projection period so that, assuming average weather conditions, continued government support is anticipated. Soybean prices are projected to remain in the $5.30 to $5.90 per bushel range.

Livestock Sector Baseline

Hog production in Iowa is projected to continue to increase in 1992 in response to favorable returns to producers through the middle of 1991. After 1992, patterns in hog production are expected to follow closely the national projections. As expected from traditional market relations, production and prices generally move in opposite directions. The hog market price is projected to peak near the end of the projection period at nearly $61 per hundredweight.

Iowa cattle production is also projected to follow the U.S. pattern throughout the projection period, with modest expansion through the mid-1990s. A slow decrease in beef production in Iowa is offset by stronger market prices, and the value of production increases marginally through 2001.

Milk production in Iowa declined in 1991, because of lower market prices. Production is projected to decrease slightly in 1992, and to expand slowly thereafter. The milk price is projected to increase after 1993, but never to reach the $13 per hundredweight level of 1989 and 1990.

Farm Income Baseline

The results of the outlook for Iowa farm income and production expenses are provided in Table 3. Assuming constant or rising interest rates, energy prices, and general inflation, variable and fixed production expenses are expected to continue to increase moderately through the projection period. Production cost estimates are very sensitive to macroeconomic conditions, and farmers have demonstrated an ability to reduce asset purchases and other costs when economic circumstances require.

Figure 1 graphs historical levels of Iowa net farm income from 1983 through 1991, and the baseline projection of net farm income through 2001. Net farm income is projected to fall in 1992, as a result of lower farm marketings from livestock, reduced government payments, and higher production expenses. Farm income is projected to rebound in 1993 with growth in livestock

Table 3. Results of the 10-year projections on Iowa farm income

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
							(Million Dollars)							
GROSS FARM INCOME	10,619	11,497	12,045	11,615	11,128	11,603	11,952	12,243	12,205	12,061	12,275	12,740	13,206	13,196
Farm Marketings	8,792	9,049	10,319	10,278	9,904	10,189	10,606	10,983	10,971	10,812	10,947	11,359	11,841	11,920
Crops	3,744	3,755	4,437	4,543	4,601	4,670	4,736	4,899	5,086	5,069	4,949	4,965	5,123	5,382
Livestock	5,048	5,293	5,882	5,735	5,303	5,520	5,870	6,083	5,885	5,743	5,999	6,393	6,718	6,538
Government Payments	1,665	981	754	817	753	908	804	682	633	638	687	696	635	528
Other Income	484	682	571	520	472	506	542	579	600	611	641	686	729	748
Cash	283	470	343	301	288	292	304	319	337	357	379	402	426	451
Noncash	201	212	228	219	184	215	238	261	263	254	262	284	303	296
Value of Inventory Adj.	-323	785	401											
PRODUCTION EXPENSES														
Total	8,560	8,775	9,080	9,001	8,876	9,000	9,230	9,508	9,830	10,097	10,315	10,651	11,010	11,227
Feed	1,133	1,182	1,154	1,153	1,180	1,191	1,202	1,223	1,246	1,221	1,178	1,167	1,185	1,219
Livestock	892	890	1,046	1,041	1,012	996	976	935	947	1,010	1,034	1,105	1,174	1,124
Seed	303	321	323	329	332	339	353	368	385	403	420	438	457	478
Fertilizer & Lime	514	521	508	499	536	530	553	582	607	628	651	678	705	735
Pesticides	300	356	375	377	382	396	415	433	454	478	502	527	553	579
Fuels & Oil	305	295	355	345	333	332	342	353	364	376	386	397	409	421
Hired Labor	254	271	306	311	316	322	332	347	362	376	390	407	424	444
Interest	1,017	1,002	980	938	865	836	843	882	934	979	1,011	1,038	1,064	1,089
Real Estate	559	543	534	524	494	479	485	507	537	555	558	556	548	539
Nonreal Estate	458	460	446	415	371	357	358	375	397	424	454	482	515	550
Capital Consumption	1,024	1,052	1,054	1,084	1,034	1,038	1,062	1,112	1,171	1,182	1,159	1,134	1,096	1,077
Miscellaneous	2,818	2,884	2,979	2,924	2,885	3,019	3,152	3,271	3,361	3,444	3,584	3,761	3,943	4,062
NET CASH INCOME	3,294	2,874	3,508	3,598	3,225	3,554	3,680	3,728	3,430	3,050	3,024	3,115	3,174	2,944
Total Cash Income	10,740	10,500	11,416	11,396	10,945	11,389	11,714	11,983	11,941	11,807	12,013	12,457	12,902	12,899
Total Cash Expenses	7,446	7,626	7,908	7,797	7,720	7,835	8,034	8,255	8,511	8,757	8,990	9,341	9,729	9,955
NET FARM INCOME	2,059	2,722	2,964	2,614	2,253	2,603	2,722	2,736	2,375	1,965	1,960	2,089	2,196	1,968

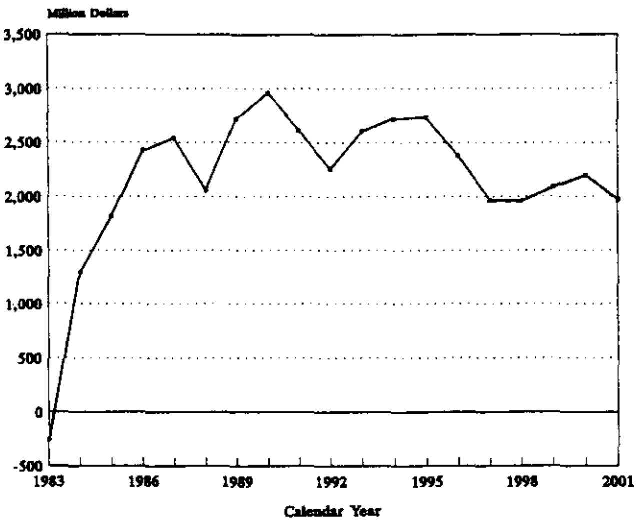

Figure 1. Iowa net farm income

receipts. After modest projected growth in income through 1996, increasing production expenses combined with a downturn in the livestock cycle cause farm income to fall to around $2 billion and to remain at that level throughout the remainder of the projection period.

Implications of a GATT Agreement on Iowa Agriculture

In addition to the valuable information for state farm organizations in the baseline results, this state model can be useful in analyzing the implications of important policy issues such as the GATT negotiations for state agriculture. For this study, the U.S. results of the FAPRI analysis of the Dunkel text on agriculture (CARD 1992) are imposed on the Iowa model. Because the Dunkel proposal, as interpreted and analyzed in the CARD report, is expected to affect various commodities differently, its implications for Iowa are likely to be different from the "bottom line" estimated for U.S. agriculture. Since Iowa's production is concentrated in commodities that benefit from the Dunkel proposal, Iowa is expected to benefit.

The proposed changes to agriculture and agricultural trade in the Dunkel text can be summarized as follows: reduction of subsidy export expenditures by 36 percent and quantities exported with the benefit of subsidies by 24 percent from 1986-90 levels; reduction of internal support as measured by an aggregate measure of support (AMS) using a 1986-88 average world reference price by 20 percent from 1986 levels, with credit given for reductions made since 1986; and the conversion of import restrictions to tariffs and their reduction across the board by a simple average of 36 percent. Where import barriers are in place, either minimum access of 3 percent of domestic consumption in 1993, rising to 5 percent in 1999, or minimum access of 1986-88 average import levels is to be provided, whichever is greater.

Under these proposed changes, the United States is in a position where it would not have to make many modifications to agricultural policies because program changes already made since 1986 bring the United States into compliance with most provisions of the Dunkel text. None of these changes affects the policies for Iowa's commodities, with the exception of milk. Given the FAPRI baseline for the United States, the support price for milk would be reduced, but not until 1998. Tables 4 and 5 report the nominal impacts of analyzing the Dunkel text on the Iowa agricultural sectors.

The United States is able to capture market share of world corn trade, primarily as a result of increased corn imports in the European Community caused by the minimum access requirement. The United States also increases soybean exports as a result of higher EC imports as more beans are crushed for meal to offset lower rapeseed crush. Additionally, increased pork and broiler production in the United States causes feed use for corn and meal to increase. In Iowa, this increase in demand for both corn and beans results in higher prices for both commodities and expanded acreage. The sum of the value of production in Iowa for both crops is projected to increase by more than $600 million by 2001/02.

In the livestock sector, the GATT scenario is projected to have a positive impact on both the hog and cattle industries, despite higher feed costs. The United States benefits from an expanded export market for pork as import tariffs for pork are reduced and imports increase in Japan. Pork exports from the European Community are also expected to decline in compliance with the export subsidy expenditure reduction commitment.

Output prices are higher for both hogs and beef. The increase in the beef price more than offsets initial decreases in production caused by removing additional heifers from the market and adding them to the beef cow herd. As a result of both higher prices and expanded Iowa production, the value of hog production is projected to increase by nearly $300 million above the baseline level by 2001. U.S. beef exports are not expected to increase substantially as a result of the Dunkel proposal because the FAPRI baseline incorporates relaxation of import barriers in the Japanese beef market. There are modest increases in the value of Iowa cattle production because of marginally higher prices. In the Iowa dairy sector, marginal decreases in production throughout the projection period are caused by the higher feed costs that producers would face.

Table 4. Nominal impacts of the GATT scenario on Iowa crops, livestock, and dairy

	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01
CORN														
Area Planted (mil. a.)	.0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.27	0.23	0.24	0.30	0.34	0.33	0.32
Area Harvested (mil. a.)	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.24	0.21	0.21	0.27	0.30	0.30	0.29
Yield (bu./a.)	0.00	0.00	0.00	0.00	0.00	0.00	-0.49	-0.41	-0.43	-0.42	-0.38	-0.39	-0.34	-0.39
Production (mil. bu.)	0.00	0.00	0.00	0.00	0.00	0.00	22.27	25.71	21.50	22.08	29.71	34.46	34.17	32.75
Market Price ($/bu.)	0.00	0.00	0.00	0.00	0.00	0.03	0.08	0.06	0.05	0.11	0.16	0.15	0.15	0.21
Value of Prod. (mil. $)	0.00	0.00	0.00	0.00	0.00	46.84	171.86	151.23	129.51	227.75	325.44	320.44	321.91	424.25
SOYBEANS														
Area Planted (mil. a.)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.08	0.06	0.04	0.03	0.04	0.06
Area Harvested (mil. a.)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.08	0.06	0.04	0.03	0.04	0.06
Yield (bu./a.)	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.09	-0.14	-0.11	-0.08	-0.06	-0.07	-0.11
Production (mil. bu.)	0.00	0.00	0.00	0.00	0.00	0.00	0.35	1.42	2.30	1.85	1.09	0.87	1.03	1.57
Market Price ($/bu.)	0.00	0.00	0.00	0.00	0.00	0.08	0.30	0.29	0.18	0.24	0.31	0.35	0.42	0.47
Value of Prod. (mil. $)	0.00	0.00	0.00	0.00	0.00	28.42	106.02	110.39	77.02	95.48	119.94	133.45	163.57	186.78
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
HOGS														
Production (mil. lb.)	0.00	0.00	0.00	0.00	-0.04	1.28	33.95	59.91	16.72	3.32	4.66	53.22	66.41	52.65
Price ($/cwt)	0.00	0.00	0.00	0.00	0.01	3.46	1.68	0.73	3.30	4.31	2.86	2.18	3.55	4.41
Value of Prod. (mil. $)	0.00	0.00	0.00	0.00	0.56	206.55	117.17	77.58	204.83	259.11	173.08	160.09	250.36	292.73
CATTLE														
Production (mil. lb.)	0.00	0.00	0.00	0.00	0.32	-1.22	-2.18	-1.61	-0.04	1.86	3.47	4.83	5.41	5.09
Price ($/cwt)	0.00	0.00	0.00	0.00	-0.03	1.71	1.57	1.18	1.22	0.97	0.72	0.34	0.38	0.63
Value of Prod. (mil. $)	0.00	0.00	0.00	0.00	-0.34	32.43	29.21	22.24	24.12	20.25	16.54	10.33	11.89	16.15
MILK														
Production (mil. lb.)	0.00	0.00	0.00	0.00	-0.35	-9.54	-25.73	-29.44	-26.94	-25.08	-28.78	-37.21	-47.58	-53.10
Price ($/cwt)	0.00	0.00	0.00	0.00	0.00	-0.06	0.07	0.03	0.03	0.07	0.06	-0.03	-0.10	0.04
Value of Prod. (mil. $)	0.00	0.00	0.00	0.00	-0.04	-3.76	-0.00	-2.26	-1.98	0.05	-0.80	-6.00	-10.22	-4.99

Table 5. Nominal impacts of the GATT scenario on Iowa farm income

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
							(Million Dollars)							
GROSS FARM INCOME	0.00	0.00	0.00	0.00	4.67	320.56	307.10	243.02	353.50	419.17	342.43	333.03	444.89	511.41
Farm Marketings	0.00	0.00	0.00	0.00	17.63	348.80	351.35	280.57	404.51	527.06	488.53	479.24	613.80	704.26
Crops	0.00	0.00	0.00	0.00	17.59	100.29	193.22	174.10	167.51	238.93	292.72	310.29	356.34	393.16
Livestock	0.00	0.00	0.00	0.00	0.04	248.51	158.13	106.47	237.01	288.13	195.81	168.95	257.46	311.10
Government Payments	0.00	0.00	0.00	0.00	-13.23	-46.24	-61.49	-51.20	-70.86	-131.42	-165.33	-164.91	-193.88	-221.57
Other Income	0.00	0.00	0.00	0.00	0.26	18.00	17.24	13.65	19.85	23.54	19.23	18.70	24.98	28.72
Cash	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Noncash	0.00	0.00	0.00	0.00	0.26	18.00	17.24	13.65	19.85	23.54	19.23	18.70	24.98	28.72
Value of Inventory Adj.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION EXPENSES														
Total	0.00	0.00	0.00	0.00	4.61	133.76	154.12	131.23	141.09	172.77	176.70	174.86	201.60	229.20
Feed	0.00	0.00	0.00	0.00	4.99	21.16	23.93	13.23	13.17	34.23	45.06	42.77	49.55	56.47
Livestock	0.00	0.00	0.00	0.00	-1.04	32.48	31.96	21.14	21.61	17.10	12.38	6.22	7.57	13.35
Seed	0.00	0.00	0.00	0.00	0.00	3.16	3.87	3.82	3.66	4.08	4.46	4.42	4.56	5.03
Fertilizer & Lime	0.00	0.00	0.00	0.00	0.00	10.96	11.88	10.37	10.47	13.09	14.87	14.46	14.14	15.96
Pesticides	0.00	0.00	0.00	0.00	0.00	0.62	0.76	0.75	0.72	0.80	0.88	0.87	0.90	0.99
Fuels & Oil	0.00	0.00	0.00	0.00	0.00	2.24	2.75	2.72	2.60	2.90	3.17	3.14	3.24	3.58
Hired Labor	0.00	0.00	0.00	0.00	0.02	1.39	1.67	1.68	1.68	1.97	2.23	2.28	2.38	2.57
Interest	0.00	0.00	0.00	0.00	0.00	0.38	9.58	15.49	16.51	18.35	21.88	23.94	24.36	26.50
Real Estate	0.00	0.00	0.00	0.00	0.00	0.05	3.51	5.53	6.10	7.66	9.35	9.58	9.62	10.85
Nonreal Estate	0.00	0.00	0.00	0.00	0.00	0.33	6.07	9.96	10.40	10.69	12.53	14.37	14.74	15.65
Capital Consumption	0.00	0.00	0.00	0.00	-0.01	16.77	24.97	28.21	21.48	21.91	24.10	30.43	32.99	33.59
Miscellaneous	0.00	0.00	0.00	0.00	0.65	44.61	42.73	33.82	49.19	58.33	47.65	46.34	61.91	71.16
NET CASH INCOME	0.00	0.00	0.00	0.00	-0.21	185.57	160.70	126.36	214.04	244.77	170.61	169.89	251.30	287.08
Total Cash Income	0.00	0.00	0.00	0.00	4.40	302.56	289.85	229.37	333.65	395.63	323.20	314.33	419.91	482.69
Total Cash Expenses	0.00	0.00	0.00	0.00	4.62	116.99	129.15	103.02	119.61	150.86	152.59	144.44	168.61	195.61
NET FARM INCOME	0.00	0.00	0.00	0.00	0.05	186.80	152.98	111.79	212.41	246.40	165.73	158.16	243.29	282.21

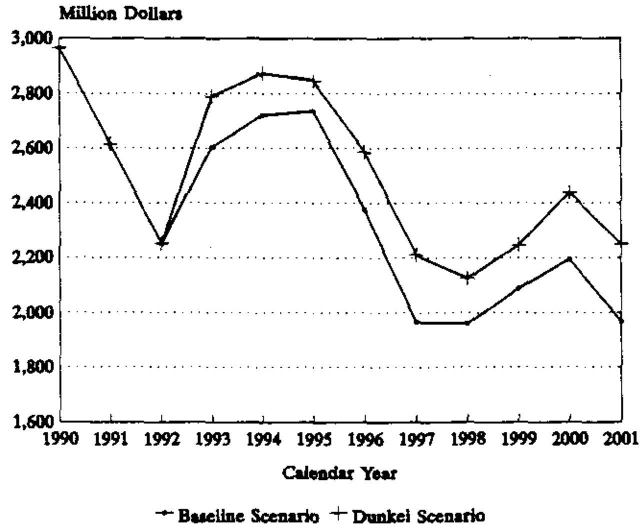

Figure 2. Baseline and Dunkel scenario impacts on Iowa net farm income

Overall, the Dunkel proposal is projected to have a positive effect on Iowa net farm income in all years of the projection period. Figure 2 graphs Iowa net farm income in both the baseline and GATT scenarios. Higher corn prices are partially offset by reduced deficiency payments, but crop market receipts increase more than government payments. Likewise, the increase in livestock product prices more than offsets the increase in feed costs. Other increases in production costs, caused by the growth in agricultural production and the higher commodity prices, are not sufficient to counter the growth in gross farm income. The average proportional increase in Iowa net farm income under the scenario is significantly larger than the corresponding increase in U.S. net farm income, because Iowa's agricultural economy is concentrated in commodities that benefit from the Dunkel text.

Summary

Since many farm organizations and agricultural groups are organized at the state-level, this model is an effective way to provide additional insights about the implications of national and international agricultural policy issues. The crop and livestock sectors of the Iowa model are estimated recursively from the FAPRI U.S. model. The production expense equations are based on the cropping pattern and livestock mix within Iowa and include national macroeconomic variables. When used to analyze and evaluate the Dunkel text on agriculture, Iowa's commodity mix and the costs of production associated with it result in proportionately higher farm income impacts than on the U.S. as a whole.

International markets are likely to continue to be an important outlet for agricultural commodities, especially those produced in Iowa. Efforts to reform agricultural trade, such as the GATT negotiations and NAFTA, increase the complexity of issues affecting agricultural producers. State-level policy models such as the Iowa agricultural sector model can help producers and agribusiness to anticipate and understand trends and issues in their industries.

APPENDIX

Table A.1. Definitions of the Iowa model variables

Variable	Definition and Source
CAPFMIA	Iowa cattle farm price, dollars per hundredweight[a]
CAPOSU9	Omaha steer price, dollars per hundredweight[b]
CASHDIF	Actual minus calculated Iowa cash expenses, million dollars[c]
CCSPRIA	Iowa cattle and calf production, million pounds[d]
CCSPRU9	U.S. beef production, million pounds[b]
CCVPRIA	Iowa cattle value of production, million pounds[c]
COAHAIA	Iowa corn acres harvested, million acres[a]
COAHAU9	U.S. corn acres harvested, million acres[e]
COAPAIA	Iowa corn acres planted, million acres[a]
COAPAU9	U.S. corn acres planted, million acres[e]
COPFMIA	Iowa corn farm price, dollars per bushel[a]
COPFMU9	U.S. corn market price, dollars per bushel[e]
COSPRIA	Iowa corn production, million bushels[c]
COSPRU9	U.S. corn production, million bushels[e]
COVPRIA	Iowa corn value of production, million dollars[c]
COYHAIA	Iowa corn yield, bushels per harvested acre[a]
COYHAU9	U.S. corn yield, bushels per harvested acre[e]
DM189	Dummy variable: 1989=1, 0 otherwise
DM1S83	Dummy variable: 1 beginning in 1983, 0 otherwise
DM1S84	Dummy variable: 1 beginning in 1984, 0 otherwise
DM1S86	Dummy variable: 1 beginning in 1986, 0 otherwise
FCPFMKC	Kansas City feeder cattle price, dollars per hundredweight[b]
FIECCIA	Iowa total calculated cash expenses, million dollars[c]
FIEINIA	Iowa farm non-real estate interest expenses, million dollars[f]
FIEIRIA	Iowa farm real estate interest expenses, million dollars[f]
FIEOTIA	Iowa total other farm expenses, million dollars[f]
FIEPFIA	Iowa farm feed expenses, million dollars[f]
FIEPLIA	Iowa livestock and poultry purchased on farms, million dollars[f]
FIEPOIA	Iowa farm fuel and oil expenses, million dollars[f]
FIEPPIA	Iowa pesticide expenses, million dollars[f]
FIEPSIA	Iowa farm seed purchased, million dollars[f]
FIEPZIA	Iowa farm fertilizer and lime expenses, million dollars[f]
FIEROIA	Iowa farm capital consumption expenses, million dollars[f]
FIETCIA	Iowa total cash expenses, million dollars[f]
FIETPIA	Iowa total production expenses, million dollars[c]
FIEWRIA	Iowa farm contract and hired labor expenses, million dollars[f]
FINCIIA	Iowa net cash income, million dollars[c]
FINFIIA	Iowa net farm income, million dollars[c]
FIRIAIA	Iowa value of inventory adjustment, million dollars[f]
FIRCRIA	Iowa farm marketings from crops, million dollars[f]
FIRCRIAR	Iowa farm marketings from crops—restricted, million dollars[c]
FIRLVIA	Iowa farm marketings from livestock, million dollars[f]
FIRLVIAR	Iowa farm marketings from livestock—restricted, million dollars[c]
FIROCIA	Iowa other farm cash income, million dollars[f]

Table A.1. Continued

Variable	Definition and Source
FIRONIA	Iowa other farm noncash income, million dollars[f]
FIROTIA	Iowa total farm income, million dollars[c]
FIRTCIA	Iowa total cash income, million dollars[c]
FIRTOIA	Iowa total farm income, million dollars[c]
FTPPIU9	U.S. all fertilizer PPI, 1982=100[g]
HPPBGU9	U.S. 7-market barrow and gilt price, dollars per hundredweight[b]
HPPFMIA	Iowa hog farm price, dollars per hundredweight[a]
HPSPRIA	Iowa hog and pig production, million pounds[a]
HPSPRU9	U.S. pork production, million pounds[d]
HPVPRIA	Iowa hog and pig value of production, million dollars[c]
MIPFMIA	Iowa milk farm price, dollars per hundredweight[a]
MIPFMU9	U.S. milk farm price, dollars per hundredweight[b]
MISPRIA	Iowa milk production, million pounds[a]
MISPRU9	U.S. milk production, million pounds[a]
MIVPRIA	Iowa milk value of production, million dollars[c]
PPIWRU9	U.S. PPI for wage rates, 1910-14=1[h]
PW	U.S. producer price index for all commodities, 1967=100[i]
PW050U9	PPI for fuels, related products and power, 1967=100[i]
RCORPSAAA	Moody's AAA corps bond seasonalized interest rate[i]
RCP6M	Prime commercial paper 6-month interest rate[i]
SBAHAIA	Iowa soybean acres harvested, million acres[a]
SBAHAU9	U.S. soybean acres harvested, million acres[e]
SBAPAIA	Iowa soybean acres planted, million acres[a]
SBAPAU9	U.S. soybean acres planted, million acres[e]
SBPFMIA	Iowa soybean farm price, dollars per bushel[a]
SBPFMU9	U.S. soybean farm price, dollars per bushel[e]
SBSPRIA	Iowa soybean production, million bushels[c]
SBSPRU9	U.S. soybean production, million bushels[e]
SBVPRIA	Iowa soybean value of production, million dollars[c]
SBYHAIA	Iowa soybean yield, bushels per harvested acre[a]
SBYHAU9	U.S. soybean yield, bushels per harvested acre[e]
SMPFMU9	U.S. soybean meal Decatur 44% protein market price, dollars per ton[b]
TREND	Calendar year
TRND8284	Trend from 1982-84: 1982 = 1, 1983 = 2, 1984, 1985 = 3, etc., 0 otherwise

[a]*Iowa Agricultural Statistics* (various issues).
[b]*Situation and Outlook Report* (various issues).
[c]Calculated.
[d]*Agricultural Statistics* (various issues).
[e]Agricultural Stabilization and Conservation Service (various issues).
[f]*Economic Indicators of the Farm Sector: State Financial Summary* (various issues).
[g]*Fertilizer Use and Price Statistics* (various issues).
[h]FAPRI n.d.
[i]The WEFA Group (various issues).

Table A.2. Structural parameter estimates of equations for Iowa crops

Corn Area Planted

$$COAPAIA = 0.65903 * COAPAU9 - 0.00317 * COAPAU9^2 - 19.0342 \qquad (1)$$

(3.42)	(2.44)	(2.68)
[3.98]	[-1.47]	

Fit over:	1970-1989	Std Error	=	0.2700
R Sq	= 0.9689	D.W. (1)	=	1.4129
Adj R Sq	= 0.9652	LHS Mean	=	12.6450

Corn Area Harvested

$$COAHAIA = 0.91689 * COAPAIA + 11.3834 * COAHAU9/COAPAU9 - 9.5420 \qquad (2)$$

(60.59)	(10.59)	(10.31)
[0.96]	[0.82]	

Fit over:	1970-1989	Std Error	=	0.0941
R Sq	= 0.9959	D.W. (1)	=	1.4646
Adj R Sq	= 0.9954	LHS Mean	=	11.9845

Corn Yield

$$COYHAIA = 1.27172 * COYHAU9 - 0.83174 * TREND + 1629.54 \qquad (3)$$

(10.55)	(2.65)	(2.64)
[1.16]		

Fit over:	1970-1989	Std Error	=	6.1842
R Sq	= 0.8925	D.W. (1)	=	1.3770
Adj R Sq	= 0.8799	LHS Mean	=	107.450

Corn Production

$$COSPRIA = COAHAIA * COYHAIA \qquad (4)$$

Table A.2. Continued

Corn Market Price

$$COPFMIA = \underset{\substack{(29.97)\\ [1.01]}}{0.97733} * COPFMU9 - \underset{(0.19)}{0.01438} \qquad (5)$$

Fit over:	1970-1989	Std Error	=	0.0816
R Sq	= 0.9804	D.W. (1)	=	1.6080
Adj R Sq	= 0.9793	LHS Mean	=	2.2110

Corn Value of Production

$$COVPRIA = COPFMIA * COSPRIA \qquad (6)$$

Soybean Area Planted

$$SBAPAIA = \underset{\substack{(3.22)\\ [3.03]}}{0.38673} * SBAPAU9 + \underset{(2.82)}{0.60055} * DM1S86 - \underset{\substack{(2.32)\\ [-1.13]}}{0.00236} * SBAPAU9^{2} \qquad (7)$$

$$+ \underset{(2.33)}{.62060} * \rho_{t-1} - \underset{(1.97)}{7.06681}$$

Fit over:	1971-1989	Std Error	=	0.2276
R Sq	= 0.9470	D.W. (1)	=	1.8220
Adj R Sq	= 0.9318	LHS Mean	=	7.6532

Soybean Area Harvested

$$SBAHAIA = \underset{\substack{(195.83)\\ [1.00]}}{0.99119} * SBAPAIA + \underset{(0.56)}{0.02158} \qquad (8)$$

Fit over:	1970-1989	Std Error	=	0.0210
R Sq	= 0.9995	D.W. (1)	=	1.9493
Adj R Sq	= 0.9995	LHS Mean	=	7.5110

Table A.2. Continued

Soybean Yield

$$SBYHAIA = \underset{\substack{(5.88)\\ [0.90]}}{1.09922} * SBYHAU9 + \underset{(0.66)}{3.60044} \qquad (9)$$

Fit over:	1970-1989	Std Error	=	2.3946
R Sq	= 0.6578	D.W. (1)	=	1.8689
Adj R Sq	= 0.6388	LHS Mean	=	35.6750

Soybean Production

$$SBSPRIA = SBAHAIA * SBYHAIA \qquad (10)$$

Soybean Market Price

$$SBPFMIA = \underset{\substack{(32.41)\\ [0.95]}}{0.94396} * SBPFMU9 + \underset{(1.67)}{0.28813} \qquad (11)$$

Fit over:	1970-1989	Std Error	=	0.1714
R Sq	= 0.9832	D.W. (1)	=	1.6240
Adj R Sq	= 0.9822	LHS Mean	=	5.7305

Soybean Value of Production

$$SBVPRIA = SBPFMIA * SBSPRIA \qquad (12)$$

Table A.3. Structural parameter estimates of equations for Iowa livestock and dairy

Hog and Pig Production

$$HPSPRIA = \underset{\substack{(2.06)\\ [4.85]}}{1.74563} * HPSPRU9 - \underset{\substack{(1.67)\\ [-2.00]}}{0.00005} * HPSPRU9^{2} - \underset{(1.58)}{9490.14} \quad \textbf{(13)}$$

Fit over:	1970-1989	Std Error	= 257.125
R Sq	= 0.7651	D.W. (1)	= 1.6021
Adj R Sq	= 0.9990	LHS Mean	= 5147.70

Hog Farm Price

$$HPPFMIA = \underset{\substack{(44.27)\\ [1.00]}}{0.96957} * HPPBGU9 - \underset{(0.02)}{0.02235} \quad (14)$$

Fit over:	1970-1989	Std Error	= 0.9193
R Sq	= 0.9909	D.W. (1)	= 2.1049
Adj R Sq	= 0.9904	LHS Mean	= 40.7350

Hog and Pig Value of Production

$$HPVPRIA = HPSPRIA * HPPFMIA/100 \quad (15)$$

Cattle and Calves Production

$$CCSPRIA = \underset{\substack{(1.57)\\ [0.32]}}{0.03581} * CCSPRU9 - \underset{(5.97)}{200.243} * TRND8284 \quad (16)$$

$$- \underset{(2.40)}{351.396} * LN(TREND - 1960) + \underset{(4.96)}{2967.67}$$

Fit over:	1970-1989	Std Error	= 120.517
R Sq	= 0.9167	D.W. (1)	= 2.3257
Adj R Sq	= 0.9011	LHS Mean	= 2559.26

Table A.3. Continued

Cattle Price

$$CAPFMIA = \underset{\substack{(15.40)\\ [1.05]}}{0.98669} * CAPOSU9 + \underset{(2.65)}{0.54984} * \rho_{t-1} - \underset{(0.73)}{2.72844} \qquad (17)$$

Fit over:	1970-1989	Std Error	=	1.9973
R Sq	= 0.9805	D.W. (1)	=	1.81
Adj R Sq	= 0.9782	LHS Mean	=	50.0800

Cattle Value of Production

$$CCVPRIA = CCSPRIA * CAPFMIA/100 \qquad (18)$$

Milk Production

$$MISPRIA = \underset{(1.88)}{0.28701} * MISPRIA.1 + \underset{\substack{(4.94)\\ [1.23]}}{0.03917} * MISPRU9 \qquad (19)$$

$$- \underset{(3.37)}{1029.09} * LN(TREND - 1960) - \underset{(4.62)}{376.728} * DMIS83 + \underset{(1.22)}{1010.04}$$

Fit over:	1970-1989	Std Error	=	84.8093
R Sq	= 0.8967	H	=	0.4297
Adj R Sq	= 0.8691	LHS Mean	=	4112.30

Milk Farm Price

$$MIPFMIA = \underset{\substack{(140.88)\\ [1.12]}}{1.06027} * MIPFMU9 - \underset{(14.54)}{1.21367} \qquad (20)$$

Fit over:	1970-1989	Std Error	=	0.0938
R Sq	= 0.9991	D.W. (1)	=	1.2248
Adj R Sq	= 0.9990	LHS Mean	=	10.1720

Milk Value of Production

$$MIVPRIA = MISPRIA * MIPFMIA/100 \qquad (21)$$

Table A.4. Structural parameter estimates of equations for Iowa production expenses

Total Production Expenses

$$FIETPIA = FIEPFIA + FIEPLIA + FIEPSIA + FIEPZIA + FIEPPIA + FIEPOIA + FIEOFIA + FIEINIA + FIEIRIA + FIEROIA + FIEWRIA + FIEOVIA \quad (22)$$

Total Cash Expenses

$$FIETCIA = FIETPIA - FIEROIA - CASHDIF \quad (23)$$

Difference Between Total and Calculated Cash Expenses

$$CASHDIF = \underset{\substack{(8.78)\\[0.88]}}{0.44539} * PW + \underset{(1.09)}{13.6484} \quad (24)$$

Fit over:	1970-1989	Std Error	=	17.5191
R Sq	= 0.8109	D.W. (1)	=	1.2388
Adj R Sq	= 0.8004	LHS Mean	=	117.940

Feed Expenses

$$FIEPFIA = \underset{\substack{(4.83)\\[0.39]}}{180.178} * (COPFMIA/3 + COPFMIA.1 * 2/3) \quad (25)$$

$$+ \underset{\substack{(3.56)\\[0.35]}}{2.14230} * (SMPFMU9/4 + SMPFMU9.1 * 3/4) + \underset{(1.67)}{6.39871} * TREND - \underset{(1.64)}{12353.7}$$

Fit over:	1970-1989	Std Error	=	77.3081
R Sq	= 0.8744	D.W. (1)	=	1.3175
Adj R Sq	= 0.8509	LHS Mean	=	1061.55

Table A.4. Continued

Livestock and Poultry Purchases

$$FIEPLIA = \underset{\substack{(5.69)\\ [1.12]}}{15.7944} * FCPFMKC + \underset{\substack{(5.42)\\ [2.19]}}{0.69909} * CCSPRIA - \underset{(4.11)}{1890.07} \quad (26)$$

Fit over:	1970-1989	Std Error	=	153.397
R Sq	= 0.6814	D.W. (1)	=	1.4046
Adj R Sq	= 0.6439	LHS Mean	=	818.470

Seed Expenses

$$FIEPSIA = \underset{\substack{(18.77)\\ [0.83]}}{0.86435} * PW + \underset{\substack{(6.28)\\ [1.04]}}{12.1279} * (COAPAIA + SBAPAIA) - \underset{(5.91)}{208.348} \quad (27)$$

Fit over:	1970-1989	Std Error	=	13.9654
R Sq	= 0.9747	D.W. (1)	=	1.6650
Adj R Sq	= 0.9717	LHS Mean	=	239.040

Fertilizer and Lime Expenses

$$FIEPZIA = \underset{\substack{(8.33)\\ [0.70]}}{4.69652} * FTPPIU9 + \underset{\substack{(4.52)\\ [1.40]}}{44.2737} * COAPAIA - \underset{(3.46)}{423.098} \quad (28)$$

Fit over:	1970-1988	Std Error	=	60.2367
R Sq	= 0.8755	D.W. (1)	=	1.5762
Adj R Sq	= 0.8599	LHS Mean	=	475.195

Pesticide Expenses

$$FIEPPIA = \underset{\substack{(7.21)\\ [1.10]}}{1.11202} * PW + \underset{\substack{(1.15)\\ [0.18]}}{0.07069} * PW050U9 + \underset{\substack{(0.80)\\ [0.21]}}{2.39118} * (SBAPAIA + COAPAIA) \quad (29)$$

Fit over:	1970-1989	Std Error	=	20.4271
R Sq	= 0.9687	D.W. (1)	=	1.9239
Adj R Sq	= 0.9628	LHS Mean	=	219.855

Table A.4. Continued

Fuel and Oil Expenses

$$FIEPOIA = \underset{\substack{(15.85)\\ {[1.08]}}}{0.80728} * PW050U9 - \underset{(4.56)}{7.44716} * TREND + \underset{\substack{(2.38)\\ {[0.57]}}}{8.62232} * (COAPAIA + SBAHAIA) + \underset{(4.51)}{14544.5} \qquad (30)$$

Fit over:	1970-1989	Std Error	=	24.7877
R Sq	= 0.9762	D.W. (1)	=	1.2600
Adj R Sq	= 0.9718	LHS Mean	=	302.715

Farm Contract and Hired Labor Expenses

$$FIEWRIA = \underset{\substack{(5.80)\\ {[0.87]}}}{8.04856} * PPIWRU9 + \underset{\substack{(1.94)\\ {[0.62]}}}{0.05114} * CCSPRIA + \underset{\substack{(1.86)\\ {[0.54]}}}{5.57951} * (SBAPAIA + COAPAIA) - \underset{(2.43)}{216.749} \qquad (31)$$

Fit over:	1970-1989	Std Error	=	21.0076
R Sq	= 0.8843	D.W. (1)	=	1.1073
Adj R Sq	= 0.8626	LHS Mean	=	209.505

Real Estate Interest Expenses

$$FIEIRIA = \underset{(10.54)}{0.62681} * FIEIRIA.1 + \underset{\substack{(6.30)\\ {[0.72]}}}{35.0895} * RCORPSAAA + \underset{\substack{(1.66)\\ {[0.20]}}}{0.01085} * FIRTOIA.1 - \underset{(5.20)}{249.429} \qquad (32)$$

Fit over:	1971-1989	Std Error	=	32.2991
R Sq	= 0.9862	H	=	0.9159
Adj R Sq	= 0.9835	LHS Mean	=	481.863

Table A.4. Continued

Non-Real Estate Interest Expenses

$$\begin{aligned} FIEINIA = {} & \underset{\substack{(7.97)\\ [0.59]}}{0.61009} * FIEINIA.1 + \underset{\substack{(2.87)\\ [0.33]}}{18.8815} * RCP6M \\ & + \underset{\substack{(2.43)\\ [0.53]}}{0.08317} * (FIEPLIA.1 + FIEPSIA.1 + FIEPFIA.1 \\ & + FIEPZIA.1 + FIEPPIA.1 + FIEPOIA.1) \\ & - \underset{(3.31)}{216.111} \end{aligned} \qquad (33)$$

Fit over:	1971-1989	Std Error	= 52.1208
R Sq	= 0.9643	H	= -0.6571
Adj R Sq	= 0.9571	LHS Mean	= 479.337

Capital Consumption Expenses

$$\begin{aligned} FIEROIA = {} & \underset{\substack{(3.11)\\ [0.88]}}{104.195} * RCORPSAAA + \underset{\substack{(2.29)\\ [1.11]}}{63.7517} * (COAPAIA + SBAPAIA) \\ & + \underset{\substack{(1.08)\\ [0.60]}}{0.13559} * HPSPRIA - \underset{(2.64)}{1846.91} \end{aligned} \qquad (34)$$

Fit over:	1970-1989	Std Error	= 190.391
R Sq	= 0.8018	D.W. (1)	= 1.3448
Adj R Sq	= 0.7647	LHS Mean	= 1158.29

Total Other Expenses

$$FIEOTIA = \underset{\substack{(3.64)\\ [0.60]}}{5.39491} * PW + \underset{\substack{(2.78)\\ [0.60]}}{0.13915} * FIRTOIA - \underset{(2.25)}{426.440} \qquad (35)$$

Fit over:	1970-1989	Std Error	= 193.544
R Sq	= 0.9424	D.W. (1)	= 0.9750
Adj R Sq	= 0.9356	LHS Mean	= 2090.57

Table A.5. Structural parameter estimates of equations for Iowa farm income

Gross Farm Income

$$FIRTOIA = FIRCRIA + FIRLVIA + FIROTIA + FIRIAIA + FIRGPIA \quad (36)$$

Net Farm Income

$$FINFIIA = FIRTOIA - FIETPIA \quad (37)$$

Total Cash Income

$$FIRTCIA = FIRCRIA + FIRLVIA + FIROCIA + FIRGPIA \quad (38)$$

Net Cash Income

$$FINCIIA = FIRTCIA - FIETCIA \quad (39)$$

Other Cash Income

$$FIROCIA = \underset{(1.90)}{0.39467} * FIROCIA.1 + \underset{\substack{(2.53)\\ [1.12]}}{0.68897} * PW + \underset{(2.87)}{161.364} * DM1S89 - \underset{(1.55)}{74.9291} \quad (40)$$

Fit over:	1971-1989	Std Error	=	52.1674
R Sq	= 0.8650	H	=	0.7335
Adj R Sq	= 0.7900	LHS Mean	=	151.300

Table A.5. Continued

Other Noncash Income

$$FIRONIA = \underset{\substack{(1.14)\\ [0.15]}}{17.4423} * RCORPSAAA + \underset{\substack{(3.49)\\ [1.50]}}{0.05949} * (FIRCRIA + FIRLVIA + FIRGPIA) \quad (41)$$

$$- \underset{(3.76)}{222.481} * DMIS84 - \underset{(2.34)}{204.370}$$

Fit over:	1970-1989	Std Error	= 79.9742
R Sq	= 0.8072	D.W. (1)	= 1.2459
Adj R Sq	= 0.7711	LHS Mean	= 415.765

Farm Marketings From Crops (restricted)

$$FIRCRIAR = \underset{(6.00)}{0.51973} * (COVPRIA/3 + COVPRIA.1 * 2/3) + \underset{(2.47)}{33.1858} * TREND - \underset{(2.46)}{65276.5}$$

(42)

Fit over:	1970 to 1989	Std Error	= 305.080
R Sq	= 0.8104	D.W. (1)	= 2.1115
Adj R Sq	= 0.7881	LHS Mean	= 1862.44

Farm Marketings From Crops

$$FIRCRIA = FIRCRIAR + (SBVPRIA/3 + SBVPRIA.1 * 2/3) \quad (43)$$

Farm Marketings From Livestock and Dairy (restricted)

$$FIRLVIAR = \underset{(8.56)}{1.38952} * CCVPRIA + \underset{(12.55)}{1.00318} * HPVPRIA + \underset{(2.28)}{373.435} \quad (44)$$

Fit over:	1970-1989	Std Error	= 145.417
R Sq	= 0.9732	D.W. (1)	= 1.3707
Adj R Sq	= 0.9700	LHS Mean	= 4197.59

Farm Marketings From Livestock and Dairy

$$FIRLVIA = FIRLVIAR + MISPRIA * MIPFMIA/100 \quad (45)$$

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