A State-Level Agricultural Sector Policy Model: Baseline and Implications of the Dunkel Text on Agriculture for Iowa

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Abstract
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Keywords
Agriculture, Policy, Models and assessment tools

Disciplines
Agricultural and Resource Economics | Agriculture | Economic Policy | Statistical Models

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CONTENTS

Abstract ........................................................................................................ v
Method of Analysis .................................................................................. 2
The Iowa Agricultural Model ...................................................................... 2
  Theoretical Specification of the Model ............................................... 3
  Statistical Results ............................................................................... 5
Baseline Results for Iowa ......................................................................... 7
  Crops Sector Baseline ...................................................................... 8
  Livestock Sector Baseline ................................................................. 10
  Farm Income Baseline .................................................................... 10
Implications of a GATT Agreement on Iowa Agriculture ......................... 12
Summary .................................................................................................. 16
Appendix .................................................................................................... 18
References .................................................................................................. 33

FIGURES

1. Iowa net farm income .......................................................................... 12
2. Baseline and Dunkel scenario impacts on Iowa net farm income .......... 16

TABLES

1. Theoretical specification of the Iowa agricultural model ................. 4
2. Results of the 10-year projections on Iowa crops, livestock and dairy 9
3. Results of the 10-year projections on Iowa farm income .................. 11
4. Nominal impacts of the GATT scenario on Iowa crops, livestock and dairy 14
5. Nominal impacts of the GATT scenario on Iowa farm income .......... 15
A.1. Definitions of the Iowa model variables ...................................... 20
A.2. Structural parameter estimates of equations for Iowa crops ........ 22
A.3. Structural parameter estimates of equations for Iowa livestock and dairy 25
A.4. Structural parameter estimates of equations for Iowa production expenses 27
A.5. Structural parameter estimates of equations for Iowa farm income .... 31
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**

\[
Total \text{ production expenses} = \text{Feed expenses} + \text{Livestock expenses} + \text{Seed expenses} + \text{Fertilizer expenses} + \text{Fuel, oil expenses} + \text{Labor expenses} + \text{Real estate interest expenses} + \text{Non-real estate interest expenses} + \text{Capital consumption expenses} + \text{Other expenses}
\]

\[
Total \text{ cash expenses} = \text{Total production expenses} - \text{Capital consumption expenses} - \text{Difference between total actual and calculated cash expenses}
\]

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

**Farm Income**

\[
Gross \text{ farm income} = \text{Crop receipts} + \text{Livestock receipts} + \text{Other income} + \text{Government payments} + \text{Value of inventory adjustment}
\]

\[
Net \text{ farm income} = \text{Gross farm income} - \text{Total production expenses}
\]

\[
Total \text{ cash income} = \text{Crop receipts} + \text{Livestock receipts} + \text{Other cash expenses} + \text{Government payments}
\]

\[
Net \text{ cash income} = \text{Total cash income} - \text{Total cash expenses}
\]

- Crop receipts = \( f(\text{Value of production of corn and soybeans}) \)
- Livestock receipts = \( f(\text{Value of production of beef, pork and dairy}) \)
- Other cash income = \( f(\text{Wholesale price index, lagged other cash income}) \)
- Other noncash income = \( f(\text{Moody’s AAA rate, total cash receipts}) \)
- Government payments = \( \text{Deficiency payments} + \text{Diversion payments} + \text{Disaster payments} + \text{Conservation payments} \)
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

<table>
<thead>
<tr>
<th></th>
<th>87/88</th>
<th>88/89</th>
<th>89/90</th>
<th>90/91</th>
<th>91/92</th>
<th>92/93</th>
<th>93/94</th>
<th>94/95</th>
<th>95/96</th>
<th>96/97</th>
<th>97/98</th>
<th>98/99</th>
<th>99/00</th>
<th>00/01</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CORN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area Planted (mil. a.)</td>
<td>10.40</td>
<td>11.30</td>
<td>12.60</td>
<td>12.80</td>
<td>12.50</td>
<td>13.08</td>
<td>12.51</td>
<td>12.57</td>
<td>12.77</td>
<td>12.83</td>
<td>12.77</td>
<td>12.75</td>
<td>12.78</td>
<td>12.78</td>
</tr>
<tr>
<td>Yield (bu/a.)</td>
<td>130.0</td>
<td>84.0</td>
<td>118.0</td>
<td>126.0</td>
<td>117.0</td>
<td>125.2</td>
<td>126.5</td>
<td>127.5</td>
<td>127.9</td>
<td>128.7</td>
<td>129.4</td>
<td>129.9</td>
<td>130.3</td>
<td>131.0</td>
</tr>
<tr>
<td>Production (mil. bu.)</td>
<td>1,320</td>
<td>899</td>
<td>1,446</td>
<td>1,562</td>
<td>1,427</td>
<td>1,598</td>
<td>1,551</td>
<td>1,574</td>
<td>1,607</td>
<td>1,630</td>
<td>1,640</td>
<td>1,649</td>
<td>1,664</td>
<td>1,678</td>
</tr>
<tr>
<td>Market Price ($/bu.)</td>
<td>1.89</td>
<td>2.45</td>
<td>2.29</td>
<td>2.21</td>
<td>2.35</td>
<td>2.13</td>
<td>2.19</td>
<td>2.23</td>
<td>2.32</td>
<td>2.27</td>
<td>2.17</td>
<td>2.14</td>
<td>2.14</td>
<td>2.23</td>
</tr>
</tbody>
</table>

| **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  | 44.2  | 44.2  | 44.5  |
| Production (mil. bu.) | 343.7 | 251.1 | 322.9 | 327.9 | 350.3 | 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  | 5.85  | 5.90  | 5.93  | 5.46  | 5.29  | 5.39  | 5.69  |
| Value of Prod. (mil. $) | 2,052 | 1,841 | 1,815 | 1,846 | 1,890 | 1,938 | 1,941 | 1,968 | 2,075 | 2,114 | 1,992 | 1,948 | 2,001 | 2,134 |

| **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 |

| **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 | 73.30 | 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 | 1,573 |

| **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 |
| 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

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PRODUCTION EXPENSES

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NET CASH INCOME

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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

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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.
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<td>Iowa total calculated cash expenses, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIEINIA</td>
<td>Iowa farm non-real estate interest expenses, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIEIRIA</td>
<td>Iowa farm real estate interest expenses, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIEOTIA</td>
<td>Iowa total other farm expenses, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIEPFIA</td>
<td>Iowa farm feed expenses, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIEPLIA</td>
<td>Iowa livestock and poultry purchased on farms, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIEPOIA</td>
<td>Iowa farm fuel and oil expenses, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIEPPIA</td>
<td>Iowa pesticide expenses, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIEPSIA</td>
<td>Iowa farm seed purchased, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIEPZIA</td>
<td>Iowa farm fertilizer and lime expenses, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIEROIA</td>
<td>Iowa farm capital consumption expenses, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIETCIA</td>
<td>Iowa total cash expenses, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIETPIA</td>
<td>Iowa total production expenses, million dollars&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIEWRIA</td>
<td>Iowa farm contract and hired labor expenses, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FINCIA</td>
<td>Iowa net cash income, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FINFIA</td>
<td>Iowa net farm income, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIRAIA</td>
<td>Iowa value of inventory adjustment, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIRCIA</td>
<td>Iowa farm marketings from crops, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIRCRIAR</td>
<td>Iowa farm marketings from crops—restricted, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIRL VIA</td>
<td>Iowa farm marketings from livestock, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIRLVIAR</td>
<td>Iowa farm marketings from livestock—restricted, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>FIROCIA</td>
<td>Iowa other farm cash income, million dollars&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
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</table>
Table A.1. Continued

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition and Source</th>
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</thead>
<tbody>
<tr>
<td>FIRONIA</td>
<td>Iowa other farm noncash income, million dollars</td>
</tr>
<tr>
<td>FIROTIA</td>
<td>Iowa total farm income, million dollars</td>
</tr>
<tr>
<td>FIRTCAIA</td>
<td>Iowa total cash income, million dollars</td>
</tr>
<tr>
<td>FIRTOIA</td>
<td>Iowa total farm income, million dollars</td>
</tr>
<tr>
<td>FTPPIU9</td>
<td>U.S. all fertilizer PPI, 1982=100</td>
</tr>
<tr>
<td>HPPBGU9</td>
<td>U.S. 7-market barrow and gilt price, dollars per hundredweight</td>
</tr>
<tr>
<td>HPPFMIA</td>
<td>Iowa hog farm price, dollars per hundredweight</td>
</tr>
<tr>
<td>HPSPRIA</td>
<td>Iowa hog and pig production, million pounds</td>
</tr>
<tr>
<td>HPSPRU9</td>
<td>U.S. pork production, million pounds</td>
</tr>
<tr>
<td>HPVPRIA</td>
<td>Iowa hog and pig value of production, million dollars</td>
</tr>
<tr>
<td>MIPFMIA</td>
<td>Iowa milk farm price, dollars per hundredweight</td>
</tr>
<tr>
<td>MIPFMU9</td>
<td>U.S. milk farm price, dollars per hundredweight</td>
</tr>
<tr>
<td>MISPRIA</td>
<td>Iowa milk production, million pounds</td>
</tr>
<tr>
<td>MISPRU9</td>
<td>U.S. milk production, million pounds</td>
</tr>
<tr>
<td>MIVPRIA</td>
<td>Iowa milk value of production, million dollars</td>
</tr>
<tr>
<td>PPIWTRU9</td>
<td>U.S. PPI for wage rates, 1910-14=1</td>
</tr>
<tr>
<td>PW</td>
<td>U.S. producer price index for all commodities, 1967=100</td>
</tr>
<tr>
<td>PW050U9</td>
<td>PPI for fuels, related products and power, 1967=100</td>
</tr>
<tr>
<td>RCORPSAA</td>
<td>Moody’s AAA corps bond seasoned interest rate</td>
</tr>
<tr>
<td>RC86M</td>
<td>Prime commercial paper 6-month interest rate</td>
</tr>
<tr>
<td>SBAHAIA</td>
<td>Iowa soybean acres harvested, million acres</td>
</tr>
<tr>
<td>SBAHAU9</td>
<td>U.S. soybean acres harvested, million acres</td>
</tr>
<tr>
<td>SBAPAIA</td>
<td>Iowa soybean acres planted, million acres</td>
</tr>
<tr>
<td>SBAPAU9</td>
<td>U.S. soybean acres planted, million acres</td>
</tr>
<tr>
<td>SBPFMIA</td>
<td>Iowa soybean farm price, dollars per bushel</td>
</tr>
<tr>
<td>SBPFMU9</td>
<td>U.S. soybean farm price, dollars per bushel</td>
</tr>
<tr>
<td>SBSPRIA</td>
<td>Iowa soybean production, million bushels</td>
</tr>
<tr>
<td>SBSPRU9</td>
<td>U.S. soybean production, million bushels</td>
</tr>
<tr>
<td>SBVPRIA</td>
<td>Iowa soybean value of production, million dollars</td>
</tr>
<tr>
<td>SBYHAIA</td>
<td>Iowa soybean yield, bushels per harvested acre</td>
</tr>
<tr>
<td>SBYHAU9</td>
<td>U.S. soybean yield, bushels per harvested acre</td>
</tr>
<tr>
<td>SMPFMU9</td>
<td>U.S. soybean meal Decatur 44% protein market price, dollars per ton</td>
</tr>
<tr>
<td>TREND</td>
<td>Calendar year</td>
</tr>
<tr>
<td>TRN8284</td>
<td>Trend from 1982-84: 1982 = 1, 1983 = 2, 1984, 1985 = 3, etc., 0 otherwise</td>
</tr>
</tbody>
</table>

\(^{a}\)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

\[ COAPALA = 0.65903 \times COAPAU9 - 0.00317 \times COAPAU9^2 - 19.0342 \]

(1)

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

\[ COAHALA = 0.91689 \times COAPALA + 11.3834 \times COAHAU9/COAPAU9 - 9.5420 \]

(2)

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

\[ COYHALA = 1.27172 \times COYHAU9 - 0.83174 \times TREND + 1629.54 \]

(3)

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

\[ COSPRIA = COAHALA \times COYHALA \]
Table A.2. Continued

Corn Market Price

\[ \text{COPFMIA} = 0.97733 \times \text{COPFMU9} - 0.01438 \]
\[ \text{(29.97)} \quad \text{(0.19)} \]
\[ \text{[1.01]} \]

\[
\begin{align*}
\text{Fit over:} & \quad 1970-1989 & \text{Std Error} & = 0.0816 \\
\text{R Sq} & = 0.9804 & \text{D.W. (1)} & = 1.6080 \\
\text{Adj R Sq} & = 0.9793 & \text{LHS Mean} & = 2.2110
\end{align*}
\]

Corn Value of Production

\[ \text{COVPRIA} = \text{COPFMIA} \times \text{COSPRI} \]

Soybean Area Planted

\[ \text{SBAPALA} = 0.38673 \times \text{SBAPAU9} + 0.60055 \times \text{DMIS86} - 0.00236 \times \text{SBAPAU9}^2 \]
\[ \text{(3.22)} \quad \text{(2.82)} \quad \text{(2.32)} \]
\[ \text{[3.03]} \quad \text{[-1.13]} \]
\[ + 0.6060 \times \rho_{t-1} - 7.06681 \]
\[ \text{(2.33)} \quad \text{(1.97)} \]

\[
\begin{align*}
\text{Fit over:} & \quad 1971-1989 & \text{Std Error} & = 0.2276 \\
\text{R Sq} & = 0.9470 & \text{D.W. (1)} & = 1.8220 \\
\text{Adj R Sq} & = 0.9318 & \text{LHS Mean} & = 7.6532
\end{align*}
\]

Soybean Area Harvested

\[ \text{SBAHALA} = 0.99119 \times \text{SBAPALA} + 0.02158 \]
\[ \text{(195.83)} \quad \text{(0.56)} \]
\[ \text{[1.00]} \]

\[
\begin{align*}
\text{Fit over:} & \quad 1970-1989 & \text{Std Error} & = 0.0210 \\
\text{R Sq} & = 0.9995 & \text{D.W. (1)} & = 1.9493 \\
\text{Adj R Sq} & = 0.9995 & \text{LHS Mean} & = 7.5110
\end{align*}
\]
Table A.2. Continued

**Soybean Yield**

\[
S_{BYHAI} = 1.09922 \times S_{BYHAI}u9 + 3.60044 \\
\text{(5.88)} \quad \text{(0.66)} \quad [0.90]
\]

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

**Soybean Production**

\[
S_{SBSPRI} = S_{SBAHAI} \times S_{BYHAI}
\]

**Soybean Market Price**

\[
S_{SBPFMIA} = 0.94396 \times S_{SBPFMU9} + 0.28813 \\
\text{(32.41)} \quad \text{(1.67)} \quad [0.95]
\]

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

**Soybean Value of Production**

\[
S_{SBVPRI} = S_{SBPFMIA} \times S_{SBSPRI}
\]
Table A.3. Structural parameter estimates of equations for Iowa livestock and dairy

Hog and Pig Production

\[ HPSPRIA = 1.74563 \times HPSPRU9 - 0.00005 \times HPSPRU9^2 - 9490.14 \]
\[ \text{(2.06)} \quad \text{(1.67)} \quad \text{(1.58)} \]
\[ \text{[4.85]} \quad \text{[-2.00]} \]

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

Hog Farm Price

\[ HPPFMIA = 0.96957 \times HPPBGU9 - 0.02235 \]
\[ \text{(44.27)} \quad \text{(0.02)} \]
\[ \text{[1.00]} \]

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

Hog and Pig Value of Production

\[ HPVPRIA = HPSPRIA \times HPPFMIA/100 \]

Cattle and Calves Production

\[ CCSPRIA = 0.03581 \times CCSPRU9 - 200.243 \times TRND8284 \]
\[ \text{(1.57)} \quad \text{(5.97)} \]
\[ \text{[0.32]} \]
\[ - 351.396 \times LN(TREND - 1960) + 2967.67 \]
\[ \text{(2.40)} \quad \text{(4.96)} \]

Fit over: \(1970-1989\)  
R Sq = 0.9167  
Adj R Sq = 0.9011  
Std Error = 120.517  
D.W. (1) = 2.3257  
LHS Mean = 2559.26
Table A.3. Continued

Cattle Price

\[ CAPFMI = 0.98669 \times CAPOSU9 + 0.54984 \times \rho_{t-1} - 2.72844 \]
\[ (15.40) \quad (2.65) \quad (0.73) \]
\[ [1.05] \]

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

\[ CCVPRIA = CCSPRIA \times CAPFMI/100 \]

(18)

Milk Production

\[ MISPRIA = 0.28701 \times MISPRIA,1 + 0.03917 \times MISPRU9 \]
\[ (1.88) \quad (4.94) \quad [1.23] \]
\[ - 1029.09 \times LN(TREND - 1960) - 376.728 \times DMIS83 + 1010.04 \]
\[ (3.37) \quad (4.62) \quad (1.22) \]

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

\[ MIPFMI = 1.06027 \times MIPFMU9 - 1.21367 \]
\[ (140.88) \quad (14.54) \quad [1.12] \]

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

\[ MIVPRIA = MISPRIA \times MIPFMI/100 \]

(21)
Table A.4. Structural parameter estimates of equations for Iowa production expenses

**Total Production Expenses**

\[
FIE\text{TPIA} = FIE\text{PFI}A + FIE\text{PLI}A + FIE\text{PSI}A + FIE\text{PZI}A + FIE\text{PLI}A + FIE\text{POLI}A + FIE\text{OFI}A + FIE\text{NI}A + FIE\text{IRI}A + FIE\text{ROI}A + FIE\text{WRI}A + FIE\text{OVI}A
\]

(22)

**Total Cash Expenses**

\[
FIE\text{TClA} = FIE\text{TPI}A - FIE\text{ROI}A - CASH\text{DIF}
\]

(23)

**Difference Between Total and Calculated Cash Expenses**

\[
CASH\text{DIF} = 0.44539 * PW + 13.6484
\]

(8.78) \hspace{1cm} (1.09)

[0.88]

(24)

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

**Feed Expenses**

\[
FIE\text{PFIA} = 180.178 * (COP\text{FMI}A/3 + COP\text{FMI}A.1 * 2/3)
\]

(4.83) \hspace{1cm} [0.39]

\[
+ 2.14230 * (SMP\text{FMU9/4} + SMP\text{FMU9.1} * 3/4) + 6.39871 * TREND - 12353.7
\]

(3.56) \hspace{1cm} (1.67) \hspace{1cm} (1.64)

[0.35]

Fit over: 1970-1989 \hspace{1cm} Std Error = 77.3081
R Sq = 0.8744 \hspace{1cm} D.W. (1) = 1.3175
Adj R Sq = 0.8509 \hspace{1cm} LHS Mean = 1061.55
Table A.4. Continued

Livestock and Poultry Purchases

\[
FIEPLIA = 15.7944 * FCPFMKC + 0.69909 * CCSPRIA - 1890.07
\]
\[
(5.69) \quad (5.42) \quad (4.11)
\]
\[
[1.12] \quad [2.19]
\]

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

Seed Expenses

\[
FIEPSIA = 0.86435 * PW + 12.1279 * (COAPAIA + SBAPAIA) - 208.348
\]
\[
(18.77) \quad (6.28) \quad (5.91)
\]
\[
[0.83] \quad [1.04]
\]

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

Fertilizer and Lime Expenses

\[
FIEPZIA = 4.69652 * FTPPIU9 + 44.2737 * COAPAIA - 423.098
\]
\[
(8.33) \quad (4.52) \quad (3.46)
\]
\[
[0.70] \quad [1.40]
\]

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

Pesticide Expenses

\[
FIEPPIA = 1.11202 * PW + 0.07069 * PW050U9 + 2.39118 * (SBAPAIA + COAPAIA)
\]
\[
(7.21) \quad (1.15) \quad (0.80)
\]
\[
[1.10] \quad [0.18] \quad [0.21]
\]

Fit over: 1970-1989
R Sq = 0.9687
Adj R Sq = 0.9628
Std Error = 20.4271
D.W. (1) = 1.9239
LHS Mean = 219.855
### Table A.4. Continued

#### Fuel and Oil Expenses

\[
FIEPOLA = 0.80728 \times PW050U9 - 7.44716 \times TREND
\]

\[
(15.85) \quad (4.56)
\]

\[
+ 8.62232 \times (COAPALA + SBAHALA) + 14544.5
\]

\[
(2.38) \quad (4.51)
\]

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

#### Farm Contract and Hired Labor Expenses

\[
FIEWRLA = 8.04856 \times PPSWRU9 + 0.05114 \times CCSPRLA
\]

\[
(5.80) \quad (1.94)
\]

\[
+ 5.57951 \times (SBAPALA + COAPALA) - 216.749
\]

\[
(1.86) \quad (2.43)
\]

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

#### Real Estate Interest Expenses

\[
FIEIRLA = 0.62681 \times FIEIRLA.1 + 35.0895 \times RCORPSAAA
\]

\[
(10.54) \quad (6.30)
\]

\[
+ 0.01085 \times FIRTOIA.1 - 249.429
\]

\[
(1.66) \quad (5.20)
\]

Fit over: 1971-1989  
R Sq = 0.9862  
Adj R Sq = 0.9835  
Std Error = 32.2991  
H = 0.9159  
LHS Mean = 481.863
Table A.4. Continued

Non-Real Estate Interest Expenses

\[
FIEINIA = 0.61009 \times FIEINIA.1 + 18.8815 \times RCP6M
\]
\[
(7.97) \quad (2.87)
\]
\[
+ 0.08317 \times (FIEPLIA.1 + FIEPSLA.1 + FIEPFLA.1)
\]
\[
(2.43) \quad [0.53]
\]
\[
+ FIEPZIA.1 + FIEPPIA.1 + FIEPGLA.1)
\]
\[
- 216.111
\]
\[
(3.31)
\]

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

\[
FIEROLA = 104.195 \times RCORPSA A + 63.7517 \times (COAPA A + SBAPA A)
\]
\[
(3.11) \quad (2.29)
\]
\[
[0.88] \quad [1.11]
\]
\[
+ 0.13559 \times HPSPA A - 1846.91
\]
\[
(1.08) \quad (2.64)
\]
\[
[0.60]
\]

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

\[
FIEOTLA = 5.39491 \times PW + 0.13915 \times FIRTO A - 426.440
\]
\[
(3.64) \quad (2.78)
\]
\[
[0.60] \quad [0.60]
\]

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

\[ FIRTOIA = FIRCRIA + FIRLVIA + FIROTIA + FIRLIA + FIRGPIA \]  \hspace{1cm} (36)

Net Farm Income

\[ FINFILA = FIRTOIA - FIELPIA \]  \hspace{1cm} (37)

Total Cash Income

\[ FIRTCIA = FIRCRIA + FIRLVIA + FIROClIA + FIRGPIA \]  \hspace{1cm} (38)

Net Cash Income

\[ FINCIIA = FIRTCIA - FIELTCIA \]  \hspace{1cm} (39)

Other Cash Income

\[ FIROCIA = 0.39467 \times FIROClIA.1 + 0.68897 \times PW + 161.364 \times DMIS89 \]
\[ \begin{align*} 
\text{COEF} & \text{ (1.90)} \\
\text{COEF} & \text{ (2.53)} \\
\text{COEF} & \text{ (2.87)} \\
\text{COEF} & \text{ [1.12]}
\end{align*} \]
\[ - 74.9291 \]  \hspace{1cm} (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

\[
FIRONIA = 17.4423 \times RCORPSAAA + 0.05949 \times (FIRCRIA + FIRLVIA + FIRGPIA)
\]
\[
(1.14) \quad (3.49)
\]
\[
[0.15] \quad [1.50]
\]
\[
- 222.481 \times DMIS84 - 204.370
\]
\[
(3.76) \quad (2.34)
\]

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

Farm Marketings From Crops (restricted)

\[
FIRCRIAR = 0.51973 \times (COVPRIA/3 + COVPRIA.1 \times 2/3) + 33.1858 \times TRENDB - 65276.5
\]
\[
(6.00) \quad (2.47)
\]

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

Farm Marketings From Crops

\[
FIRCRIA = FIRCRIAR + (SBVPRIA/3 + SBVPRIA.1 \times 2/3)
\]

Farm Marketings From Livestock and Dairy (restricted)

\[
FIRLVIA = 1.38952 \times CCVPRIA + 1.00318 \times HPVPRIA + 373.435
\]
\[
(8.56) \quad (12.55) \quad (2.28)
\]

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

Farm Marketings From Livestock and Dairy

\[
FIRLVIA = FIRLVIA + MISPRIA \times MPFMIA/100
\]

(45)
REFERENCES


