Quarterly Livestock Sector Adjustments to Changes in Feed Grain Prices

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Abstract

A quarterly econometric model for U S agriculture is used to illustrate shortrun and longrun adjustments in major livestock subsectors resulting from changes in feed grain prices Adjustments in the different livestock subsectors differ sharply in both speed and magnitude because of underlying biological and economic constraints, feed-use efficiencies, and industry structures All livestock producers benefit from lower feed grain prices Cattle feeders, hog producers, and dairy producers appear to benefit most in the long run, whereas poultry producers and cow-calf enterprises benefit least Consumers also benefit from reduced feed grain prices because retail prices for meats are generally lower after an initial period of somewhat higher meat prices as current production is reduced to expand cattle and hog breeding herds

Keywords

Feed grains, livestock, quarterly model, cross-commodity linkages, biological constraints, net returns, model simulations, impact analysis

This article examines quarterly adjustments in the livestock sector resulting from reductions in feed grain prices as could occur under the Food Security Act of 1985 Even small policy changes for feed grains can have large effects on the livestock sector because of the importance of feed grains in the livestock production process Total U S farm expenditures for feed were about $20 billion in 1984, almost 15 percent of all farm production expenses (*6*) [1] Feed expenditures exceeded spending on inputs such as seed, fertilizers, and fuel, and nearly equaled the combined interest charges on short-term and real estate debt

Feed grains account for roughly half the total value of grains, oilseed meals, and hay used in animal feeding In turn, domestic animal feeding is the largest single use of feed grains, accounting for about 60 percent of annual disappearance This interdependency means that changes in feed grain policies that alter feed grain prices can have substantial effects on the profitability of livestock production The effects are direct, through lower feed grain costs, and indirect, through induced changes in costs of complementary and substitute feeds In addition, cost-of-production changes cause adjustments in livestock production, which further alter profitability through price changes in livestock and livestock products

As livestock production operations have become larger and more specialized, leading to fewer mixed enterprises, feed grain/livestock interdependencies have become more important Livestock producers, therefore, are now more vulnerable to swings in feed prices and, consequently, feed grain policies are more important for livestock producers (*1, 3*) Such cross-commodity effects are often given secondary importance in the formulation and evaluation of crop policies The main goal of crop policies is usually to enhance the income of crop producers Furthermore, in the debate leading to the Food Security Act of 1985, the need for lower loan rates was almost completely attributed to the loss of competitiveness in export markets for crops, the need to

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[1] Italicized numbers in parentheses refer to items in the References at the end of this article

regain market share, and the need to reduce program outlays to lower the budget deficit

In an article discussing the effects of Federal grain programs on the livestock sector, Todd surveyed a number of econometric models and calculated the longrun effects on livestock production, prices, and gross income (*10*) An increase in feed grain prices will generally cause production in the livestock sector to fall in the long run, with prices and gross income rising Todd points out, however, that most of the estimated increases in gross income are too small to cover the higher feed grain costs, so producer returns net of feed costs are lower in the long run

In this article, we use a quarterly econometric model to illustrate quarterly adjustment patterns in major livestock subsectors that result from a reduction in feed grain prices This allows us to examine, not only the longrun impacts on livestock production, prices, income, and net returns, as Todd did, but also, with the quarterly framework, the dynamic time paths of adjustments to compare shorter run impacts across the different livestock subsectors Of particular interest are the adjustments of production and prices and the comparison of gross receipts and net returns of livestock producers with each other and across time

The Model

The analysis uses a quarterly econometric model of the U S agricultural sector, including subsector models for corn, wheat, soybeans, cattle, hogs, poultry, and dairy (*13, 14*)

An important feature of the model is its explicit linkages between and among the crop and livestock subsectors, thereby allowing examination of cross-commodity effects of alternative scenarios Two types of cross-commodity linkages are of particular importance for our application First are the linkages between feed grains and livestock subsectors These linkages primarily occur in equations for decision variables affecting livestock production as feed grain prices are used to represent major livestock production costs The second important types of linkages are those among the various livestock subsectors These linkages occur primarily in the pricing equations where the price of any particular meat is generally affected by production of competing meats

The livestock subsectors also include lags that reflect biological constraints on the different production processes and on the addition of animals to the breeding stocks (figs 1-5) Cattle and dairy producers face the longest biological constraints.

Because we are primarily interested here in livestock sector adjustments, we now present a summary of the livestock subsectors in the model [2]

Cattle

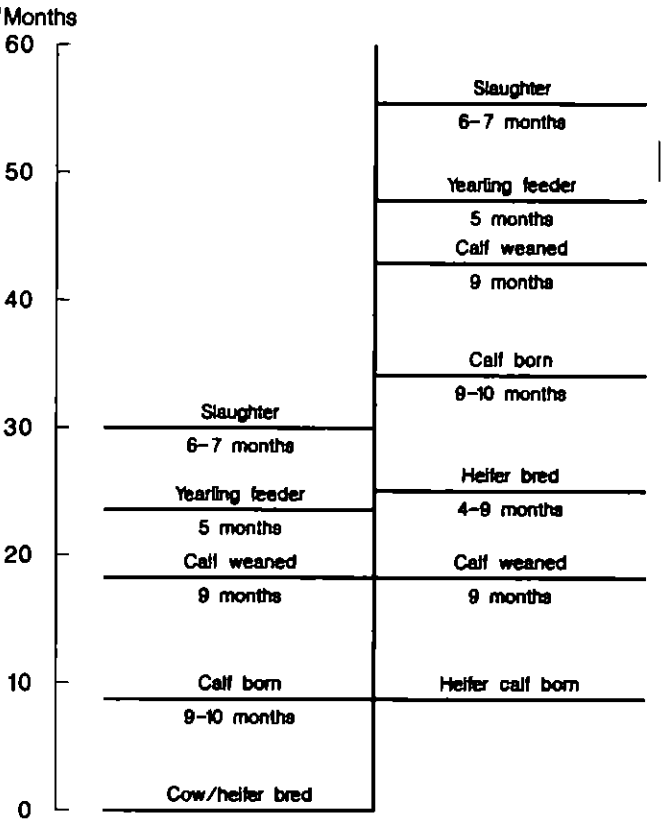
In the cattle sector, cow-calf operations are represented by eight annual cattle inventory equations and two quarterly breeding herd liquidation equations Because the cow inventory represents the capital stock from which cattle production is drawn, these equations set production constraints for the rest of the cattle subsector

The three most important categories in representing cow-calf operations are additions to the breeding herd, breeding herd liquidations, and the

[2]Readers interested in a discussion of the crop subsectors, a more detailed discussion of the livestock subsectors, a presentation of the model's individual equations, or model validation statistics are referred to (*13*) and (*14*)

Figure 1

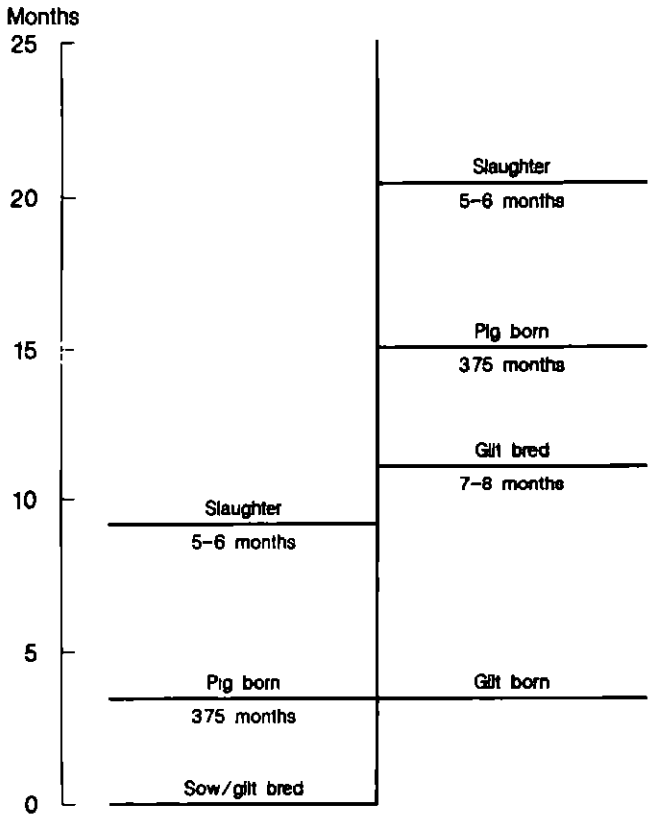
Cattle Sector Biological Lags



Based on (*2 7*)

Figure 2

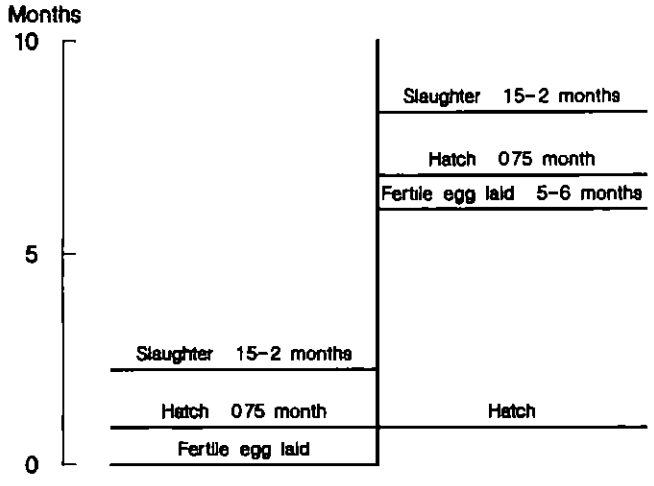
Hog Sector Biological Lags



Based on (*4 11*)

Figure 3

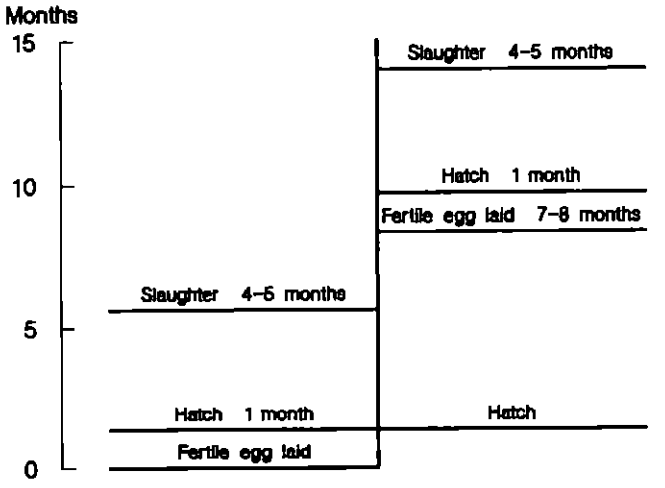
Broiler Sector Biological Lags



Based on (*5*)

Figure 4

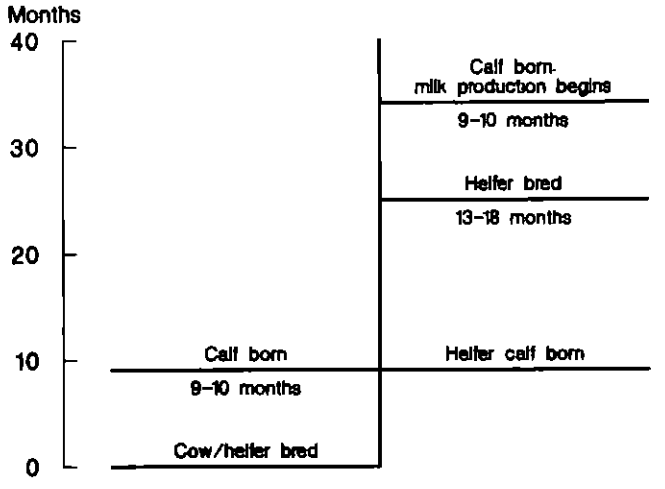
Turkey Sector Biological Lags



Based on (*9*).

Figure 5

Dairy Sector Biological Lags



Based on (*7*)

calf crop Additions to the breeding herd and the calf crop are functions of deflated feeder steer prices, representing expected returns of producing feeders and deflated hay prices as a proxy for grazing conditions Breeding herd liquidations are inversely related to a distributed lag of feeder steer prices, again to represent expected returns of producing feeders

The equation for net placements of cattle into feedlots provides the major linkages between feed grain prices and the cattle sector as well as the linkages between cow-calf operations and cattle feeders Net placements are a function of expected returns of feeding relative to feed costs, represented by a ratio of a distributed lag of fed-steer prices to lagged corn prices, and a distributed lag of the cost of feeder cattle Additionally, net feedlot placements are constrained by the size of recent calf crops Net feedlot placements are used to derive fed-cattle marketings and fed-steer and heifer slaughter

Nonfed steer and heifer slaughter is also a function of fed-steer prices and corn prices, although these factors have the opposite effect here than they do in the feedlot placement decision The more attractive cattle feeding is, the smaller is nonfed slaughter Furthermore, similar to the net placements equation, nonfed slaughter is constrained by the size of recent calf crops

Combining breeding herd liquidations with both fed and nonfed steer and heifer slaughter and then multiplying by averaged dressed weights gives commercial beef production One adds beginning stocks, imports, and farm production of beef to commercial production to derive total beef supplies

Cold storage beef stocks are estimated as a function of beginning stocks and imports Exports, shipments, and military use of beef are exogenous The model derives beef consumption in an identity by subtracting ending cold storage stocks, exports, shipments, and military use from total beef supplies

The price for fed steers is a function of fed and nonfed steer and heifer slaughter and disposable personal income The price for feeder steers is then related to fed-steer prices to represent the demand for feeders, the previous year's calf crop to represent potential feeder supplies, and lagged corn prices to represent expected feeding costs

Hogs

In the hog subsector, the most important equation is for sows farrowing Sows farrowing is a function of expected returns to hog production represented by a distributed lag of a seven-market hog price This equation also includes a one-quarter lag of prices for corn, the major hog feed, to represent expected costs of production The model multiplies the number of sows farrowing by an exogenously determined number of pigs saved per litter to derive the pig crop as an identity Barrow and gilt slaughter then draws on the pig crops in the two previous quarters, representing the 5- to 6-month farrow-to-finish production process

Sow slaughter and boar slaughter represent breeding herd liquidation decisions They depend on expected returns and costs, represented by lagged hog prices and corn prices Total hog slaughter is the sum of barrow and gilt slaughter, sow slaughter, and boar slaughter A series of pork supply identities give pork production and total pork supplies

The equation for ending cold storage pork stocks is a function of beginning stocks and production Exports, shipments, and military use of pork are exogenous as for beef, and the model derives pork consumption in an identity by subtracting ending cold storage stocks, exports, shipments, and military use from total pork supplies

The average hog price for seven major markets is a function of pork production, representing supplies, beef production, representing competing meat supplies, and disposable personal income

Poultry

In the poultry subsector, broiler pullets placed in hatchery supply flocks represent additions to the capital stock from which slaughter broilers are drawn Expected feeding costs are represented by a two-quarter lag of a feed cost variable, derived by using a 70-percent corn and a 30-percent soybean meal feed ration Expected returns are represented by a two-quarter lag of broiler prices

Broilers hatched draw from the hatchery supply flock, represented by a weighted moving sum of pullets placed two to four quarters earlier The equation for broilers hatched also includes one-quarter lags of broiler prices and feed prices to represent expected returns and expected production costs, respectively Broiler production is related to the one-quarter lag of broiler hatch to reflect the time needed to bring broilers to market weight As before, expected returns and costs are represented by lagged prices for broilers and feed The model derives total chicken supplies by adding beginning cold storage stocks to production

The equation for ending chicken stocks in cold storage is a function of beginning stocks and broiler production Similar to beef and pork, the model derives chicken consumption in an identity, subtracting ending cold storage stocks and exogenously determined exports, shipments, and military use from chicken supplies

The 12-city broiler price is a function of broiler production, representing supplies, beef and pork production, representing competing meat supplies, and disposable personal income

Turkey production is estimated directly without any explicit link to a supporting set of breeding inventory equations Turkey production is related to two-quarter lags of turkey prices and corn prices to reflect expected returns and feeding costs The model derives total turkey supplies by adding beginning cold storage stocks to production

Ending cold storage stocks of turkey are a function of beginning stocks and turkey production As in the other meat subsectors, exports, shipments, and military use of turkey are exogenous, and the model derives turkey consumption in an identity by subtracting ending cold storage stocks, exports, shipments, and military use from supplies

A price equation for turkeys is a function of the sum of beef, pork, and broiler production, representing competing meat supplies, and disposable personal income

Dairy

In the dairy subsector, the milk cow inventory equation is related to lagged effective milk prices, lagged feed prices (83-percent corn, 17-percent soybean meal), and cattle prices to represent expected returns, production costs for the major dairy feeds, and profitability of competing beef enterprises, respectively An equation for production per cow is estimated as a function of expected returns, represented by lagged effective milk prices, and production costs, represented by lagged soybean meal prices

The model derives milk production in an identity by multiplying the milk cow inventory by production per cow Milk use on farms, commercial dairy stocks, and dairy imports are exogenously determined Marketings are equal to production minus milk use on farms Total milk supplies are equal to marketings, beginning commercial dairy stocks, and dairy imports

Commercial use is the major demand for milk It is estimated as a function of milk prices to represent factor costs and disposable personal income to represent final product demand

Net Government removals of milk represent the role of the Government in the dairy sector This equation serves as the market-clearing equation in the dairy subsector It sets net Government removals of milk equal to total milk supplies less commercial milk use and ending commercial stocks

The farm-level milk price is a function of the support price, to reflect the role of the Government, aggregate production, to represent supplies, and commercial milk use, to represent non-Governmental demand factors An effective milk price is calculated that differs from the farm-level milk price by the level of milk price deductions that producers have been assessed

Gross Receipts, Net Returns, and Retail Prices

Two additional blocks are appended to the commodity subsectors of the quarterly agriculture model for use in this analysis First, various indicators of livestock producers' costs and returns are derived (*8*) Estimates of gross receipts and returns net of feed costs for producers of the different types of livestock are provided

Second, a model for retail prices (*12*) is used to compare adjustments in consumer prices for beef, pork, poultry, and dairy products This model uses a modified stage of processing approach where the retail price of any product is represented as a function of prices for inputs used in its production, including prices of raw materials and costs of marketing, as well as retail prices for close substitutes or complements In particular, the retail price equations for beef, pork, and poultry are simultaneous

The Policy Scenarios

The most significant departure from recent policies in the commodity titles of the Food Security Act of 1985 is the provision for sharply lower loan rates for crops The changes providing for lower feed grain loan rates include (1) basing the computed loan rate on a percentage of past market prices, with a maximum annual decline limited to 5 percent, (2) authority to lower loan rates up to an additional 20 percent by use of the so-called Findley Amendment, and (3) authority to allow loan repayment at levels below the loan rate determined for the crop Moreover, application of the Gramm-Rudman-Hollings balanced budget act has lowered and may continue to lower effective loan rates and market prices

Here we examine the effects on the livestock sector of lower feed grain prices that could result from implementing lower feed grain loan rates under the provisions of the Food Security Act of 1985 Two

dynamic simulations of the quarterly agriculture sector model discussed in the previous section are performed over a 17-quarter period from the October-December quarter of 1986 through the end of calendar year 1990, with different policy assumptions used in each In the base scenario, we assumed that regular nonrecourse and farmer-owned reserve loan rates for feed grains would continue at their 1985/86 levels In the alternative scenario, we assumed that loan rates for feed grains would be lowered by about 25 percent from 1985/86 levels beginning in the 1986/87 crop year and extending through the remainder of the simulation For example, we set the loan rate for corn at $2 55 per bushel in the base scenario and reduced it to $1 92 per bushel in the alternative scenario

In both simulations, we set prices for corn and other feed grains in the model exogenously equal to their loan rate on a season-average basis, with typical seasonal patterns assumed through the marketing year For corn, again, we set prices in the base scenario simulation at $2 45 per bushel in each harvest quarter and at $2 55, $2 65, and $2 55 per bushel in the subsequent quarters of each crop year, whereas we set corn prices in the alternative scenario simulation at $1 82 per bushel in each harvest quarter and at $1 92, $2 02, and $1 92 per bushel in the following quarters of each crop year We also reduced hay prices by about 25 percent in the alternative scenario Policy assumptions regarding other subsectors were held the same in both scenarios [3] Other subsectors were, however, left endogenous in the simulations, allowing both direct and indirect effects on livestock to occur Endogenously determined adjustments in soybean meal prices, for example, affected some livestock sector responses

We then determined livestock sector adjustments by comparing the two model solutions These comparisons can be used to address a number of questions concerning crop policy changes on livestock For example, what classes of livestock initially benefit most from lower feed grain prices? As adjustments occur, how do relative gross incomes and net returns among livestock classes change? How long does it take before the initial increases in net returns are reduced by the livestock production responses? How long is it before benefits to meat consumers begin? The next section discusses these issues

[3]For example, we assumed a moderate dairy herd buyout in both scenarios Furthermore, the milk price support was exogenously set in both scenarios at $11 60 per hundredweight (cwt) in the October-December quarter of 1986, $11 35 per cwt for the first three quarters of 1987, and $11 10 per cwt thereafter

Results

Tables 1-4 summarize the major impacts in the livestock sector resulting from an approximate 25-percent decline in feed grain loan rates and market prices from 1985/86 levels The tables show percentage changes in each selected variable from the base scenario solution

Cattle

Table 1 shows selected impacts in the cattle sector Lower feed prices, particularly for corn, provide economic incentives for increased cattle feeding Increased cattle feeding raises the demand for feeder cattle, initially pushing feeder steer prices higher Higher receipts minus feed costs for cow-calf operators trigger an increase in the breeding herd through reduced cow slaughter and the addition of more heifers Consequently, the calf crops are larger in the alternative scenario Cattle placed in feedlots, cattle on feed, and fed-cattle marketings are all higher in the alternative scenario, resulting in higher fed steer and heifer slaughter Nonfed slaughter, however, is sharply lower as more cattle are placed in feedlots and added to the breeding herd As a result, total steer and heifer slaughter is initially reduced Then, beginning in the sixth quarter, higher fed slaughter offsets reduced nonfed slaughter, resulting in increased total steer and heifer slaughter Fed-steer prices are higher for about a year, during the period that total slaughter is lower Fed steer prices are subsequently reduced Consumers face higher retail beef prices for a little more than a year before the effects of the increased total meat production push retail prices below the base scenario levels as well Total revenues and returns net of feed costs for cattle feeders are higher throughout the simulation period, with the differences from the base scenario narrowing as fed slaughter increases With lower fed-steer prices after the first year, feeder steer prices are bid down, reducing total revenues for cow-calf operators after the second simulation year Net returns for cow-calf operators remain higher, however, because of reductions in costs of feed grains, hay, and soybean meal Consequently, although cow slaughter is generally higher in the latter years of the simulation, largely reflecting the normal culling of a larger herd, a more-than-offsetting number of heifers are added, so the cow inventory remains larger than in the base scenario

Hogs

Table 2 shows selected impacts in the hog sector Total revenues minus feed costs rise sharply at

Table 1—Selected cattle sector impacts of a 25-percent reduction in feed grain prices. Simulated changes from base scenario, 1986-IV through 1990

Year and quarter	Cow slaughter	Heifers entering the cow herd (annual)	Calf crop (annual)	Feeder steer price	Fed steer price	Beef and veal CPI
				Percent change		
1986-IV	0			0	0	0
1987-I	6	4 2	3 1	8 7	3 5	2 2
1987-II	−2 3			9 1	3 8	3 8
1987-III	−4 1			8 9	3 9	4 0
1987-IV	−4 5			7 1	2 6	3 6
1988-I	−3 7	5 6	4 7	− 8	−3 1	0
1988-II	− 4			− 3	−2 5	−2 1
1988-III	1 7			1 2	−1 2	− 9
1988-IV	1 9			1	−2 2	− 2
1989-I	3 6	6 0	4 4	−7 4	−8 0	−3 2
1989-II	6 4			−5 7	−6 4	−4 3
1989-III	7 8			−3 4	−4 4	−2 5
1989-IV	6 9			−3 0	−4 2	−1 6
1990-I	7 3	5 1	4 4	−7 6	−8 3	−3 5
1990-II	8 3			−6 3	−6 9	−4 5
1990-III	8 7			−3 6	−4 6	−3 1
1990-IV	7 3			−3 1	−4 3	−2 3

		Steer and heifer slaughter			Total revenues		Total revenues minus feed costs	
	Feedlot placements	Fed	Nonfed	Total	Cow-calf	Feeding	Cow-calf	Feeding
					Percent change			
1986-IV	0	0	0	0	0	0	10 2	6 9
1987-I	4 5	1 0	−77 4	−2 4	9 3	4 6	24 6	12 5
1987 II	5 9	2 1	−86 2	−2 4	9 6	6 0	25 0	13 8
1987-III	7 1	3 2	−75 7	−2 2	9 4	7 3	22 6	14 8
1987-IV	12 0	5 8	−63 3	− 8	7 7	8 5	19 7	15 8
1988-I	10 8	7 0	−87 6	4 2	9	3 7	10 4	9 3
1988-II	7 7	7 0	−88 9	3 9	1 4	4 3	11 1	9 9
1988-III	9 7	7 5	−91 7	2 8	2 9	6 2	12 2	12 2
1988-IV	13 5	9 4	−64 2	4 1	1 8	7 0	10 3	12 7
1989-I	11 9	10 1	−50 0	9 6	−4 8	1 2	1 5	5 3
1989-II	7 3	9 2	−71 9	8 1	− 3 1	2 2	3 8	6 5
1989-III	9 5	9 1	−84 5	6 1	− 7	4 3	6 4	9 2
1989-IV	11 5	10 0	−52 0	6 3	− 4	5 3	6 7	10 3
1990-I	11 3	10 4	−50 0	10 0	−5 1	1 3	1 0	5 2
1990-II	6 2	9 2	−51 3	8 7	−3 7	1 6	2 8	5 6
1990-III	8 7	8 9	−84 9	6 3	− 9	3 9	6 1	8 6
1990-IV	11 2	9 8	−50 4	6 3	− 4	5 0	6 6	9 9

Note Heifers entering the cow herd and the calf crop are annual variables in the model Percentage changes shown for these variables are, therefore, annual impacts

'Blanks indicate not applicable

Table 2—Selected hog sector impacts of a 25-percent reduction in feed grain prices: Simulated changes from base scenario, 1986-IV through 1990

Year and quarter	Sow slaughter	Sow farrowings	Barrow and gilt slaughter	Hog Slaughter	Hog price	Total revenues	Total revenues minus feed costs	Pork CPI
				Percent change				
1986-IV	−7 0	0	0	−0 4	0 7	0 3	16 4	0 2
1987-I	−9 2	3 2	0	− 4	2 7	2 2	27 5	1 4
1987-II	−5 9	5 0	1 1	7	1	9	31 0	1 6
1987-III	−2 6	6 9	4 0	3 6	−6 0	−2 7	10 5	− 4
1987-IV	9	6 3	5 6	5 3	−10 4	−5 7	− 4	−3 1
1988-I	4 6	6 7	6 5	6 3	−17 4	−12 2	−14 9	−6 7
1988-II	8 4	4 3	6 0	6 1	−17 7	−12 6	−16 3	−8 8
1988-III	8 0	2 4	5 7	5 9	−14 5	−9 5	−7 0	−7 7
1988-IV	5 3	− 2	3 6	3 7	−9 8	−6 5	1 0	−5 4
1989-I	2 1	− 5	1 3	1 4	−9 8	−8 5	2 3	−4 9
1989 II	2	−1 3	− 3	− 2	−5 4	−5 6	16 5	−4 1
1989-III	−2 9	−1 7	− 8	− 9	−2 4	−3 3	21 9	−2 0
1989-IV	−4 7	−1 7	−1 4	−1 6	− 5	−2 1	17 9	− 6
1990-I	−8 2	5	−1 7	−1 9	−2 7	−4 6	19 7	−1 1
1990-II	−5 1	1 1	− 8	−1 0	−3 9	−4 9	23 1	−2 2
1990-III	−3 5	1 6	8	5	−6 1	−5 6	16 1	−2 6
1990 IV	−2 0	1 3	1 3	1 1	−6 4	−5 4	8 4	−2 9

Table 3—Selected poultry sector impacts of a 25-percent reduction in feed grain prices: Simulated changes from base scenario, 1986-IV through 1990

Year and quarter	Broiler production	Broiler price	Broiler revenues	Broiler revenues minus feed costs	Turkey production	Turkey price	Turkey revenues	Turkey revenues minus feed costs	Poultry CPI
					Percent change				
1986-IV	0	0 3	0 3	12 0	0	0 2	0 2	9 0	0 1
1987-I	3	1 7	2 0	15 1	0	1 7	1 7	11 5	9
1987-II	1 5	−1 4	0	14 1	3 0	6	3 6	14 7	5
1987 III	1 4	−3 3	−1 9	8 6	2 6	−1 0	1 6	10 7	− 4
1987 IV	9	−4 6	−3 7	4 8	2 4	−2 5	− 2	6 8	−1 5
1988-I	1 1	−9 7	−8 7	−2 9	3 4	−6 7	−3 6	2 4	−4 2
1988-II	9	−10 3	−9 5	−2 4	2 1	−6 8	−4 9	2 1	−5 7
1988-III	7	−7 6	−7 0	1 2	6	−5 3	−4 7	2 5	−4 7
1988-IV	8	−6 8	−6 1	1 7	7	−4 5	−3 8	2 6	−3 6
1989 I	1 1	−10 1	−9 1	−3 0	1 7	−7 3	−5 8	1	−4 4
1989-II	8	−8 5	−7 7	1 7	1 3	−5 9	−4 6	3 2	−4 2
1989-III	7	−5 6	−5 0	5 5	4	−3 9	−3 6	4 6	−2 8
1989-IV	1 2	−5 5	−4 3	4 8	9	−3 3	−2 5	4 6	−2 1
1990 I	1 5	−8 9	−7 5	− 4	2 1	−6 0	−4 0	2 6	−3 2
1990-II	1 1	−9 1	−8 1	1 0	1 7	−5 9	−4 4	3 4	−3 9
1990-III	9	−7 4	−6 6	2 9	7	−5 0	−4 3	3 4	−3 6
1990-IV	1 2	−7 6	−6 5	1 4	8	−4 8	−4 0	2 6	−3 5

Table 4—Selected dairy sector impacts of a 25-percent reduction in feed grain prices: Simulated changes from base scenario, 1986-IV through 1990

Year and quarter	Milk cow inventory	Milk production	Commercial milk use	Milk price	Net Government removals	Total revenues	Total revenues minus feed costs	Dairy CPI
				Percent change				
1986-IV	0	0	0	0	−0 1	0	8 9	0
1987 I	0	0	0	0	2	6	10 2	0
1987-II	1	0	0	0	2	6	10 5	0
1987 III	1	0	0	0	9	6	10 0	0
1987-IV	1	0	0	0	2 4	5	9 4	0
1988-I	2	1	0	− 1	1 2	− 2	9 2	0
1988-II	3	3	01	− 2	3 2	− 1	9 7	− 1
1988-III	3	3	01	− 3	16 3	1	9 3	− 1
1988-IV	4	4	01	− 3	15 5	0	8 6	− 2
1989 I	5	5	01	− 4	5 7	− 7	8 4	− 2
1989-II	6	7	02	− 6	11 2	− 5	8 9	− 3
1989 III	7	8	02	− 7	16 7	− 2	8 6	− 3
1989-IV	8	8	02	− 6	16 4	− 1	8 2	− 3
1990-I	9	9	02	− 8	12 0	− 6	8 3	− 4
1990-II	1 0	1 1	02	−1 0	23 6	− 6	8 6	− 5
1990 III	1 1	1 1	02	−1 0	17 7	− 2	8 5	− 5
1990-IV	1 2	1 2	02	− 9	17 8	0	8 2	− 5

first As in the cattle sector, this increase diminishes breeding herd liquidations in the first year, with sow slaughter and boar slaughter lower for the first four quarters Larger breeding herds then lead to increased sow farrowings, pig crops, and barrow and gilt slaughter As a result, total hog slaughter is initially lower, but then rises above the base scenario levels Combined with other livestock sector supply responses, these adjustments result in higher hog prices for the first three quarters, followed by lower prices thereafter Similarly, consumer prices for pork are initially higher, but then fall below base levels after the third quarter After the first year, total revenues minus feed costs fall for four quarters from the base scenario levels before again rising above the base, starting in late 1988 Consequently, breeding herd liquidations are higher for over a year before declining again after net returns rise The resulting cyclical adjustment patterns are shorter and more pronounced than in the cattle sector, reflecting the shorter biological lags in hog production, the larger portion of production costs accounted for by feed grains, and the greater importance of mixed enterprise farms in the hog industry Having a mixed corn/hog operation provides more producer options as corn can be marketed through hog feeding or sold directly

Poultry

Broiler and turkey production both increase relative to the base scenario, although increases are generally smaller than in the cattle and hog sectors (table 3) With relatively short biological constraints, poultry production increases are largest in the first three to six quarters before cattle and hog sector adjustments lead to higher red meat production Poultry prices are higher in the short run, which reflects initially reduced total supplies of red meats and poultry Poultry prices then decline, however, as poultry and red meat production increase The largest poultry price declines, however, occur after those periods when poultry production adjustments are largest, reflecting the increased production of competing red meats Consumer prices for poultry are lower after the third quarter, with the largest declines also occurring when red meat production is higher Although total revenues are lower after the initial three to four quarters, producer returns net of feed costs remain above the base scenario throughout most of the simulation interval, providing the economic incentive for continued higher production

Dairy

Impacts on production of dairy products, commercial use, and prices are relatively small (table 4) Milk cow inventories rise in response to higher net returns, although biological constraints limit the expansion Production per cow falls initially, reflecting the implicit retention at the margin of cows that would have otherwise been culled Production per cow then rises, reflecting lower feeding costs

Figure 6

Impacts of Lower Feed Grain Prices on Gross Revenues: Cow Calf, Fed Cattle, and Hogs

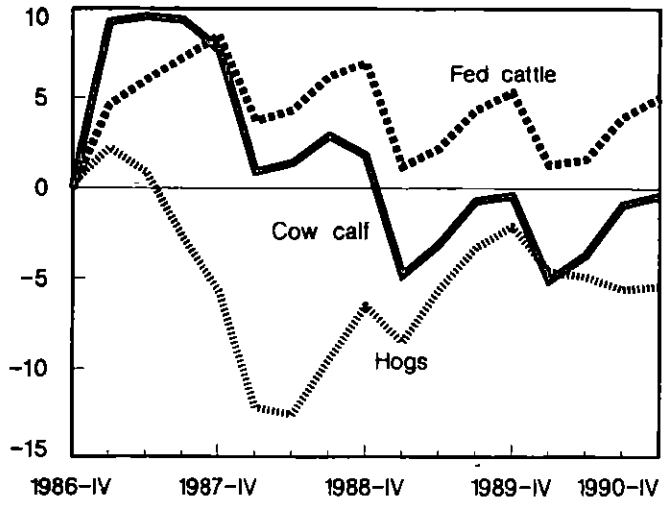
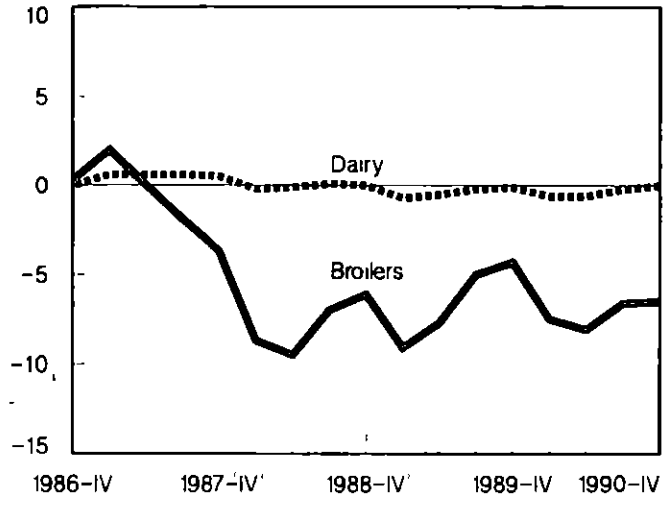


Figure 7

Impacts of Lower Feed Grain Prices on Gross Revenues: Broilers and Dairy



The resulting production gains, however, are minimal as are changes in commercial use and prices Nonetheless, increases in production exceed those in use, resulting in higher net Government removals of dairy products Without an accompanying revision in dairy policy, reduced market prices for feed grains would increase Government costs of the dairy programs

Gross Revenues and Net Returns

We can measure the differential impact of the change in feed grain prices on producers of the various types of livestock products by comparing changes in their gross revenues and returns net of feed costs Gross receipts for cattle feeders are higher throughout the simulation period as their production increases offset their price declines (figs 6 and 7) [4] Gross receipts for cow-calf enterprises are initially higher as well, but then fall below base scenario levels after about 2 years Gross revenues for other livestock producers are generally lower after three to five quarters with reduced feed grain prices

As Todd (*10*) points out, however, a more appropriate measure of producer well-being is total revenues minus feed costs (net returns) [5] All livestock producers appear to benefit from lower feed grain prices because net returns are generally all higher than in the base scenario (figs 8 and 9) The initial rise in net returns is led by hog producers, cow-calf operations, and poultry producers Cattle feeders, hog producers, and dairy producers appear to benefit most in the longer run, although net returns for hog producers display a pronounced cyclical pattern with lower net returns in four quarters Poultry producers and cow-calf enterprises appear to benefit least in the longer run Even so, except for broiler returns in 4 of the 17 quarters, net returns for poultry producers and cow-calf enterprises are still increased with lower feed grain prices

Consumer Prices

Consumer prices for all meats ultimately are lower with reduced prices for feed grains (fig 10) In the short run, however, retail prices for beef, pork, and poultry are higher as red meat production is reduced while breeding herds are expanded The length of time that retail beef and pork prices are higher reflects the biological constraints involved, pork prices are higher in the initial impact and two subsequent quarters, and beef prices are higher in the initial impact and four subsequent quarters Poultry prices are higher in the first impact and two subsequent quarters, although biological constraints for poultry production are shorter, because

[4] Impacts on gross revenues and net returns for turkey producers have similar patterns, although not identical magnitudes, to those for broiler producers and, consequently, are not included in the graphs

[5] This measure also seems to be more consistent with the implied economic incentives underlying the production responses discussed earlier

Figure 8

Impacts of Lower Feed Grain Prices on Net Returns: Cow Calf, Fed Cattle, and Hogs

Percentage change from base

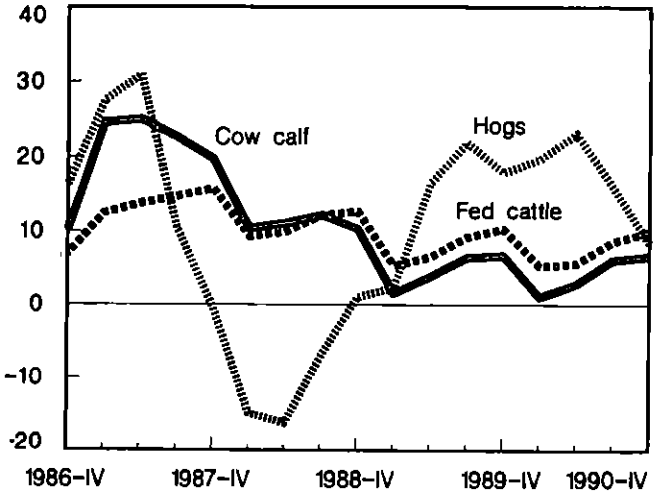
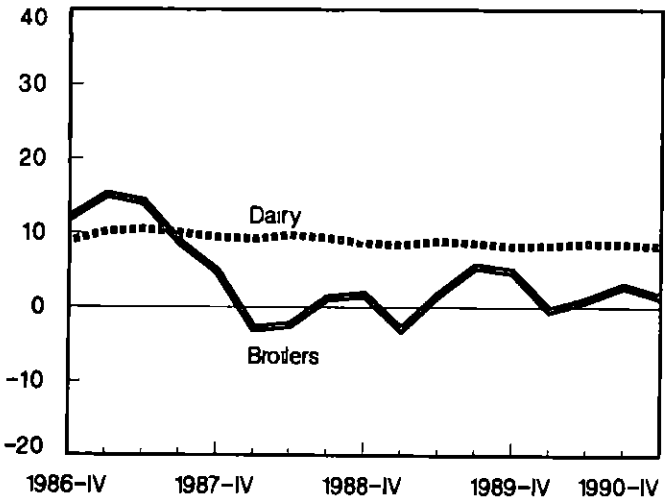


Figure 9

Impacts of Lower Feed Grain Prices on Net Returns: Broilers and Dairy

Percentage change from base



reduced supplies of red meats offset poultry production increases

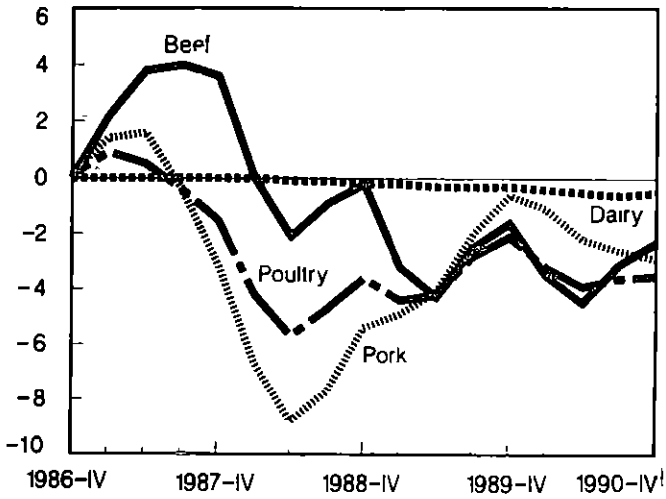
Conclusions

Adjustments in the different livestock subsectors resulting from a decline in feed grain prices differ sharply in both speed and magnitude because of underlying biological and economic constraints,

Figure 10

Impacts of Lower Feed Grain Prices on Consumer Prices

Percentage change from base



feed-use efficiencies, and industry structures Thus, the timing and magnitude of benefits also differ for various livestock producers Results of the model simulations conducted here suggest that all livestock producers benefit from lower feed grain prices Hog producers, cow-calf operations, and poultry producers benefit most in the short run In the longer run, cattle feeders, hog producers, and dairy producers appear to benefit most, whereas poultry producers and cow-calf enterprises apparently benefit least

Cattle feeders have a consistently large increase in returns net of feed costs over the simulation period Biological lags in increasing the supply of feeder cattle, however, restrict the speed and magnitude of feedlot expansion in the short run Cow-calf enterprises have their largest increases in net returns in the first two simulation years when the increased demand for feeders exceeds the biologically constrained supply response In subsequent periods, cow-calf operators appear to benefit relatively less as increases in their net returns are smaller

The speed and magnitude of adjustments in the hog sector are less constrained by biological factors than in the cattle sector In addition, the relative importance of mixed-enterprise farms in the hog industry facilitates the marketing of corn through hog feeding as an alternative to selling corn directly As a consequence, the hog sector overresponds to the lower feed grain prices, causing pronounced cyclical adjustments

The largest poultry production adjustments are in the short run because poultry is least constrained by biological lags. Over the longer run, poultry production adjustments are the smallest among meat producers However, reductions in producer prices are larger in the longer run, reflecting increased production of competing meats As a result, poultry producers appear to benefit least in the longer run as the impacts on their net returns are the smallest

Dairy producers benefit from the reduction in feed grain prices Their costs are reduced, but production, consumption, and prices of milk change little, reflecting biological constraints to herd expansion and the role of price supports in the sector Government removals of dairy products are higher for almost the entire simulation period

Consumers also benefit Retail prices for meats are generally lower following an initial period of somewhat higher meat prices as production is first reduced to increase cattle and hog breeding herds

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