The 1996 grain price shock: how did it affect food inflation?

The dynamics of food inflation appear to have changed,such that the 1996 grain price shocks had a smaller impact than shocks in the past

Jerry Light and Thomas Shevlin

The Midwestern drought of 1995–96, rising foreign demand for U.S. feed grains,[1] and substantial commodity market speculation combined to markedly drive up feed grain prices in 1995 and 1996. This sharp increase initiated a classic pattern for food inflation. The price increases, especially those for corn, soybeans, and wheat, ignited the inflationary spiral at the most basic or crude stage of processing. As time passed, this inflationary swell spilled over into intermediate and finished goods, culminating in an overall increase in food prices.

This article tracks an inflationary spiral in food prices from the grain fields of the Farm Belt to kitchen tables across America during the drought and in subsequent months.

Mechanics of food inflation

Prices for agricultural commodities such as feed grains are inherently volatile, because they are susceptible to both supply and demand shocks. Examples of supply shocks are weather- or disease-related shortcomings, or conversely, the production of bumper crops in good years. Demand shocks usually come in the form of unexpected purchases by foreign buyers, for example, the unexpected purchase of large amounts of American wheat in the 1970s by the Soviet Union.

Any large change in agricultural prices can have a significant impact on the Producer Price Index (PPI) for crude foodstuffs and feedstuffs, the first of the PPI's three stage-of-processing indexes for foods. The impact of the price shock can then pass from crude foodstuffs and feedstuffs on to intermediate foods and feeds, and then to finished consumer foods, along the PPI's stage-of-processing model.

As price shocks pass from one stage of processing to the next, the amplitude of the shocks tends to diminish somewhat at each stage of processing. Chart 1 illustrates the effect of the 1995 grain price shock as it passes through the food industry. The graph spans January of 1995 through December of 1997, and shows the percent change for the three PPI's based on their January 1995 levels.

Because feed grains are inputs to so many food products, higher feed grain prices can cause inflation to spread throughout almost the entire food industry. Higher wheat costs can cause higher flour prices, which in turn can cause higher bread, pasta, and cereal prices. Higher corn and soybean costs can cause higher prices for animal feeds, cooking oil, and margarine. By affecting animal feed prices, higher soybean and corn prices can also have very important consequences for the meat, poultry, egg, and dairy markets.

Late in the fall of 1995 and early in 1996, articles in major newspapers, magazines, and trade publications began to warn about the consequences of the skyrocketing feed grain prices on "downstream products" (intermediate goods and finished goods; for example, flour and bread are downstream products of wheat). Some industry economists and media reporters projected food inflation to be as high as 3 percent to 4 percent (at the retail level) in 1996, and that it might surpass that of general inflation for the first time since 1990. [2]These forecasts did in fact come true, as the Consumer Price Index for All Urban Consumers (CPI-U) for food and beverages rose 3.2 percent for 1996, whereas the CPI-U for all items rose 3.0 percent and the CPI-U for all items less food and energy rose only 2.7 percent. This was an unusual event, as food inflation has tended to be lower than general inflation for the past two decades. Chart 2 depicts the percent change in the annual averages of the Producer Price Indexes for wheat, corn, and soybeans from 1972 through

Jerry Light is an economist in the Office of Prices and Living Conditions, Bureau of Labor Statistics, and Thomas Shevlin, formerly of that office, is an economist with the U.S. Department of the Treasury.

1996. If we define a feed grain price shock as a 20-percent or greater increase in annual average PPI's of at least 2 of the 3 commodities, then the data indicate that feed grain price shocks occurred in 1973, 1974, 1988, and 1996.

These sharp increases in feed grain prices each resulted in a surge in food inflation above the core rate [3]of inflation, as measured by both the PPI and the CPI-U. Table 1 compares the aggregate PPI for food—finished consumer foods—to the PPI 'core'—finished goods less food and energy. It also compares the aggregate CPI-U for food—food and beverages—with the CPI 'core'—all items less food and energy.

As can be seen in table 1, food inflation at the producer level surpassed that of core inflation in 1973 and 1974 after the soaring grain prices of that period, and again in 1989 and 1990 after the 1988 upsurge. With the feed grain price shock of 1995–96, food inflation again surpassed core inflation at the producer level in 1996 and 1997. Food inflation also surpassed core inflation at the producer level in 1978, 1979, 1984, 1986, and 1993 in the absence of any significant feed grain shocks.

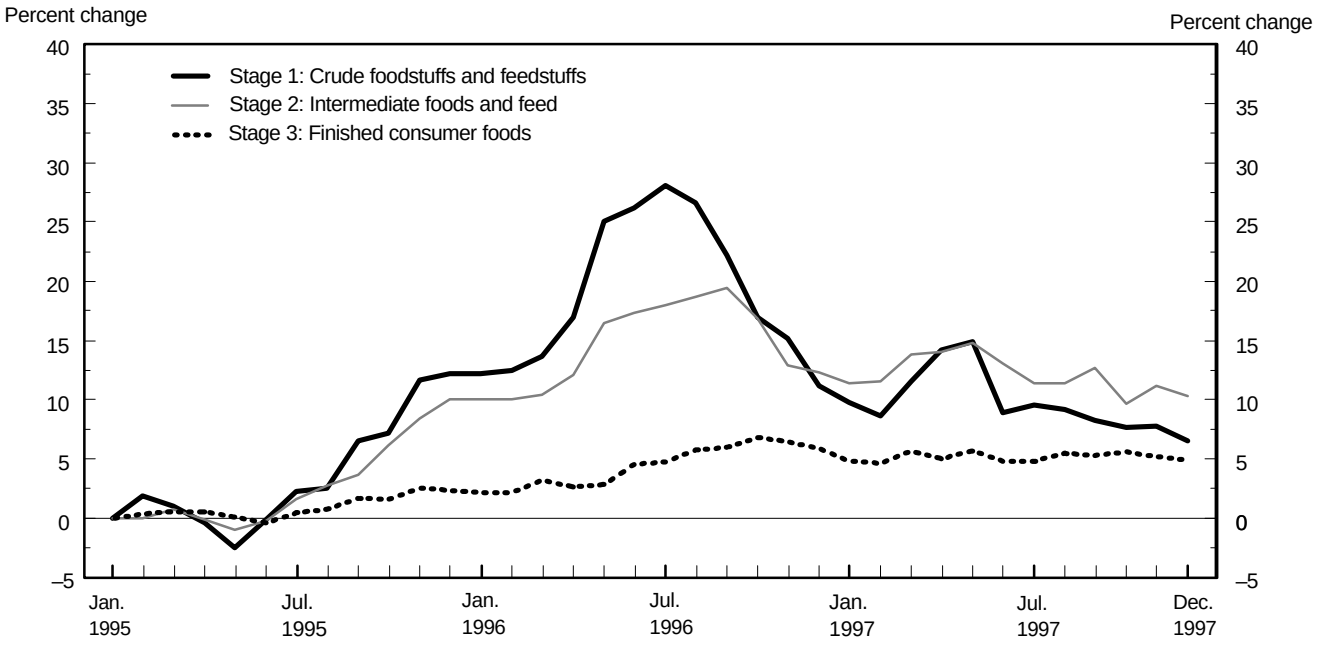
At the consumer level, however, food inflation surpassed core inflation only in 1973, 1974, 1978, 1979, 1989, 1990, 1996 and 1997. Hence, food inflation appears to be below core inflation more stubbornly at the consumer level. With the exception of the 1978–79 period, food inflation at the consumer level never surpassed core inflation except in the aftermath of a strong feed grain shock. Moreover, as chart 2 shows, there were strong price increases for feed grains at the time of the 1978–79 food inflation, although not as significant as in the other periods.

Using a simple econometric model, we found some evidence of a statistical relationship between feed grain prices and consumer food prices. The tests suggested that we would expect a 100-point, 1-month increase in the feed grain index to be associated with a 4.1-point cumulative increase in the CPI-U for food and beverages over a 12-month period. The tests also suggested that, in the long run, a 100-point increase in the feed grain index should be associated with an 11.4-point increase in the CPI-U for food and beverages, and that an increase in the CPI-U for food and beverages tends to follow an increase in the PPI for feed grain. Hence, the tests were wholly supportive of the theory that feed grain shocks at the producer level can cause food inflation to rise relative to core inflation at the consumer level. The appendix provides more details of the models used in these tests.

General components of food inflation

A market basket of goods. In a quest to track and analyze what the consumer pays for food products and how that price

Chart 1. Growth trends in PPI for food items, by stage of processing, 1995–97



NOTE: The percent changes are based on the January 1995 levels.

is established, the U.S. Department of Agriculture utilizes several concepts. One pricing concept uses a "market basket" of goods, and aims to analyze changes in the price of food products at the retail level (CPI-U) at the grocery store, as opposed to prices at the producer level (PPI). "The market basket contains the average annual quantities of food purchased per household in a base period (1982–84). Since the basket relies on a fixed set of quantities, changes in the value of the market basket are strictly a result of changes in price."[4]

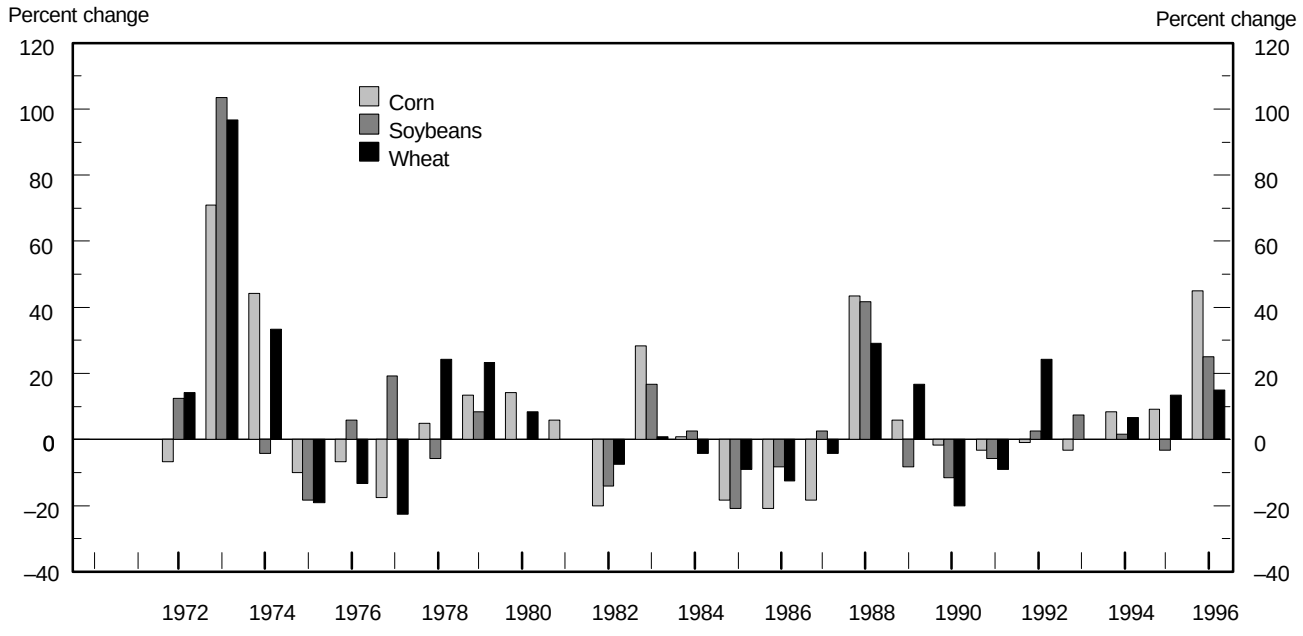
The Department of Agriculture's market basket concept relies on three components:

- *Retail price.* "The retail price component is a subset of the Consumer Price Index for food at home, adjusted to exclude imported foods, nonalcoholic beverages, and seafood. Moreover, food purchased for away-from-home consumption is excluded from the estimate."
- *Farm value.* "The farm value represents the prices received by farmers for the quantities of raw farm commodities that must be purchased from farmers in order to sell a unit of food product at retail."[6]
- *Farm-to-retail price spread.* "The farm-to-retail price spread is the difference between retail price and farm value, and represents the cost of processing, wholesaling, and retailing foods."[7] In other words, a farm-to-market spread represents the difference between average prices at two levels (farm and retail) of the food marketing system at a given point in time.

Table 2 shows the percentage that farm value makes up of the retail price of a sample of the market basket of commodities. Generally, a product's farm value decreases as the degree of processing required to make the product increases. For example, eggs require only grading, cleaning, packaging, and distribution before they end up on the supermarket shelf. For this reason, eggs had a relatively high farm value of 62 percent in 1996. In contrast, a food product that requires a high degree of processing (an 18-ounce box of corn flakes) had a farm value of only 7 percent. With such a low farm value, it becomes easier to understand how the major cereal manufacturers engaged in a price war. They were able to sustain significant reductions in cereal prices in 1996 while corn and other grain prices were at near record highs.

In the case of animal products, both the value of the animal and of the feed it ingests (a farm product) must be considered part of the farm value. Consequently, meat, dairy, egg, and animal fiber products tend to have higher farm value than products that come directly from grains or other crops. However, other factors also enter into the equation. A product such as choice beef has a higher farm value than milk, even

Chart 2. Percent change in the annual average Producer Price Indexes for corn, soybeans, and wheat, 1972–96



though both have food and feed farm value components. The reason is that it takes from 2 to 3 pounds of steer to equal l pound of choice beef. The rest is lost in processing. In contrast, a gallon of milk from a dairy farm ends up to be very nearly a gallon of milk at the processed level in the grocery store.

Orange juice concentrate, despite having no feed component, has a relatively high farm value. Citrus industry sources note that 12 to 15 oranges must be processed to manufacture a 12-ounce can of concentrate.

The farm value for the market basket of goods is becoming less important as a contributor to retail price over time. Farm value as a percentage of retail price fell from 40 percent in 1956 to 35 percent in 1984. The decline then accelerated, and farm value fell to 25 percent of retail pricein 1996.[8] This suggests that a price shock at the farm level 20 or 30 years ago would have had a much more pronounced effect on food prices than it would now.

Table 1. Comparisons of food inflation in the Producer Price Indexes (PPI) and Consumer Price Indexes for all Urban Consumers (CPI-U), 1973–97

[In percent]

Year	PPI		CPI-U	
	Finished consumer foods	Finished goods less food and energy ('core' inflation)	Food and beverages	All items less food and energy ('core' inflation)
1973[1]	20.50	[2]4.6	13.20	3.60
1974	14.00	11.40	13.70	8.30
1975	8.40	11.40	8.50	9.10
1976	–.30	5.70	3.20	6.50
1977	5.30	6.00	6.00	6.30
1978	9.00	7.50	9.70	7.40
1979	9.30	8.90	10.70	9.80
1980	5.80	11.20	8.50	12.40
1981	5.80	8.60	7.80	10.40
1982	2.20	5.70	4.10	7.40
1983	1.00	3.00	2.30	4.00
1984	4.40	2.40	3.70	5.00
1985	–80	2.50	2.30	4.30
1986	2.60	2.30	3.30	4.00
1987	2.10	2.40	4.00	4.10
1988	2.80	3.30	4.10	4.40
1989	5.40	4.40	5.70	4.50
1990	4.80	3.70	5.80	5.00
1991	–.20	3.60	3.60	4.90
1992	–.60	2.40	1.40	3.70
1993	1.90	1.20	2.10	3.30
1994	.90	1.00	2.30	2.80
1995	1.70	2.10	2.80	3.00
1996	3.50	1.40	3.20	2.70
1997	.70	.40	2.60	2.40

[1]The percent change for finished goods less food and energy for 1973 is actually the percent change for finished goods less food, as there is no index for finished goods less food and energy before 1973. In all other years, we excluded energy from the PPI and CPI broad-based indexes because its inherent volatility makes its exclusion a more commonly accepted measure of 'core' inflation.

The portion of a finished food product's price that is farm value is an important issue when considering the impact of a farm product's price change. If the farm value is low, then the change in price of a farm product will not have a significant impact on the cost of producing downstream goods. In the case of bread, for example, wheat flour is certainly an important input, but labor, capital equipment, energy, yeast, water, preservatives, packaging, shipment, storage, and advertising represent significant costs as well. If these other costs remain constant, the impact of flour inflation on the total cost of bread will be relatively small. Bread producers will prefer to keep prices as steady as possible, both because purchasers tend to resent constantly fluctuating prices and also because constantly shifting prices can create a significant accounting burden and other costs for manufacturers. Producers, therefore, tend to resist price changes when changes in production costs are small. Furthermore, even very large changes in flour prices may not significantly affect the price of bread if the price change appears to be only temporary.

A grain shock affects a food product's ultimate price by driving up its farm value. As the price of a product's farm input increases, the price of the finished product will generally rise as well. In the case of corn flakes, the farm value was so small that the finished good's price fell even though the price of the major farm input, corn, was rising substantially.

Consumer demand. While farm value and farm-to-retail price spread are important concepts to remember when analyzing food prices, remember that changes in demand can also play a role. The effect on food prices resulting from changes in consumer demand is harder to quantify or calculate than are shocks from farm value and farm price spread.

An example of how changes in consumer demand can affect prices is the increased prices of chicken wings relative to other chicken parts. Breast meat historically has been deemed as the most desirable part of a chicken. For that reason, prices and indeed price growth for breast meat had surpassed those of other chicken parts. However, in the mid-1980's, the phenomenon of 'Buffalo wings was born. Suddenly, the demand (and subsequently the price paid) for chicken wings from food service outlets and for home use turned up dramatically. According to the Department of Agriculture, the wholesale price of chicken wings rose from 37.99 cents/lb. in 1985 to 61.79 cents/lb. in 1994, whereas the wholesale price of chicken breasts fell from 101.48 cents/lb. in 1985 to 86.62 cents/lb. in 1994.[9] This phenomenon has continued to manifest itself throughout the 1990s, despite some resurgence in demand for chicken legs for export purposes.

Causes of the feed grain price shock

A combination of three factors appeared to have led to the 1996 feed grain price shock:

- The 1995 drought in the Midwestern and Western regions of the United States decreased the yields of feed grain crops, particularly corn
- Pessimistic crop forecasts, especially for wheat, fueled futures market speculation
- Foreign demand for U.S. feed grains was robust

Chart 3 illustrates feed grain price trends from January 1995 to May 1997. The chart clearly shows sharp increases in feed grains prices in the spring and part of the summer in 1996. Prices then declined to more typical ranges in the fall.

The 1995–96 drought, which gripped the Midwestern and Western regions of the United States, had a double-edged effect on prices of feed grains during that time. As this article will show, the drought significantly shortened supplies of feed grains for the season, especially corn. The second component of the drought's effect on commodity prices was the fueling of futures market speculation. This effect most clearly manifested itself in the wheat market.

Of the three principal grain commodities discussed in this article, corn has by far the largest value of shipments in the United States, and therefore is the most heavily weighted in the PPI for crude foodstuffs and feedstuffs aggregate index. Within this aggregate index, corn has a relative importance of 4.129 percent, soybeans has a relative importance of 2.419 percent, and wheat has an importance of 1.428 percent.[10]

Corn. The soaring cost of corn was undoubtedly the major driving force behind the startling upsurge in animal feed prices and had a domino effect on downstream food product prices. The high cost of corn not only directly affected prices of animal feed products, but also indirectly affected prices for beef, pork, eggs, milk, and other food commodities made from animal product inputs. Corn is used as a feed product both in its natural state (normally shelled from the cob) and as an input to the manufacture of prepared feeds. According to U.S. Commerce Department data, corn was the largest component of the $10.4 billion of materials, ingredients, containers, and supplies going into the production of $13.3 billion worth of prepared animal feeds in 1992. Important input components for animal feed production included $2.2 billion for corn and corn byproducts, $1.8 billion for soybean products, and only $0.4 billion for wheat and wheat byproducts.[11]

As noted in table 3, 1994–95 was a record year for corn production with more than 10.1 billion bushels produced at an average yearly price of $2.26 a bushel.[12] Production fell to 7.4 billion bushels in the 1995–96 crop year and the average price per bushel of corn shot up to $3.24 for that year. Stored stocks fell to historic lows of 426 million bushels to end the 1995–96 crop year.[13] The 26.7-percent decline in production from the preceding year, the 75-percent reduction in stocks, and speculation in the futures market resulted in a 43.3-percent rise in prices paid to farmers for corn, according to the Department of Agriculture's measure of average price per bushel. As chart 3 shows, the PPI for corn rose considerably over the course of the 1995–96 crop year, (from September

Table 2. Farm-value percentage of retail price for selected sample of the Department of Agriculture market basket of commodities, 1994, 1995,1996

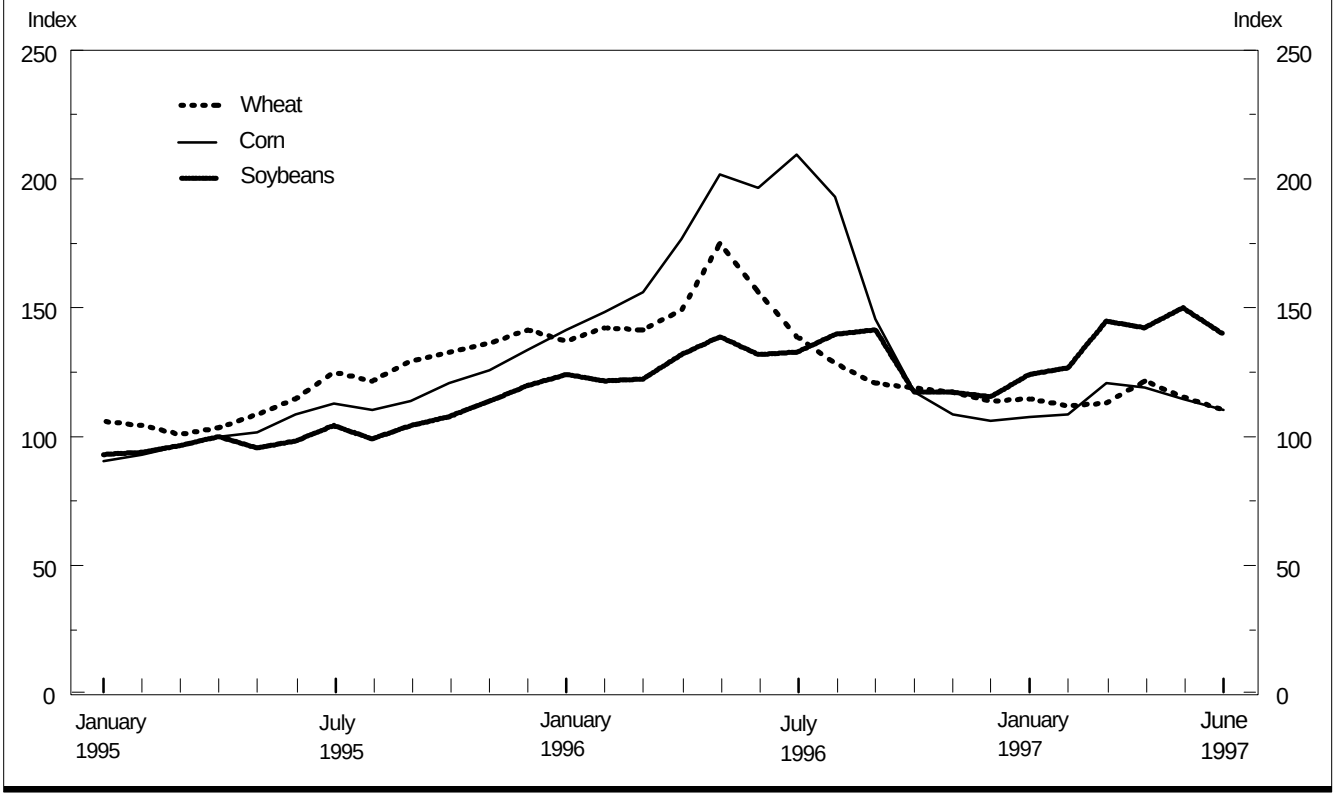
[In percent]

Commodity	1994	1995	1996
Eggs, grade A large (1 doz.)	58	59	62
Beef, choice (1lb.)	52	49	48
Chicken, broiler (1lb.)	54	53	57
Pork (1 lb.)	32	34	38
Cheese, cheddar (1 lb.)	35	34	40
Fruits and vegetables, fresh:			
Lemons, (1 lb.)	24	26	24
Apples, red delicious, (1 lb.)	22	25	23
Potatoes (10 lb.)	21	21	21
Oranges, California, (1 lb.)	20	19	17
Fruits and vegetables, frozen:			
Orange juice concentrate (12 oz.)	38	40	37
Corn (1 lb.)	12	13	13
Green beans, cut (1 lb.)	11	11	11
Fruits and vegetables canned, bottled:			
Canned peas (17 oz.)	22	24	26
Canned corn (17 oz.)	21	28	26
Applesauce (25-oz. jar)	15	16	21
Fruits and vegetables, dried:			
Beans (1 lb.)	36	35	31
Raisins (15-oz. box)	29	26	30
Prepared foods:			
Pork and beans (16 oz.)	18	20	18
Potato chips, regular, (1 lb. bag)	16	18	17
Bread, (1 lb.)	7	8	8
Corn flakes (18-oz. box)	5	6	7
Corn syrup (16-oz. bottle)	4	4	5

NOTE: The farm-value represents the percentage of the retail price of a commodity that is received by farmers.

SOURCE: Howard Elittzak, *Food Cost Review 1996*, USDA Agriculture Economic Report No. 761 (U.S. Department of Agriculture, 1997), t. 5, p. 7.

Chart 3. Inflationary trends in the Producer Price Indexes for feed grain, January 1995 through June 1997



1995 through August 1996) and then fell considerably with the beginning of the 1996–97 crop year in September 1996.

Soybeans. As shown in table 3, the drought-induced short crop of soybeans also drove up grower prices for that commodity, just as it did for corn. Production fell from 2,517 million bushels in the 1994–95 crop year to 2,177 million bushels for the 1995–96 crop year. Grower prices jumped from $5.48 a bushel to $6.77 per bushel. In other words, a 13.5-percent decrease in production coincided with a 23.5-percent increase in the Department of Agriculture's average bushel price.[15]

Most soybeans are crushed in oilseed processing plants to produce vegetable oils. These oils are major inputs to cooking oils and margarine. The byproduct of the crush is a cake or meal used for the production of animal feed. Soybeans are not used in raw form for food or animal feed. Accordingly, soybean feeds and products have a lower farm value than corn products. Consequently, the rise in soybean prices should have a smaller impact on feed prices than did the rise in corn prices.

Wheat. The grain commodity thought at first to be most devastated in the 1995–96 drought was winter wheat. This variety represents the overwhelming majority of the Nation's wheat production. For example, the Department of Agriculture's data for 1994 indicate that out of a total of 2,320,981 bushels of wheat produced, 1,661,943 bushels, or 71.6 percent, was winter wheat. Durum and other spring wheat accounted for only 659,038 bushels.[16]

Farmers plant winter wheat in autumn in the high plains of the Midwest. In a normal year, the wheat germinates, sprouts, and emerges from the soil to a height of a few inches later in the fall. The crop then lies essentially dormant through the winter months, ideally with snow cover to protect it from severely cold temperatures. In the spring, the wheat plant begins to grow and mature. The crop ripens and is ready for harvest in the summer.

Wheat was already below normal supply due to an unusually small 1995–96 wheat crop. Because of the drought, the winter wheat crop suffered from poor plant emergence in the fall of 1995. The winter of 1995–96 exacerbated the problems of poor emergence, as the winter was unusually cold, and snow failed to cover and protect the crop. "Winterkill," therefore, was thought to be unusually extensive. Much of the crop was projected in early Department of Agriculture assessments to be too severely damaged to make harvesting cost effective.

As with most agricultural commodities, feed grain trading on commodity exchanges and prices are highly sensitive to anticipation of a shortage. The Department of Agriculture monitors the Nation's crops and animal herds and forecasts both quantity and quality of production in a series of monthly

outlook reports. Early reports forecast much smaller harvests for corn, soybeans, and wheat than was normally expected. However, the actual harvest of these crops proved better than the forecasts, especially for wheat.

The Department of Agriculture had been giving dire forecasts of the 1996–97 wheat crop throughout spring of 1996. For example, in May of that year, it forecast production totals at 2,074 million bushels,[17] which would have meant a 5-percent reduction from the 2,186 million bushel near-final estimate for the 1995–96 year[18]. Moreover, at that time, the Department of Agriculture projected an even sharper reduction, 12 percent, in the winter wheat crop. This suggested that the early part of the crop year would have the biggest shortage.[19] It is important to realize that, because the 1995–96 wheat crop was already small, a dearth of wheat had already begun to develop. As the 1996–97 crop year began in June 1996, the Department of Agriculture forecast that farmers would forego harvesting 27 percent of the winter wheat crop,[20] despite record high wheat prices.[21] The forecasted harvest of winter wheat was the lowest since 1972.

As shown in table 3, total production of wheat (in bushels) actually increased 4.6 percent (from 2,183 million bushels in the 1995–96 crop year to 2,282 million bushels in the 1996–97 period). The PPI for wheat reached a zenith in May 1996, at the time of the Department of Agriculture's forecast announcement, and then began to fall as the crop year progressed and forecasts proved too pessimistic. (See chart 3.) These pessimistic forecasts appear to be the primary reason for the unusual runup increase in wheat prices at the end of the 1995–96 crop year. This rise led the 1995–96 average price per bushel of wheat to be $4.55, a 31.6-percent increase over the previous year's price of $3.45 per bushel. These price increases occurred with only a 5.9-percent decline in production between the two crop years.

Part of the reason for the better-than-forecasted production in the 1996–97 crop year (particularly in winter wheat), came in the form of "nick of time" rains in the summer of 1996. Another factor in the less-than-expected shortage of the overall wheat crop was the increased production of spring varieties of wheat. The following tabulation shows wheat production over the 1993–96 period (in millions of bushels):[22]

	1993	*1994*	*1995*	*1996*
All wheat	2,396	2,321	2,183	2,282
Winter wheat	1,760	1,662	1,544	1,478
Percent	73.50	71.60	70.70	64.80
Spring wheat	636	659	639	804
Percent	26.50	28.40	29.30	35.20

Foreign demand. At the time that feed grain prices were rising due to domestic events here in the United States, foreign demand for U.S. feed grains was putting further upward pressure on feed grain prices. The following tabulation shows income produced by U.S. agriculture exports over the 1990–96 period:

Year	*U.S. agriculture exports (in billions)*
1990	$39
1991	39
1992	43
1993	43
1994	46
1995	56
1996	60

U.S. food exports surged remarkably in 1995 and again in 1996. Rising demand in developing economies and the poor harvests abroad were the driving forces behind U.S. food exports.

Most of the increase in agricultural exports in 1995 and again in 1996 was in the area of feed grains. In 1995, there was a $10.1 billion increase in U.S. agricultural exports, of which $5.8 billion was attributed to increases in exports of corn, soybeans, and wheat. In 1996, there was a $4.6 billion increase in agricultural exports, of which $3.8 billion, or approximately 83 percent, was due to corn, soybeans, and wheat.[23] To

Table 3. Corn, soybean, and wheat production, 1994–97 and estimates for 1997–98

Grain	1994–95	1995–96	1996–97	1997–98 (estimated)
Corn (million bushels):				
Production	10,103	7,374	9,293	9,276
Total supply	10,962	8,948	9,731	10,227
Disappearance[1]	9,405	8,522	8,790	9,380
Ending stocks	1,558	426	914	847
Price per bushel	$2.26	$3.24	$2.70	$2.70
Soybeans (million bushels):				
Production	2,517	2,177	2,382	2,744
Total supply	2,731	2,516	2,576	2,874
Disappearance[1]	2,396	2,333	2,451	2,559
Ending stocks	335	183	125	305
Price per bushel	$5.48	$6.77	$7.38	([2])
Wheat (million bushels):				
Production	2,321	2,183	2,282	2,531
Total supply	2,981	2,757	2,748	3,070
Disappearance[1]	2,475	2,381	2,306	2,375
Ending stocks	507	376	444	695
Price per bushel	$3.45	$4.55	$4.35	$3.35

[1] "Disappearance" includes the total demand or use of a commodity.

[2] Data are not available.

SOURCE: Compiled data from *Feed Grains Outlook* (U.S. Department of Agriculture, Economic Research Service, Aug. 13, 1997), t. 1, pp. 4–5 of electronic version.

meet the rising foreign demand for grains, the United States largely relied on its reserves in 1995. In 1996, however, the dollar value of U.S. agricultural exports rose again, although the actual volume of exports remained roughly the same. With very little left in feed grain reserves, and with the drought causing a shortage in supplies, U.S. and foreign consumers of bulk grains were facing increasing competition for a shrinking supply.

In 1995, exports rose both in terms of volume and dollar value. As chart 4 depicts, the volume of grain exports surged dramatically in 1995, but leveled for wheat and corn in 1996. This shows that the increase in the dollar value of feed grains in 1996 was due to the rising prices. Foreign nations were reluctant to surrender recent increases in imports in the face of the higher prices. The most remarkable rise in feed grain exports was for corn.

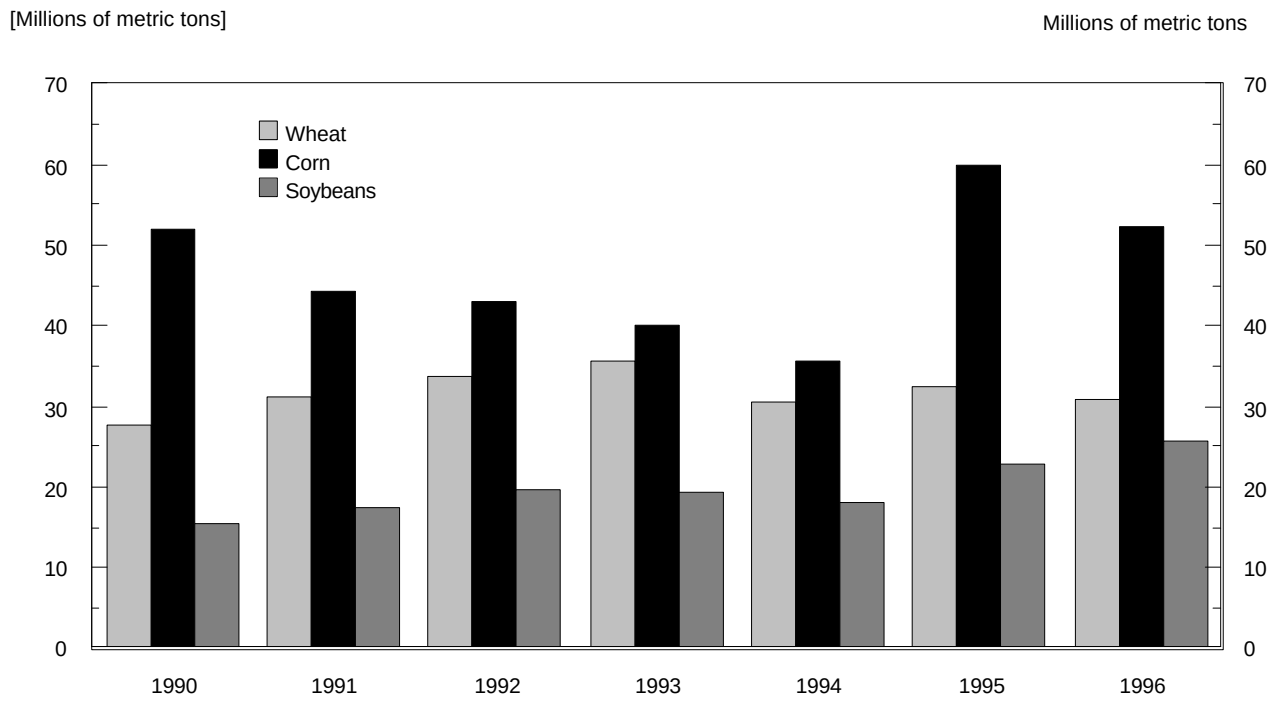
Price shock's effect on food inflation

As with the 1973 and 1988 periods of high feed grain inflation, the 1996 feed grain price shock generated a significant inflationary effect on downstream food products. The Producer Price Index for finished consumer foods rose 3.5 percent from 1995 to 1996, surpassing the PPI for finished goods less food and energy, which rose only 1.4 percent.

As shown in the following tabulation, most of the increase in the annual average between 1995 and 1996 for the PPI for finished consumer foods came from components for which feed grains are an important input either for manufacture or for a source of feed :

Product	*Component impact on the PPI for finished consumer foods*
Dairy products	1.18
Meats	.91
Cereal and bakery products	.44
Miscellaneous processed foods	.38
Processed poultry	.36
Fresh fruits and melons	.33
Processed fruits and vegetables	.33
Chicken eggs	.25
Confectionery end products	.20
Soft drinks	.07
Refined sugar	.01
Shortening and cooking oil	–.06
Unprocessed and packaged fish	–.09
Fresh and dry vegetables	–.16
Packaged beverages	–.33

Chart 4. Volume of U.S. exports of wheat, corn, and soybeans, 1990–96



SOURCE: *U.S. Agricultural Exports: Calendar Years 1990–1996* (U.S. Department of Agriculture).

As noted, dairy products; meats, cereal and bakery products; processed poultry; and chicken eggs combined accounted for a 3.14-percent increase in the PPI for finished consumer foods, and therefore accounted for about 90 percent of the overall increase in that PPI aggregate index.

Fifty-two percent of the weight for the PPI for finished consumer foods belongs to areas that are directly affected by feed grains, namely dairy products, meats, bakery products, flour, other cereals, processed poultry, shortening and cooking oil, and eggs.[24] This is why feed grain prices can have such a large impact on the PPI for finished consumer foods. Only 33 percent of the product weight belongs to products not directly affected by feed grains, specifically: the PPI for fresh fruits and melons, fresh and dry vegetables, processed fruits and vegetables, unprocessed and packaged fish, milled rice, confectionery end products, soft drinks, packaged beverages, and refined sugar. The remaining 15 percent of index weight belongs to the PPI for miscellaneous processed foods, some of which are related to feed grains and some of which are not.

Beginning about the time of the grain price increases, inflation was generally higher over the June 1995–June 1997 period for items affected by feed grains (cereals, bakery products, meat, and processed poultry) than for the PPI aggregate finished consumer foods. (See chart 5.) The PPI for cereals and bakery products was above the inflationary trend for only a short time, but PPI components meats, processed poultry, and dairy products were well above the general inflationary trend. The inflation in the PPI for cereals and bakery products came first, and was not long lived after feed grain prices began to decline. Inflation in the PPI components for meats, processed poultry, and dairy products, on the other hand, came later and was more persistent.

Flour and bread. As a result of the increase in wheat prices in late 1995 through 1996, wheat flour prices began to rise. One major flour producer, for example, raised flour prices 3.7 percent in January 1996.[25] The price movement of wheat, flour, and white pan bread is depicted in chart 6 (top panel).

As table 2 indicated, bread had a farm value of only 7 percent in 1994. Therefore, the weak relationship between wheat and bread prices is not surprising.

Prepared animal feeds. Another area in which grain price increases drove up prices for products downstream almost immediately is the animal feed industry. Animal feeds are not a component of the PPI for finished consumer foods, so their price movement did not directly contribute to the fact that food inflation surpassed that of core inflation in 1996. However, when faced with extremely expensive feed costs, farmers and other producers make decisions to minimize their costs; for example, they can scale back production. For meat, poultry, egg, and dairy producers, scaling back production generally means eliminating part of their herd or flock. As shown in chart 6 (lower panel), prices for animal feeds derived from grains shot up substantially during the first part of 1996 and stayed at high levels for most of the year.

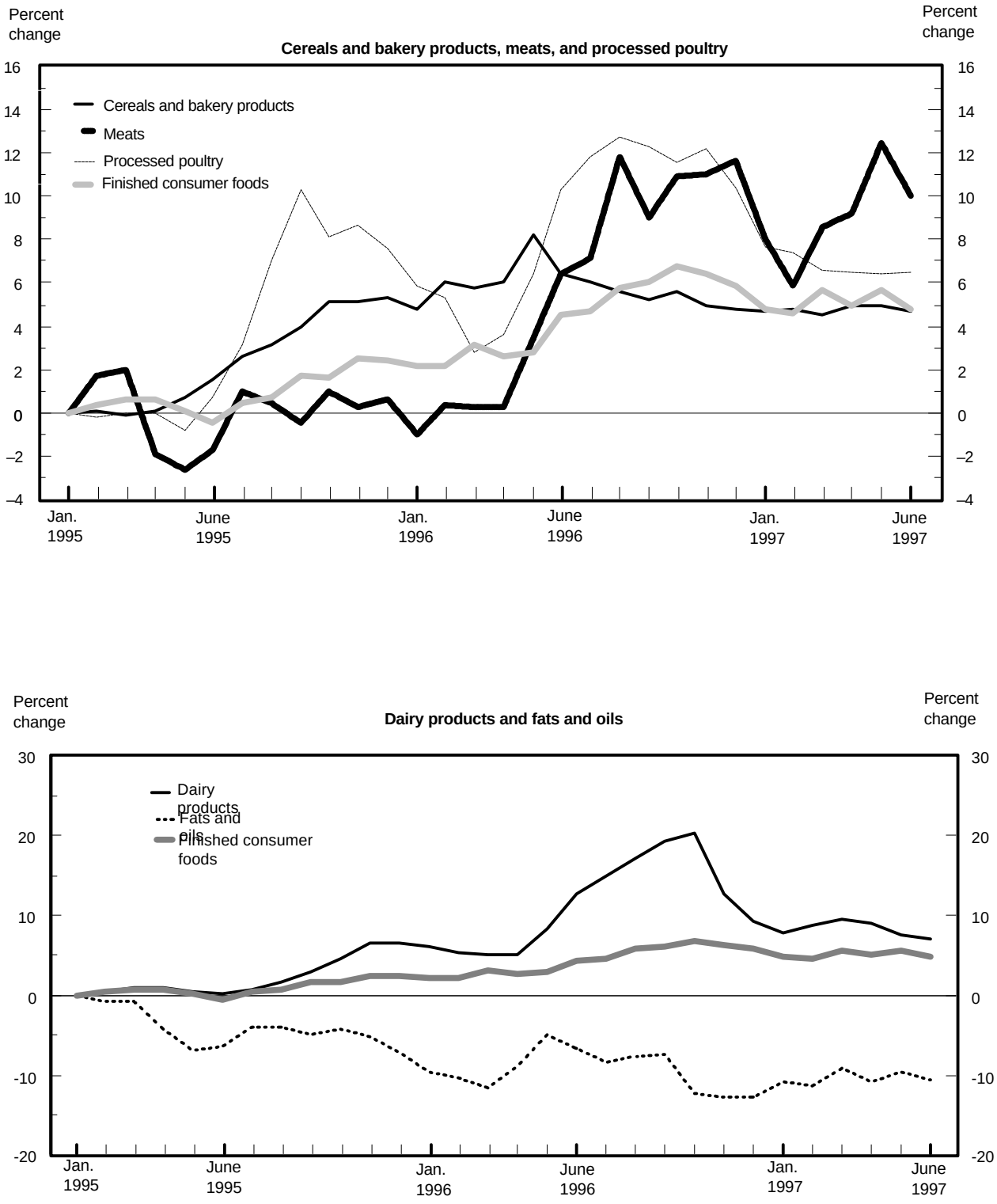
Cattle and beef. As feed costs increased, farmers sent a large portion of their herds to slaughter, causing an initial decrease in the prices of slaughter cattle and beef. (See chart 7, top panel.) Slaughter rates began to grow significantly in the fall of 1995 when the ramifications of the drought and high feed grain prices became apparent to cattle producers. The culling of the Nation's cattle herd continued in earnest during most of 1996, and in some respects, continued on throughout most of 1997. The ending inventory between 1995 and 1996 dropped some 2.3 million head, as shown in the following:[24]

	1993	*1994*	*1995*	*1996*	*1997*
Total supply (in million head)	141.1	143.1	145.8	145	142.2
Beginning inventory, January 1	99.2	101	102.8	103.5	101.5
Calf crop and imports	41.9	42.1	43	41.6	40.7
Total disappearance	39.5	40.2	41.8	43.3	43.1
Slaughter	34.7	35.7	37.3	38.6	38.1
Deaths and exports	4.8	4.5	4.5	4.7	5.0
Ending inventory, January 1	101	102.8	103.5	101.2	99.5

Farmers and ranchers traditionally bring supply pressure to bear on the market in late fall by culling their herds to make then a manageable size to feed through the winter and also to take profits. But during late 1995 and early 1996, this selloff and the resulting freefall in prices for cattle intensified due to real and anticipated concerns about feed costs. Prices for cattle did not begin to rebound until the early summer of 1996 when natural pasture developed; it would be mid-summer before feed prices began to fall. The initial impact of the feed grain shortage, therefore, was that it drove down the price of beef. However, this shortage and subsequent selloff led to higher beef prices in the longer term, because herds take 2 to 3 years to rebuild.

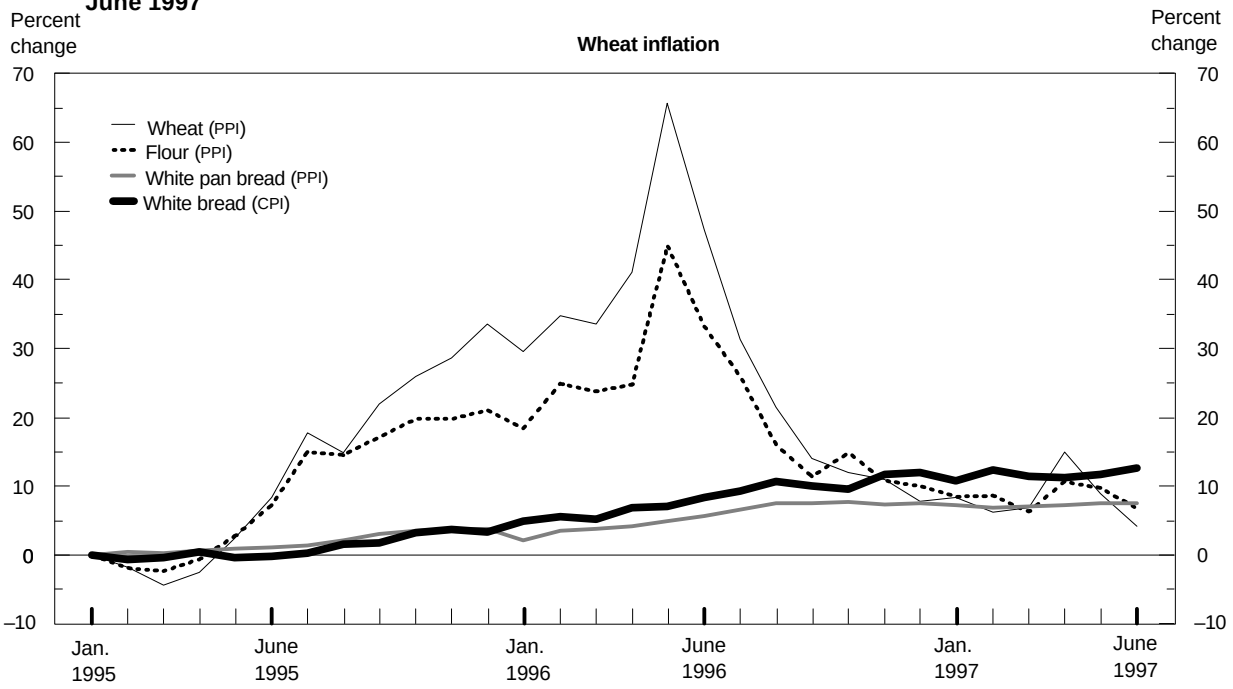
Hogs and pork. The effects of drought and high feed grain costs on pork prices are less straightforward than those for beef. (See chart 7, bottom panel.) Because hogs are even more dependent on feeds and feed grains than cows for their livelihood, it would be logical to expect that hog producers would have sold off large parts of their herds rather than pay high feed costs during the period. Indeed, the data do indicate that slaughter hog and pork prices did start dropping in November of 1995 and remained low for several months. This resulted from higher slaughter rates. But, unlike the cattle mar-

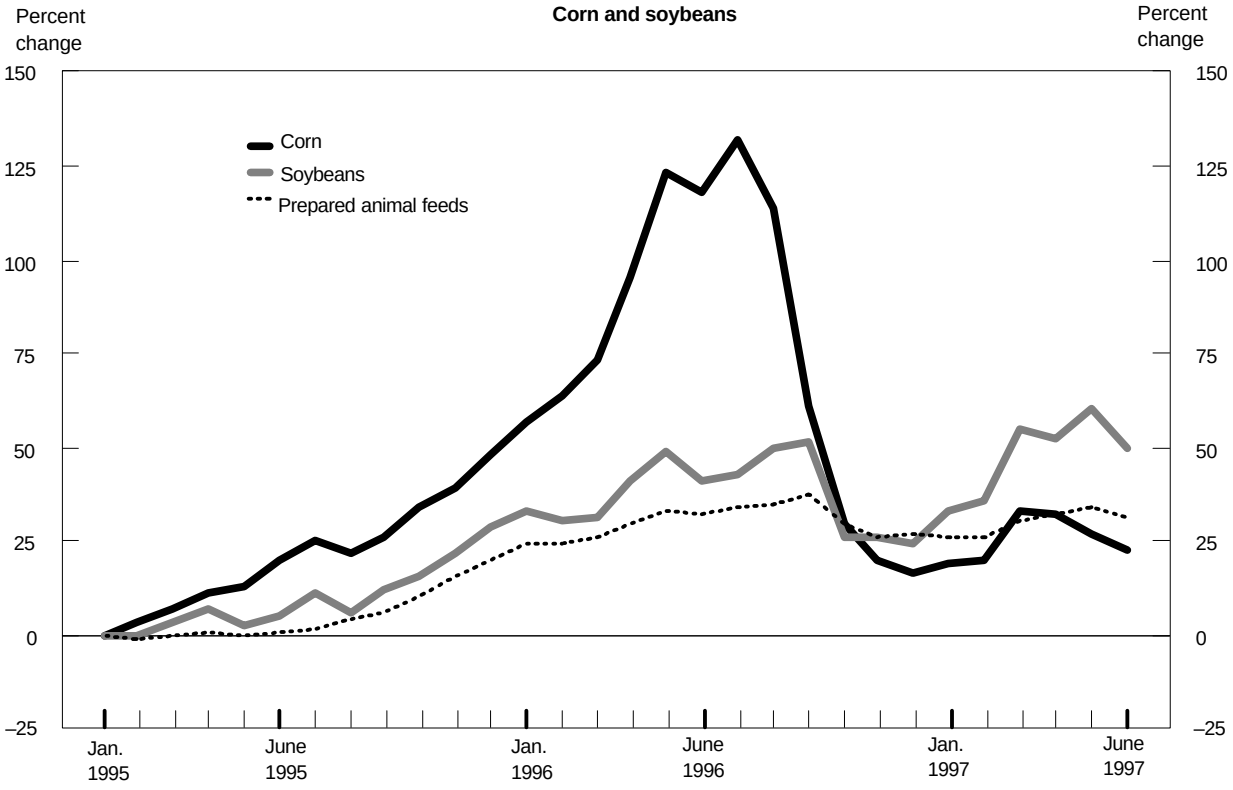
Chart 5. **Percent price changes for products directly affected by feed grains, compared with those for finished consumer foods, January 1995 through June 1997**



NOTE: The data in this chart depict the percentage change in the Producer Price Indexes above their June 1995 levels.

Chart 6. **Transmission of wheat inflation to bread and corn and soybean inflation to animal feed, January 1995 to June 1997**





ket, prices for slaughter hogs and pork began to rise sharply in February of 1996, and did not begin to drop until September. This was due in large part to strong export demand. Prices being offered for pork products actually overwhelmed the increased feed costs and kept positive returns coming in for most hog producers.

Dairy products. Prices for dairy products and for fluid milk also rose during the summer and fall of 1996, slightly lagging the increase in feed prices. (See chart 8, top panel.) Sources from the Department of Agriculture indicate that the impetus for increased prices for dairy products was twofold.[27] First, supply shortages arose when many producers tried to reduce their feed costs by sending some of their milking herds to slaughter, and many of the remaining milking cows produced less because farmers gave them less feed. Secondly, there was a significant increase in export demand for dairy products.

Poultry and eggs. Due to life span differences, it takes less time to rebuild the Nation's chicken flock than it does to restock the cattle and dairy herd. The effects of any sell off, resulting in a short-term glut in slaughter-flocks and longer term supply shortages of poultry, meat, and egg products, should pass through the economy more quickly than those for beef and dairy products.

The fierce summer heat of 1995 decimated a significant portion of the Nation's layer flock (chickens reserved for laying eggs). Many producers were reluctant to rebuild their individual flocks when they witnessed the rising feed costs. The decreased production was at least partly responsible for the increase in egg prices.

In January 1996, a major processor of chickens estimated that it would have to spend in excess of $125 million more during the first half of 1996 for chicken feed than it did for the same period in 1995. According to *The Wall Street Journal*, the processor indicated that it would pass some of that cost increase to the consumer by charging higher prices for processed chicken.[28] The rise in chicken feed costs and the resulting increase in slaughter chicken prices is evidenced in chart 8 (bottom panel).

Mitigating factors

Various reports from the Department of Agriculture and anecdotal evidence have suggested that the 1996 feed grain shock did not have as strong an impact on food inflation as shocks in the past. Research suggests that this was principally due to three important changes in the economics of the food industry: 1) the declining importance of farm value, 2) the 1996 Farm Act, and 3) the greater ability of foreign producers to fill the gaps in the U.S. market.

At each stage of processing, the relative importance of the farm portion of a product's input declines. Hence, the price shock should diminish at each stage. As farm value declines, the impact of grain shocks has a smaller impact on total production costs, and therefore has less ability to spark food inflation. As chart 9 shows, farm value and farm-to-retail spread tended to closely follow each other after 1984. Using a vector error correction model and a Chow test, we found statistical evidence that the relationship between prices for corn, soybeans, and wheat and finished food prices weakened after 1984, when farm value began to decline sharply. (See the appendix for details.)

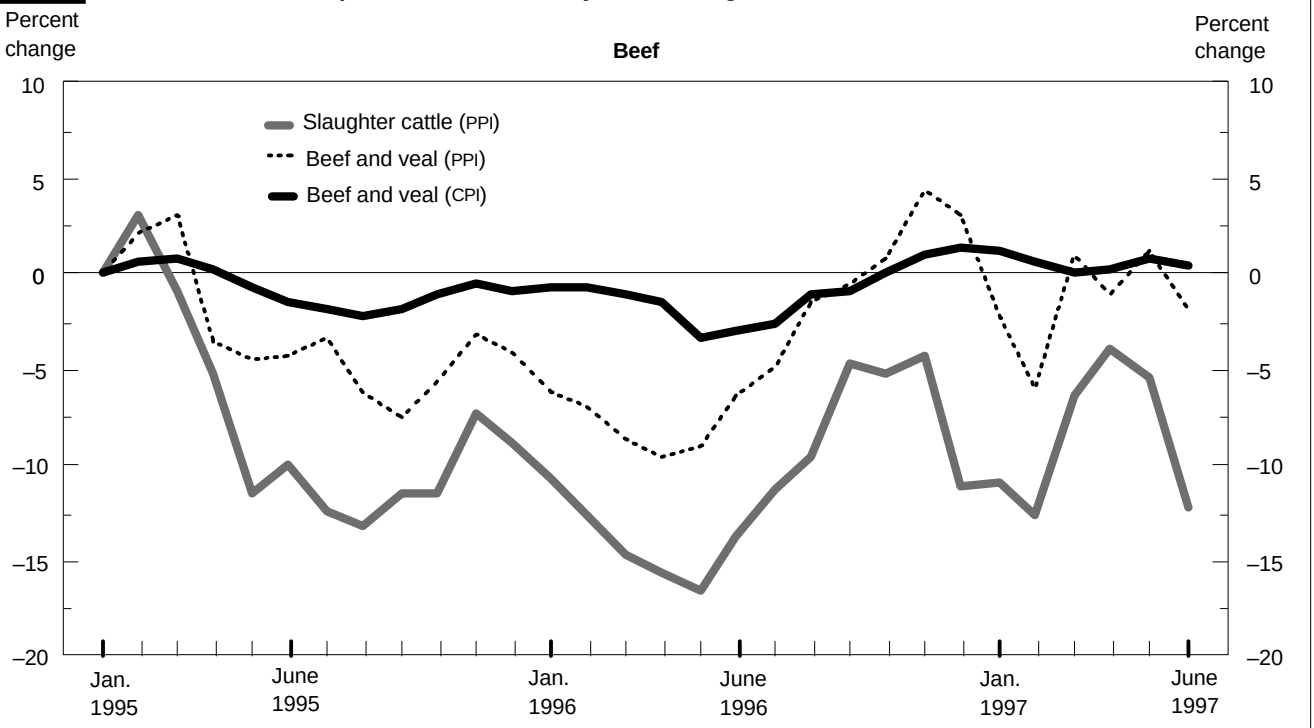
The 1996 Farm Act, also known as the Federal Agriculture Improvement and Reform Act or the "Freedom to Farm Act," removed many of the Government restrictions on agricultural production. The act deregulated the production of most major crops, including wheat, corn, and soybeans. Under the plan, farmers still receive some subsidies, but are generally free to decide what and how much to plant. This deregulation of farming allows farmers to react to 'price signals,' that is, it allows them to respond to rising prices by producing more, and to falling prices by producing less. This was also part of the reason for the increase in the 1996–97 spring wheat crop. Formerly, the Department of Agriculture established production quotas, and regular market forces were unable to correct a market shortage or glut. Farmers' greater discretion in planting now allows them to produce those goods in highest demand, which should tend to mitigate the inflationary impact of a shortage.

A Department of Agriculture report discussed the impact of the 1996 Farm Act on containing the effects of the 1996 grain price shock stating: "The 1996 Farm Act quickly and dramatically changed the decisionmaking environment for farm operators, landowners, and managers …[F]arm operators and managers have taken advantage of the elimination of acreage limitations to adjust their crop mixes. The value of now-predictable program payments (production flexibility contract payments) showed up in … reports of higher land prices, higher rental rates, and changes in the provisions of leasing arrangements."[29]

The most significant reaction by farmers to higher prices appears to have been their growing of more soybeans. As noted in chart 3, the price spikes in corn and wheat dissipated by the fall of 1996, but soybean prices still remained quite high in the fall of 1997. "U.S. soybean acreage planted in 1997 is the largest in 15 years and the third highest on record, according to USDA's Acreage report released June 30, 1997. Moreover, it marks the first time that U.S. soybean planted acreage has surpassed wheat plantings."

Greater ability of foreign producers to react to market signals played a significant role in containing the grain shock as well. Although export markets may have exacerbated the U.S. food inflationary trend by increasing demand when domestic stores were already low, other developments in overseas agricultural markets also are working to counteract the trend. De-

Chart 7. **Growth in beef and pork inflation, January 1995 through June 1997**



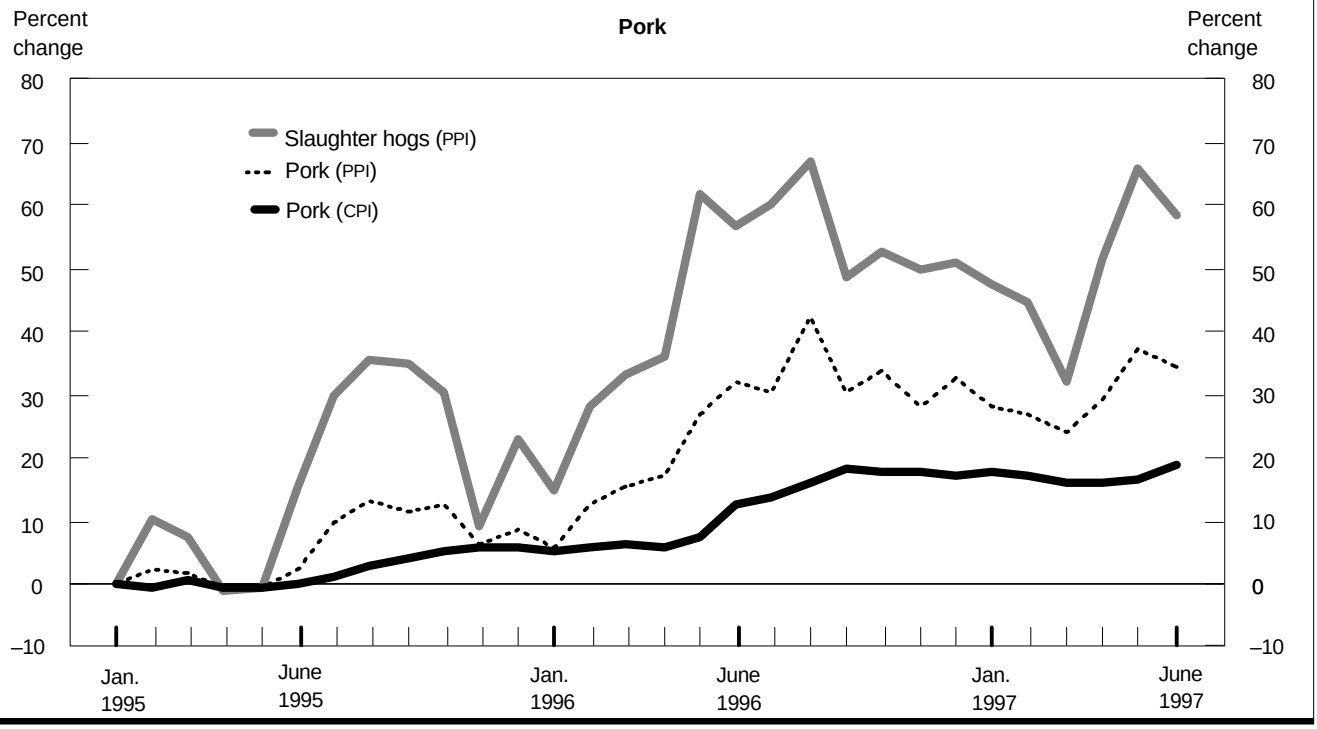


Chart 8. **Dairy and poultry inflation from feed to retail, January 1995 through June 1997**

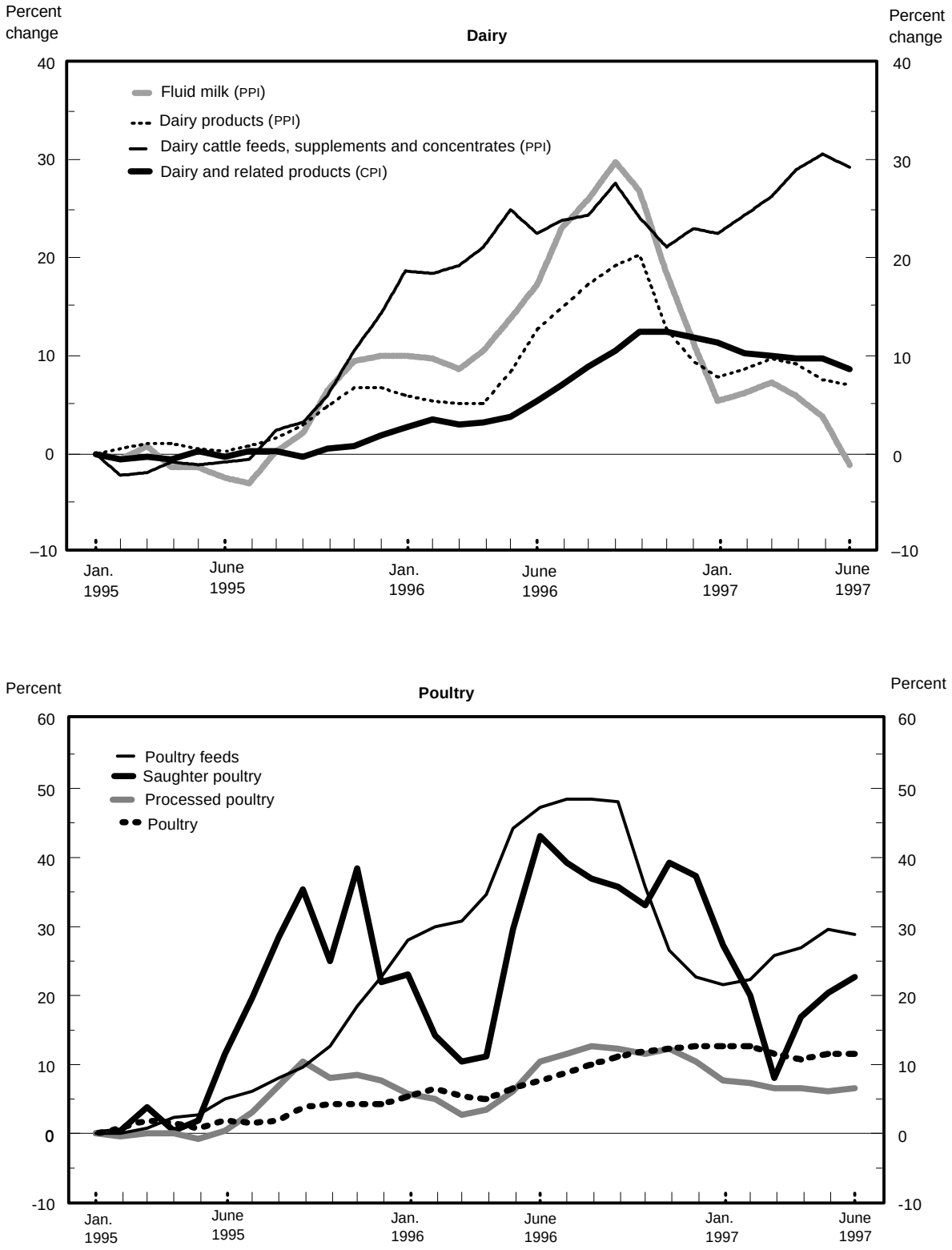
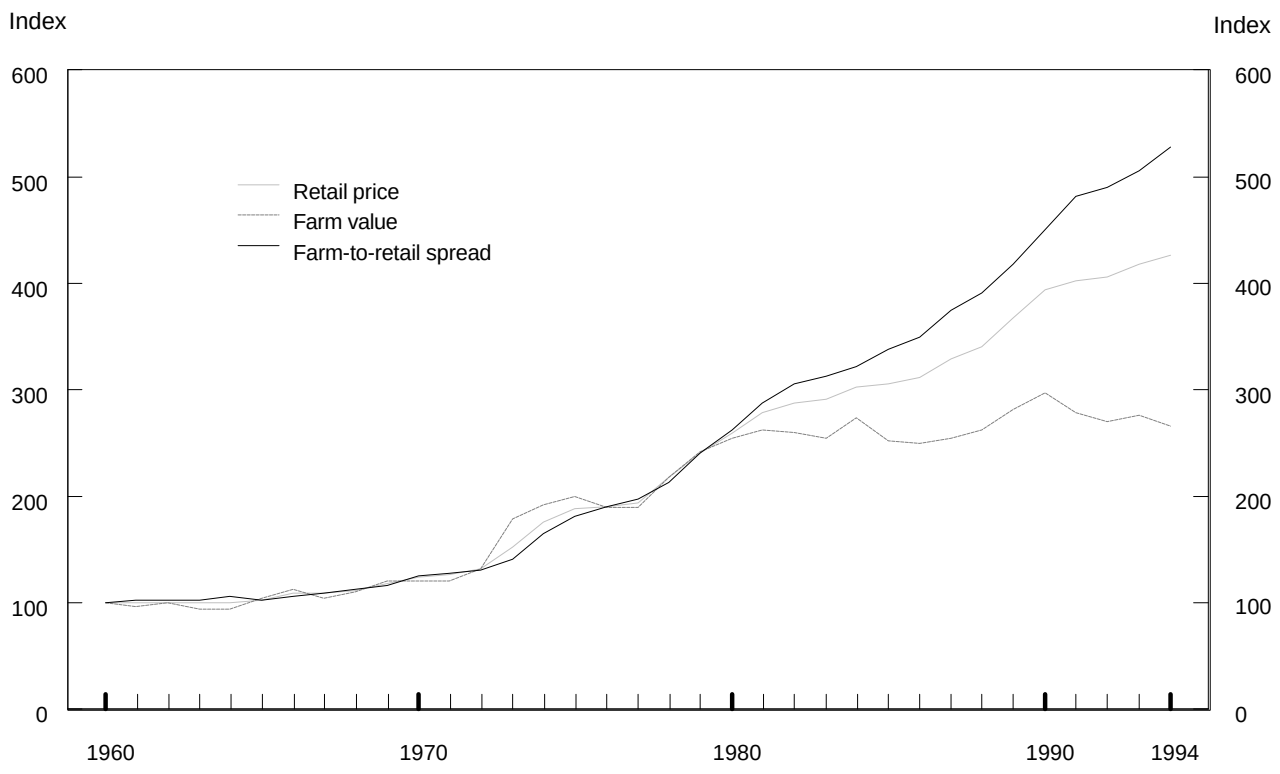


Chart 9. Comparison of retail price, farm value, and farm-to-retail spread, 1960–94



regulation of agriculture and falling trade barriers in other nations like Australia and Argentina have allowed farmers in those nations to fill in the gap caused by the U.S. drought and rising overseas demand. With world grain prices exceptionally high, such exporting nations stepped up production, especially in wheat.[31]

The foreign increase in wheat production was so strong that the Department of Agriculture projected the volume of U.S. wheat exports to decline 23 percent in the 1996–97 season from the previous year. The Department of Agriculture cited the cause of the export decline to be "increased output by several major exporters (Australia, Argentina, Canada, and the EU [European Union]) and importers (China and North Africa)."[32] The higher wheat prices apparently led to a 5-percent increase in foreign wheat acreage, the largest increase since the Department of Agriculture started tracking foreign wheat acreage in 1960.[33]

Conclusions

As we have seen, the 1995–96 runup in grain prices did affect food prices. Food inflation surpassed core inflation in 1996 and 1997. However, it is difficult to say whether this would have been the case if not for the robust export demand for both grain and processed food products that manifested itself at the same time.

Significant price fluctuation for agricultural commodities will continue so long as there are supply shocks brought about by adverse weather conditions, temporary shortages in labor and equipment, and a host of other reasons. Grocery shoppers will occasionally experience sticker shock, particularly for items such as fresh vegetables after a freeze in Florida or a flood in California. Demand shocks from unexpected export markets (as was the case in 1973 with the Soviet Union grain purchases) will probably always be with us as well. Among recent demand shocks are the outbreaks of "mad cow" disease in Britain and swine diseases in Taiwan, which created strong demand for U. S. beef and pork products.

The economics of food inflation are clearly changing for a number of reasons. One way in which the dynamics of food inflation has changed is that the price that we pay for food has become less dependent on what price the farmer receives. The farm value portion for food costs has trended downward for a number of years, and there is no apparent reason to believe that the trend will reverse itself.

Another way in which the dynamics have changed is that agribusiness has become more concentrated, leading to increased economies of scale.[34] The accompanying slower rise in per unit production costs and the presence of competition have further reduced the impact of farm supply shocks on food inflation.

OVERALL, FOOD INFLATION appears to have grown more stable over time. Farmers' responsiveness to price signals has reduced commodity price shocks. At the same time, declining farm value has reduced the impact that a commodity price shocks have. This suggests that grain price shocks may have a diminished impact on retail food prices in the future. □

Footnotes

[1] Feed grains (as used in this article) are grains that are inputs to food and animal feeds. The predominant feed grains are corn, soybeans, and wheat. 'Cash grains,' 'bulk grains,' and 'grain commodities' are all synonymous with feed grains.

[2] Scott Killman and Richard Gibson, "Big Grain Rally Seeds Food Price Rise," *The Wall Street Journal*, Jan. 26, 1996, p. A2.

[3] "Core inflation" is inflation measured by the broadest aggregate minus food and energy prices. Therefore, the CPI core is the CPI-U for *all items less food and energy*, and includes all goods and services measured by the CPI-U except those two items. The PPI core is the PPI for *finished goods less food and energy*, and includes all finished goods (except construction and horticulture) in the mining, manufacturing, and agricultural sectors that are not food or energy goods.

[4] Howard Elitzak, "USDA Agricultural Economic Report," *Food Cost Review, 1996 (*U.S. Department of Agriculture, December 1997), p. 6.

[5] *Ibid*.

[6] *Ibid*.

[7] *Ibid*.

[8] *Ibid*. table 4, p. 5.

[9] *Poultry Yearbook: 1995*, Statistical Bulletin No. 927 (U.S. Department of Agriculture, Economic Research Service, December 1995), pp. 93–97, t. 98 and 100.

[10] These figures represent the relative importance of component series in the PPI by stage of processing, December 1996.

[11] "1992 Census of Manufacturers," *Grain Mill Products—Industry Series* (U.S. Department of Commerce, June 1995), table 7, page 29.

[12] *Feed Outlook Report* (U.S. Department of Agriculture, Economic Research Service, Aug., 13, 1997), table 1 of the electronic copy. Internet address: http://mann77.mannlib.cornell.edu/reports/erssor/field/fds-bb/feed_outlook_08.13.97c.

[13] ibid.

[14] ibid.

[15] *Oil Crops Outlook Report* (U. S. Department of Agriculture, Economic Research Service, Aug. 13, 1997), pp. 4–5, t. 1 of the electronic copy. Internet address: http://mann77.mannlib.cornell.edu/reports/erssor/field/ocs-bb/oil_crops_outlook_08.13.97c

[16] *Wheat Situation and Outlook Yearbook* (U.S. Department of Agriculture, Economic Research Service, March 1997), p. 47, t. 3d.

[17] The U.S. Department of Agriculture made this forecast on May 10, 1996. Also, the crop year for wheat begins June 1, and begins August 1 for corn and soybeans.

[18] *Agricultural Outlook* (U. S. Department of Agriculture, February–July 1996).

[19] "Field Crop Overview," *Agricultural Outlook* (U. S. Department of Agriculture, June 1996).

[20] Winter wheat planted in the fall of 1995 would be harvested in the 1996–97 crop year.

[21] Edward Allen, "Weather Problems Beset US Winter Wheat Crop," *Agricultural Outlook* (U.S. Department of Agriculture, June 1996), p. 5.

[22] *Wheat Situation and Outlook Yearbook* (U.S. Department of Agriculture, Economic Research Service, March 1997), p. 47, t. 3.

[23] "US Agricultural Exports, calendar years 1990–1996," (U.S. Department of Agriculture).

[24] The numbers for this tabulation do not sum to the exact annual average show in PPI table due to rounding. Also this text tabulation uses the relative importance of items as of December 1996.

[25] *Killman and Gibson, The Wall Street Journal*,1996.

[26] *USDA Cattle Reports* (U.S. Department of Agriculture, Jan. 31, 1998), Electronic versions available at: http://mann77..mannlib.cornell.edu/reports/nassr/livestock

[27] *Agriculture Outlook* (U.S. Department of Agriculture, July 1996), p. 29.

[28] *Killman and Gibson, The Wall Street Journal, 1996*.

[29] "Managing Farm Resources Under the New Farm Act" *Agricultural Outlook* (electronic edition) (U.S. Department of Agriculture, Economic Research Service, July 24, 1997).

[30] "Commodity Briefs: Field Crops," *Agricultural Outlook* (electronic edition) (U.S. Department of Agriculture, Economic Research Service, July 24, 1997).

[32] "Australia's Farmers Watch World Prices," *Agricultural Outlook* (U.S. Department of Agriculture, Economic Research Service, January–February 1997), pp. 14 and 15; and "Argentina and Brazil: Key Players in New Trade Bloc," *Agricultural Outlook* (U.S. Department of Agriculture, Economic Research Service January–February 1997), pp. 23–27.

[33] Field Crops Overview, *Agricultural Outlook*, 1996, p.3.

[34] "U.S. Agricultural Outlook for 1997," *Agricultural Outlook* (U.S. Department of Agriculture, Economic Research Service, April 1997), p. 3.

[35] "Food Prices Forecast Up 2.5-3.0 Percent in 1997" *Agricultural Outlook* (U.S. Department of Agriculture, Economic Research Service, April 1997), p. 24.

Appendix: Types of testing models

To investigate the effects of feed grain prices on the price of consumer food, the authors constructed a vector-autoregression model.[1] The first step in constructing the model was to take a simple average of the monthly index levels of the PPI's for corn, soybeans, and wheat. The authors then named this the 'feed grain' index and tested for a relationship between it and the CPI for food and beverages. To control for general inflation, the authors included the CPI for all items less food and energy (the CPI core index). The vector autoregression model therefore included the three time series (the feed grain index, CPI for food and beverages, and the CPI for All Items Less Food and Energy) and a constant. The authors used monthly index levels over the 1967–97 period.

To test for the stationarity of the data, the authors used Augmented Dickey-Fuller tests with four lags. The test failed to reject

the null hypothesis of nonstationarity for the index levels of all three series at the 95-percent level of confidence. The test did reject the null hypothesis for the first difference of all three series. The authors therefore proceeded as though the three series were first difference stationary in the first two movements.

To create the model with the most appropriate number of lags, the authors employed the Schwarz Information Criterion. This method found that a model with 12 lags had the best fit. The authors therefore employed a vector autoregression of 12 lagged endogenous variable coefficients.

To determine whether the time series were cointegrated, the authors applied a Johansen Cointegration Test. The test found that the series were cointegrated with a rank of 1. The authors therefore constructed a vector error correction model with one cointegrating equation, the three endogenous variables, 12 lags, and a constant.

The results of the model supported the hypothesis that the feed grain index tends to have a positive relationship with the CPI for food and beverages, controlling for core inflation. An *F*-test, testing for the joint significance of the 12 lags of the feed grain index on the CPI for food and beverages had a significant value at the 95-percent level of confidence. The sum of the coefficients of the 12 lags of the feed grain index on CPI for food and beverages was +0.041.

In addition, the cointegrating equation suggests a long-term equilibrating relationship of the form:

CPI for food and beverages =

3.772 + 0.832 CPI core + 0.114 feed grains

Furthermore, a pair-wise Granger Causality test found feed Grains to Granger-cause CPI: food and beverages at the 95-percent level of confidence. (Pair-wise tests also found CPI: food and beverages to Granger-cause CPI: all items less food and energy and found that CPI: all items less food and energy to Granger-cause CPI: food and beverages. No other pair-wise tests suggested Granger Causality.)

The regression analysis, therefore, was wholly supportive of the hypothesis that an increase in feed grain prices tends to increase the price for retail food prices, over some time lag. The sum of the lagged coefficients of feed grains on the CPI for food and beverages was both positive and jointly significant. Moreover, the cointegrating equation established that in the long run, a 1-point increase in feed grains should be associated with an-.11 point increase in the CPI for food and beverages. Finally, the authors found that feed grains does Granger-cause the CPI for food and beverages.

To test for the stability of the model over time, the authors employed a Chow test. The test looked at whether the relationship of the vector error correction model remained constant over two subintervals; February 1968 through December 1984 and January 1985 through December 1997.[2] The test rejected the hypothesis that the coefficients were the same for feed grains and core consumer inflation on the CPI for food and beverages at the 95-percent level of confidence. The vector error correction models, for the first, period gave a cointegrating equation coefficient of 0.10 and a sum of lagged coefficients of 0.047 for feed grains on CPI for food and beverages. For the second period, the results were 0.05 for a cointegrating equation coefficient and 0.023 for lagged coefficients. The test therefore does offer support for the hypothesis that the relationship between feed grain inflation and consumer food inflation has weakened since 1984.

Footnotes to the appendix

[1] The methodology employed follows that used by Todd E.Clark, "Do Producer Prices Lead Consumer Prices?" *Economic Review* (Federal Reserve Bank of Atlanta, 1995), and also that of S. Brock Blomberg and Ethan S. Harris, "The Commodity-Consumer Price Connection: Fact or Fable?" *Economic Policy Review*, (Federal Reserve Bank of New York, October 1995).

[2] Due to differencing and the use of 12 lags in the model, the number of observations was abridged such that the first observation was Feb 1968.