



**Food Price Inflation in Livestock Product Markets:  
From the Live Animal to Retail Prices**

**by**

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## **Food Price Inflation in Livestock Product Markets: From the Live Animal to Retail Prices**

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The boom in agricultural crop commodity prices has led to much discussion and research on food price inflation. Reasons for high crop prices vary by crop, but can fairly be characterized as including, in various portions, the growth in demand for biofuels, exports, speculative investment in commodities, and tighter supplies in other countries.

Most discussion of food price inflation over the past year has involved staple food items such as bread, rice, and foods made from corn. The discussion has largely ignored livestock-based products. Some attention was given to higher milk and egg prices in the popular press. These are livestock products with shorter production cycles whose prices fairly directly reflected other market reactions including trade and earlier low prices. On other livestock products, the linkages between input price shocks and output price effects are much more complicated.

Because of the complexity of the relationship between feed costs and retail livestock product prices, the effect of higher feed prices on the livestock and meat industry was largely ignored. Feed is one input in what can for some livestock products (e.g., beef) be a long and complex production process. Consequently, the effect of high feed prices on meat prices did not appear as clearly or as quickly as it did on grain-based products. The lags in meat and livestock production mean that the time required for the effect of input price shocks to influence end product prices is much greater than for grain-based products. In summary, the complexity of the livestock production process (involving many inputs including feed and influenced by biological factors over what can be a relatively long production cycle) greatly complicates price transmission from the farm to retail level. However, understanding this lagged effect of feed prices on livestock and meat prices is an important factor in understanding the full effects of the commodity price boom beginning in 2006 on US agricultural and food markets.

This paper conceptualizes the treatment of price discovery and transmission in livestock and dairy products that are affected by the characteristics of firms, coordination, biological lags, and policy and regulatory issues. Beef, pork, poultry, and milk are treated in this paper highlighting market structure and price transmission mechanisms leading to a contribution to food price inflation. Price transmission issues, by species, are detailed explaining different implications for the magnitude and timing of retail price adjustments. Implications for policy and trade are drawn from the paper's discussion.

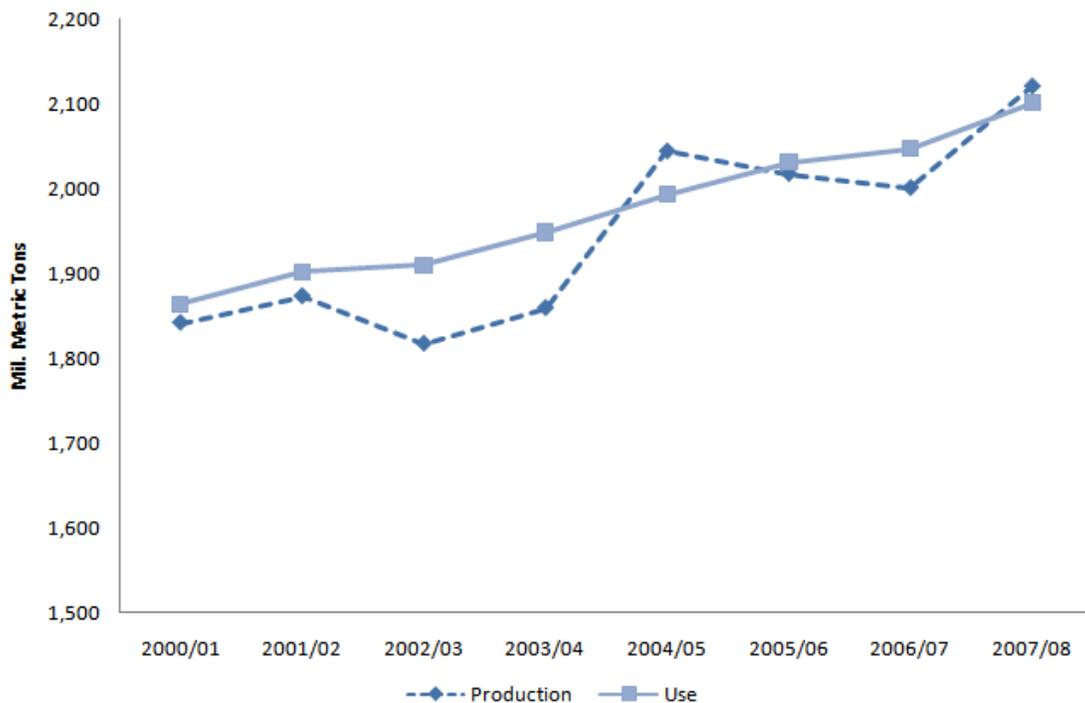
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### Tracing the Increase in Feed Costs

The issue of food price inflation came to a head in the spring of 2008. At that time, the world witnessed food riots in Egypt, Haiti, the Philippines, and a number of west African nations. In April 2008, Robert Zoellick, president of the World Bank, estimated that 33 countries were at risk of social unrest due to dramatic increases in food and energy prices (Zoellick, 2008).

While the crisis in world food markets erupted in early 2008, the seeds of the crisis had been sown much earlier. Several years of increasing grain use combined with a few disappointing harvests combined to pull grain stocks down to dangerously low levels. Figure 1 shows annual world production and use of key food and feed grains from the 2000/01 marketing year through the 2007/08 marketing year.



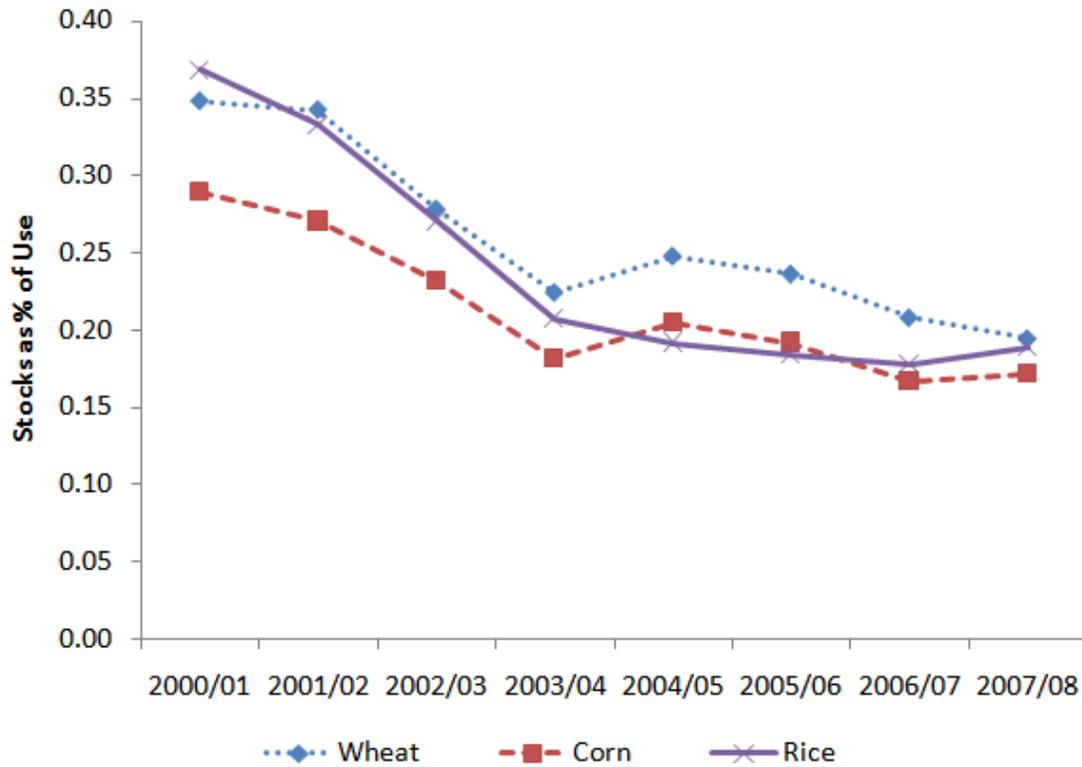
Note: Grains include wheat, coarse grains, and milled rice.

Source: USDA World Agricultural Outlook Board.

**Figure 1.** World Production and Use of Food and Feed Grains: Marketing Years, 2000/01 to 2007/08.

In six of the eight marketing years represented in Figure 1, grain use outstripped production. In only two years did production exceed use, and only in 2004/05 was the margin at all substantial. The primary consequence of this extended period of production shortfalls was to reduce world grain stocks to dangerously low levels. Figure 2 shows stocks-to-use ratios for rice, wheat, and corn for the 2001/02 to 2007/08 marketing years. Note that stocks-to-use ratios for all three of these grains reached their recent historic lows in the 2006 to 2008 time period. The very tight supply situation for all food and

feed grains in early 2008 led to significant government intervention in some key markets. Notably, India and Viet Nam imposed export tariffs on rice, artificially restricting availability even more and arguably touching off the worst of that year's food panics in import-dependent countries such as the Philippines.



Source: USDA World Agricultural Outlook Board.

**Figure 2.** Stocks-to-Use Ratios for Selected Food and Feed Grains: Marketing Years, 2000/01 to 2007/08.

For each of the major grains, the reason for declining availability was different. For rice, relatively low global production from 2000 to 2004 led to steadily declining stocks. Production rebounded after 2004, but strong rice demand made it difficult to build stocks. For wheat, two years of poor production in a number of key production regions in 2006 and especially 2007 caused a substantial unanticipated drawdown in stocks. For corn, exceptional demand, driven largely by US ethanol production, helped to pull down world stocks despite a series of record or near-record US harvests from 2004 through 2008.

While the role of US ethanol production in pushing grain prices to record levels in the 2007/08 period has been fairly hotly contested, there can be no argument that the growth in corn use from the US ethanol sector was extraordinary. According to USDA World Agricultural Outlook Board data, corn use by the US ethanol sector increased from 15.94 million metric tons (MMT) in 2000/01 to 76.86 MMT in 2007/08 – an increase of just under 61 MMT. By way of comparison, feed use of corn in all other countries combined increased by just under 68 MMT over that same period. No other country's change in

total corn use is even close to the increase in consumption from the US ethanol sector alone. China comes closest, with an increase in total domestic corn use of about 29 MMT from 2000/01 to 2007/08.

Tight rice, wheat, and corn supply situations fueled high grain prices in 2008, and that directly translated into higher prices for many food products. This effect was especially evident in the developing world, where consumers spend a much higher percentage of their income on food and also depend much more on less-processed foods that are more directly responsive to changes in underlying commodity prices. In developed countries like the United States, food price inflation was a less dramatic phenomenon. According to the US Bureau of Labor Statistics, the Consumer Price Index (CPI) for food and beverage increased by 5.4% from 2007 to 2008. This was the largest increase since the early 1990s but was obviously still a far cry from the devastating food price inflation experienced in developing countries.

The food price inflation stemming from higher grain prices beginning in late-2006 has not affected all food products in the same way or at the same rate. For example, the CPI for cereal and bakery product prices increased by just over 10% from 2007 to 2008 – a period encompassing the record high grain prices posted in May/June 2008. On the other hand, the CPI for meats (beef, pork, and poultry) increased by a little less than 3.5% over that same time period.

Feed grains are an important input in all livestock operations; however, grains are not the principal raw material input, as they are for cereal or bakery products. Moreover, some flexibility exists in how the nutritional requirements of livestock and poultry can be met. The degree of flexibility obviously differs by species, but in all cases, producers do have some ability to adjust rations so as minimize feed costs. While cost do inevitably rise with feed costs, the impact of higher costs on end product markets is delayed by the biological lags inherent in livestock production systems. As with flexibility in adjusting rations, biological lags differ considerably across different livestock industries. All of these factors – the proportion of total costs represented by feed expenditures, flexibility in feed rations, and biological lags in production – influence the nature of a particular livestock industry's response to an input price shock and the particulars of the transmission of that shock into the end product market. The following sections will discuss the details of each of these factors for key livestock and poultry industries.

### **Cattle/Beef**

The cattle/beef industry is, arguably, the slowest of all livestock industries to respond to price signals, either those originating from the demand side in the end product market or those originating from the supply side in the feed or other input markets. Delays in responding to market signals stem from a number of factors unique to the cattle/beef industry. First, the beef production process is characterized by long biological lags. From the decision to have a cow bred to the slaughter of that steer or heifer offspring is more than 2 years. That biological process typically starts with breeding in one Summer, followed by calving the next Spring, weaning and sale of the calf in the Fall, and feeding to slaughter weight approximately nine months later.

This biological lag is the basic reason for the cattle cycle. The cattle cycle has averaged about 10 years in length (none of the cycles actually lasted 10 years, but he averaged that length) measured from trough to trough. Over the last century numerous events have affected cycle length. One has been major droughts. The rapid decline in beef demand in the 1980s and 1990s had a dramatic affect on the cattle cycle by shortening the number of years of herd growth and increasing the length of the declining years. The cyclical nature of the industry is important in beef price inflation because the cycle determines the underlying direction of the market that other factors must overcome.

Second, the cattle industry has a smaller, more diverse production system at the cow/calf level than is true of most other livestock industries at the first-producer level. The average beef cow/calf operation in the U.S. is approximately 40 cows (USDA National Agricultural Statistics Service). To put that in perspective, 19,922 average size operations would be needed to supply the annual cattle needs for a 2,500 head per day packing plant. These many small producers are almost always subsidized by off-farm income. This off-farm, or non-farm, income insulates producer from the effects of changes in output prices or costs of production. This results in delays in the producer's response to price signals.

Finally, the cattle/beef industry currently possesses significant excess production capacity in key market segments. Today's cattle industry has a total inventory of 96 million head. Yet, that is down nearly 30% from the peak inventory of 135 million head in 1976. But, the packing sector and feeding industry were built for those much larger inventories of the past. The industry has adjusted by feeding and slaughtering more Canadian cattle and by importing more feeder cattle from Mexico. But, as those countries' inventories have shrunk in recent years, this excess capacity in cattle feeding and beef packing has affected the ability of managers at these levels to pass cost increases along to other participants in the supply chain. In addition to the issue of overcapacity, the high degree of asset fixity inherent in a feedlot or packing plant affects the cost pass through mechanism in the cattle and beef industry. The literature suggests that contracting would generally be used as a means of addressing the problems associated with asset fixity (e.g., see Williamson). While the use of contracting as a means of supply chain coordination has increased in the beef industry, contracting is pretty strongly resisted by many within the beef industry, and its use is complicated by other factors related to the structure of the industry as a whole – for example, the inherent uncertainty in a long biological production process and the very diffuse nature of farm-level production discussed above.

### **Hog/Pork**

The hog/pork industry can be characterized by a more intermediate biological production lag length. Sows have, on average, a little more than 2 litters per year. On average, it takes about 6 months from the time a pig is born (referred to as farrowing) to the time that pig is ready for slaughter, usually at a live weight of around 270 pounds.

More than 75 percent of the hogs produced in the U.S. are produced in a vertically integrated firm or are contracted. These operations tend to be larger, full-time operations (in contrast with the very large number of small, part-time beef operations discussed earlier). As with beef production, pigs are imported from Canada for finishing and slaughter in the U.S.

While the shorter biological lag in the production process as well as the more tightly coordinated supply chain in the hog industry would suggest that adjustments to market signals take place much more rapidly in that industry than in the beef industry, there are other sources of friction that delay price responses by hog producers. The major integrated firms and brands compete vigorously for market share. This competition creates a reluctance to cut production in response to cost increases or price declines. No firm wants to be the first to cut production, thereby potentially forfeiting hard-won market share to more aggressive competitors. This has been most apparent in the time period since feed prices increased in late 2006. Sharp increases in feed costs led to unprofitability for all producers in the industry, yet the integrated companies have shown great reluctance to cut production.

### **Broilers**

In comparison to either cattle or hogs, broilers have a very short biological production process: about 8 weeks from start to finish. The industry is composed (entirely, for all practical purposes) of vertically integrated firms that tightly control the entire production and marketing process. These firms own breeding flocks that produce birds with a very specific genetic composition. These birds are placed with contract growers for the grow-out phase of production, but ownership of the birds remains with the integrators. Birds are processed by the integrators into branded retail products.

The integrated nature of broiler production means that production processes can be quickly adjusted in response to market signals; however, as in the hog industry, the firms fight for market share, creating a reluctance to cut production in response to lower product prices or higher production costs. Over the last two years, increased costs have led to financial losses throughout the industry; yet production cuts have been slow in coming. No firm wanted to be the first to cut production, fearing a loss of market share. The fear was that other firms would not cut production; thereby reaping the longer-run rewards associated with larger market share. This amounted to firms spending equity to hold market share, with firms having deeper pockets able to hold out the longest, waiting for the “weakest link” to break. The weak link appeared in the form Pilgrims Pride, the largest producer in the U.S. The firm had taken on a large amount of debt in purchasing Goldkist in 2007. They also suffered large feed price hedging losses in 2008 that led to the firm’s bankruptcy in early 2009. In effect, Pilgrim’s Pride took a large portion of the necessary production cuts for the entire industry.

The integrated structure and short biological production lags in the broiler industry create the opportunity for firms to make production changes to affect retail product prices. Cuts in production may result in increased wholesale bird prices, benefiting the integrator. But, those cuts are ultimately borne by the contract grower.

Contract growers may experience production cuts in the form of fewer flocks for grow-out each year, fewer birds per flock, the harvest of birds at lighter weights, or some combination of these. The bottom line for the grower is reduced revenue. This can be a difficult situation for growers since a very large proportion of their total costs of production are the fixed costs associated with the grow-out facilities (which are owned by the contract grower, not the integrator). Aside from questions of profitability, production reductions can also create a difficult cash flow situation for contract growers, who are generally servicing considerable debt on their production facilities. While the integrator may be able to stabilize revenue with production cuts, such cuts carry very significant financial risks for the contract grower.

## **Dairy**

The dairy industry has been undergoing rapid structural changes. Small producers have been rapidly exiting the industry while very large dairies continue to expand to larger numbers of cows and grow in number of operations. Milk production has been expanding in recent years through more cows and more milk per cow. The structural changes in milk production have led to a series of booms and busts in milk prices throughout the decade. The current collapse in milk prices was preceded by very high milk prices and record low milk prices before that. This is the third round of milk prices bottoming below \$10 per cwt in the last 10 years. Each was followed by Class III milk prices that exceeded \$20 per cwt.

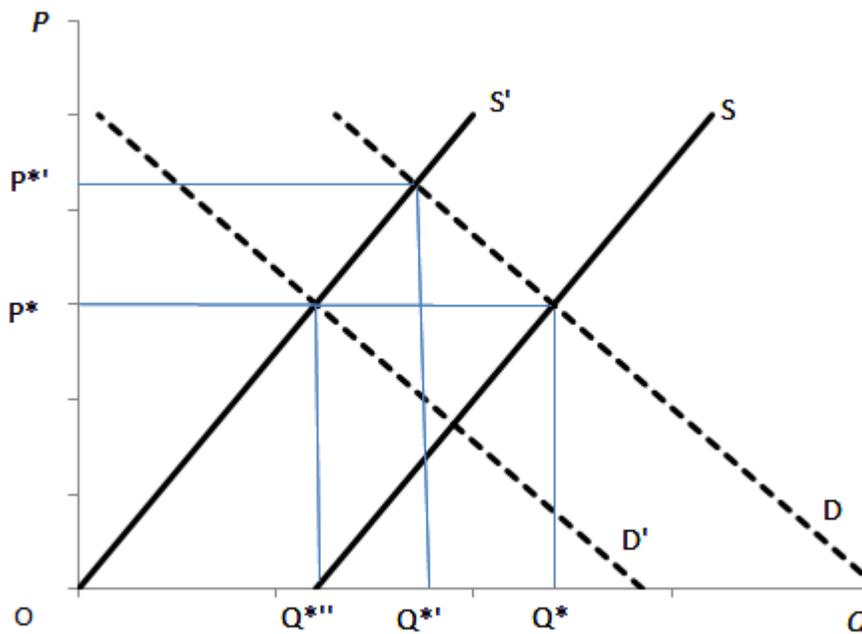
The lags in response to price signals in the dairy industry have typically been fairly long, taking a period of months. Increasing production in response to favorable profits is obviously something of a challenge. Rations can be improved to increase production per cow, and less aggressive culling can be employed to keep cows milking longer. However, adding new cows to the herd is a longer-term prospect, requiring an increase in heifer retention and development, a process that takes years rather than months. U.S. producers have used Canadian replacements to supplement domestic heifers, but that ability was sliminated due to BSE regulations. Once it resumed, those replacements allowed U.S. producers to increase production at a faster pace.

The response to reduced profits (lower milk prices and/or higher costs of production) appears to be more straightforward. Cows can be culled very quickly. However, there is considerable slippage between cow culling and declining milk production. Obviously, everyone wants to cull their worst cows. Consequently, as cows are culled, at the farm level and in the aggregate, milk production per cow tends to increase, a fact that delays the process of adjusting to reduced profitability.

Milk price is one area in the livestock complex where trade delayed the realization fo the effects of high feed costs. Tight supplies of milk products due to drought in Oceania and reduced EU production led to the U.S. having the milk supplies available to feed world demand. The result was that while production costs skyrocketed, milk price outpaced them. That came to a halt in late 2008 as the world economy faltered, demand fell, and production growth continued.

### Today's Prices

A consequence of the lags (both biological and market-structure related) in supply response in livestock industries is that it becomes very difficult to parse the effect on the market of any particular shock. It is never possible to follow the uninterrupted response to any single shock in the market. The current situation presents a perfect example of this phenomenon. The effect of the 2007/08 grain price bubble on food price inflation in the livestock product sector has been made much murkier by the economic crisis. This crisis has led to reduced demand for a wide range of products. Reduced incomes have cut demand for most livestock-related products, especially for higher priced meats and dairy products. While higher grain prices and associated higher costs for livestock production should have had the effect of reducing livestock production and increasing retail prices for livestock products, the economic crisis has been a countervailing force in the market, exerting downward pressure on retail prices due to reduced demand. Thus, the consumer impacts of higher grain prices working through the livestock sector have, for now, been somewhat muted. This situation can be illustrated with a simple model of supply and demand for a livestock-based product as shown in figure 3.



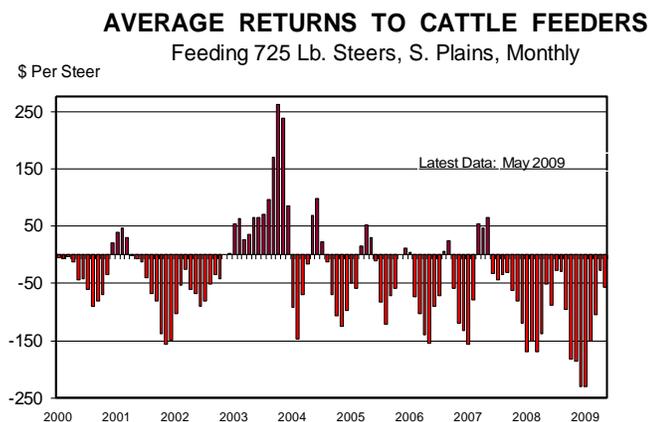
**Figure 3.** Supply and Demand Model for Hypothetical Livestock-Based Retail Product

In this example, the initial supply and demand situation is shown by curves S and D, with initial equilibrium at price  $P^*$  and quantity  $Q^*$ . Suppose that a shock to the price of a major input raises costs of production in this hypothetical industry. This would raise costs for the typical firm in the industry, shifting the marginal cost curve for the typical firm upward, and by extension, shifting the aggregate supply curve to the left, as shown by  $S'$ . The new equilibrium should be at the higher price  $P^{*'}$  and the lower quantity  $Q^{*'}$ . Suppose, however, that the leftward shift of the supply curve was accompanied by a

concurrent (though not necessarily related) shift to the left in demand for this product. In this illustration, the equilibrium price would be about the same as the original equilibrium price,  $P^*$ , but the equilibrium quantity would be at the even lower level of  $Q^{**}$ .

While this is a simplistic illustration of how shocks to a market can have opposing effects on price, it is useful to consider this possibility for livestock product markets in light of both cost of production and demand disruptions in the past two years. A couple of points bear special emphasis. First, the fact that retain meat prices may not have demonstrated the same level of inflation as other food products does not mean that livestock producers were not experiencing a significant cost of production shock. Rather, it suggests that livestock industries have had to deal with two concurrent problems: higher costs and weak demand. The implications of this for revenues in livestock industries are obviously significant (compare the area  $OQ^*P^*O$  to the area  $OQ^{**}P^*O$ ) and go far in explaining the difficulties faced in the past year by livestock industry participants (see, for example, the Pilgrim's Pride bankruptcy noted earlier). Second, the reality is that food price inflation on livestock products has not been avoided – only delayed. Once demand begins to recover, which should happen as the recession comes to an end, prices will begin to reflect the production adjustments that have been occurring for the past two years.

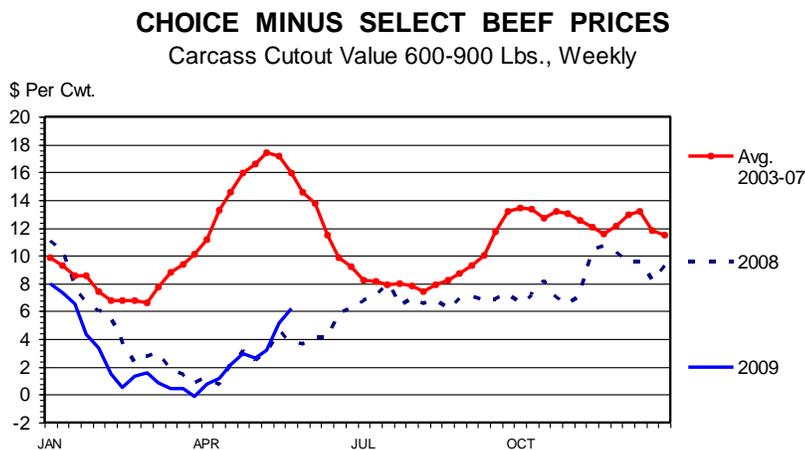
In the beef industry, the current cattle cycle has been greatly affected by drought. The Southern Plains drought in 2006 and the Southeastern drought in 2007 sharply reduced cow numbers. Fewer calves combined with large feeding capacity led to feedlots continuing to absorb losses as feed costs increased by not fully passing on the feed cost impacts to cow-calf producers. The effect has been the largest financial losses for cattle feeders in any relevant historical period. Figure 4 contains returns to cattle feeding as estimated by the LMIC. Equity losses finally led to sharply lower calf prices late in 2008.



**Figure 4. Average Returns to Cattle Feeders, 2000-2009.**

Source: LMIC.

One of the more interesting current market events affecting beef prices is the price differential between Choice and Select beef. Beef is the on meat that has the most difference in grades. Most beef is graded and placed in the categories of Choice or Select. There is a supply and demand for both. The supply of Choice beef has increased due to changes in grading technology and, generally, through increased slaughter weights. As the supply of Choice beef has increased the supply of Select beef has declined. At roughly the same time the recession has caused a decline in the demand for Choice beef. The result is a much smaller Choice-Select price spread (Figure 5) and, in fact, it was negative for week in early 2009. This is a case where there is some effect of consumer behavior, due to income and price, on prices by quality.

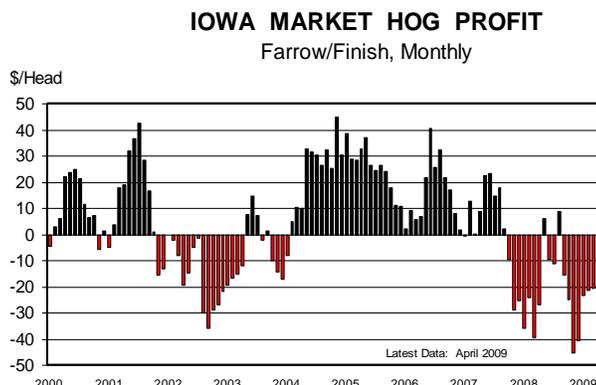


**Figure 5. Choice- Select Beef Price Spread.**  
Source: LMIC

It appears that beef production will begin to decline in 2009. The effects of declining cattle numbers and continued financial losses should result in even more rapid declines in production in 2010. This underlying production should result in higher beef prices in coming years as the industry transitions to higher input costs.

More than a year and half of financial losses for hog producers has resulted in declining pork production. Figure 6 contains estimated returns to hog producers. The large losses of the last 18 months followed an unprecedented period of profits, fueling production growth. But, influenza H1/N1 has reduced hog prices even further.

Longer term, the hog industry, probably more than any other meat, has relied on growing exports to move ever increasing production. Year-after-year of record production has gone to exports with the U.S. becoming a net exporter in the mid-1990s and exporting 20 percent of production in 2008. As exports decline in 2009 domestic prices will be pressured lower.



**Figure 6. Iowa Hog Market Profits, 2000-2009.**  
Source: LMIC and Iowa State University

Broiler production is declining sharply due to financial losses in the industry. Bernard and Willett examined price relationships in the broiler industry in the 1990s and found that wholesale market price decreases were passed on to growers more quickly than were price increases. But, wholesalers in most regions of the country were not able to pass on a larger share of price increases than decreases to consumers. Were those findings to hold today we would expect consumers to share in price decreases and increases from the wholesale market.

Declining broiler production appears to be starting to result in higher broiler prices. Broilers prices, legs and, leg quarters, and skinless/boneless breast prices have each equaled or exceeded year ago levels in recent weeks.

### **Implications For Food Price Inflation**

The longer and more varied response lag time in livestock products has some implications for food price inflation. From January 2005 through February 2008, the period including the rapid increase in feed and other input costs, retail bread prices had increased by 11.7 percent, but beef and pork retail prices had actually declined (Anderson, et al.) Broiler prices had increased 2.1 percent. To that point, the food CPI had increased, but increases in some items had been offset by falling prices in beef and pork.

Price measurement continues to be an issue in measuring inflation in meat prices. The reported retail prices reflect prices one week of each month. They do not reflect in store features, sales, and the effects of frequent buyer programs. There is some data that suggests that scanner data from actual purchases result in prices that are lower, but more volatile. As noted above in the discussion on beef prices, shifting between Choice and Select products, for instance, is not accounted for in retail price data.

Consumer responses to higher meat prices also bear some investigation. Meat, like other food, is consumed at home and away from home. The interaction, or shifts, between retail purchase between these outlets has implications for meat prices, particularly between quality grade prices, individual cuts, and competing meat tradeoffs.

An area for further research is the competitive behavior of firms. For instance in pork and poultry, in reluctance to cut production in the face of losses to maintain market share has probably delayed the response to higher costs. Yet, that delay can only go on so long before at least one company has to begin reducing production. That behavior was evidenced in poultry in late 2008 and 2009. This behavior may, in the short run, lead to lower prices, but in the longer run may result in higher prices as firms are forced to reduce production.

In the cattle and beef sector some sectors, feeding and packing, have absorbed financial losses as costs and prices have changed. In the short run, those events probably reduce price inflation to consumers, but longer term effects on the industry will likely result in even higher prices.

Each meat sector competes for the consumer's meat protein expenditures. The varying rates of adjustment in each industry may have some implications for the mix of food items purchased in the future. The more rapid ability of the broiler industry to adjust may give it further advantages over the beef industry, even though poultry are more dependent on concentrate finishing. That may offset cattle's ability to utilize pastures that may be relatively cheaper than grains due to recent events.

### **Summary**

The end result is that meat and livestock product price inflation has a much longer term effect. Biology and market structures affect the ability of each sector to respond to inflationary pressures. The effect of input and feed cost increases are only just now being felt, but they are already overshadowed by the financial and economic crises' effects on demand.

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