CHAPTER 3

FUNDAMENTAL ANALYSIS: SUPPLY AND DEMAND

INTRODUCTION

There is a continuing debate over fundamental versus technical analysis of the commodity markets and which should be employed. The debate is not really necessary. Both approaches are important, and the two approaches are in fact complementary. Each approach has inherent strengths and weaknesses. The complementarity of fundamental and technical approaches to analysis of the markets will become apparent as Chapters 3, 4, and 5 are developed, but the essence of the issue can be captured quite easily. The supply–demand fundamentals will ultimately determine price, but the technical dimension of the markets is useful in guiding the timing of actions as the supply–demand balance is being sought via price discovery processes.

It is, as suggested, a tautology that the interaction of supply and demand determines price. In the final analysis, the prices being discovered in the futures market must honor what is happening to the supply and demand relationships and the supply–demand balance. But we must remember that the futures market is attempting to discover the price that will balance supply and demand *for some future time period*. That day-to-day effort to discover the correct price is based on less-than-precise estimates of the levels of supply and demand for that future time period. Across the time span during which the price discovery process is being completed, the market is periodically "shocked" by changes in the information base. It is not surprising, therefore, that the path of discovered prices changes over time.

Analysis of the fundamental supply–demand information does not have to be sophisticated and it does not have to be capable of generating highly accurate predictions of future prices to be effective for the hedger or speculator. What is needed is the capacity to anticipate the direction of price moves and to formulate an impression of the likely price range. *The direction in which price will move will often determine what price-risk management strategy will be employed.* The producer who is a selective hedger is very interested in being able to anticipate the direction of price movement. If the consensus of the supply–demand information seems to be calling for prices to trend higher, the proper position for a selective hedger is that of cash market speculator. If the consensus is for lower prices, then the need is for aggressive placing of short hedges. For the long hedger interested in protection against higher input costs, the correct positions are just reversed, of course, but there is still keen interest in the probable direction of price movements.

Technical analysis will be covered in detail in Chapters 4 and 5, and it will be presented as the key to the timing of actions. But technical analysis will not be effective if there is a naive reliance on some technical indicator that is generating a price that the emerging supply–demand balance essentially guarantees will not develop. The basic point is important and deserves emphasis: *Fundamental analysis is needed to identify price direction and probable price ranges within the decision period. Then, technical analysis will be valuable in guiding the timing of market actions within the price ranges generated by the forces of supply and demand.*

THE SUPPLY–DEMAND FRAMEWORK

Often, we see the supply–demand framework presented in the form of a market equilibrium. A supply function and a demand function are shown and a single equilibrium or market-clearing price is demonstrated. Figure 3.1 demonstrates with the equilibrium price at level P.

In an after the fact context, a single market-clearing price makes sense. After all the changes in information have been registered, there is—conceptually, at least—a single equilibrium price that balances or matches the forces of supply and demand. The price of Choice steers in Omaha for last year was $74.30 per hundredweight, for example. But marketing and pricing decisions cannot be made in an *ex post* context. They have to be made during periods when a great deal of uncertainty exists about the exact level of supply and demand. Decisions are therefore made in the face of high levels of price uncertainty.

Figure 3.2 is a better picture of what is actually happening. Buyers and sellers bring to the marketplace some preconceived expectations of the "true" supply and demand. But access to information differs, the information base is never complete and perfect, and not all buyers and sellers would interpret the same set of information in exactly the same way. What we have, therefore, is a *distribution* of the estimated sup-

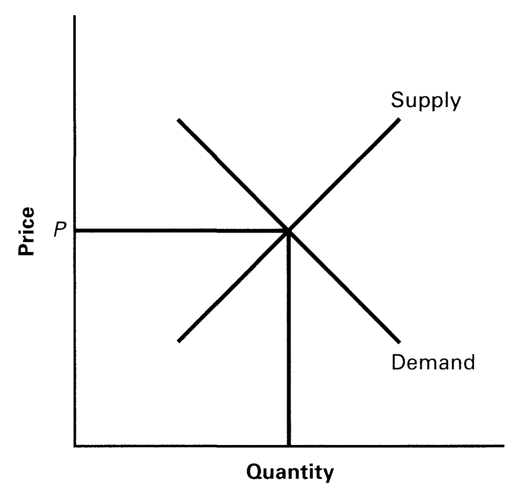
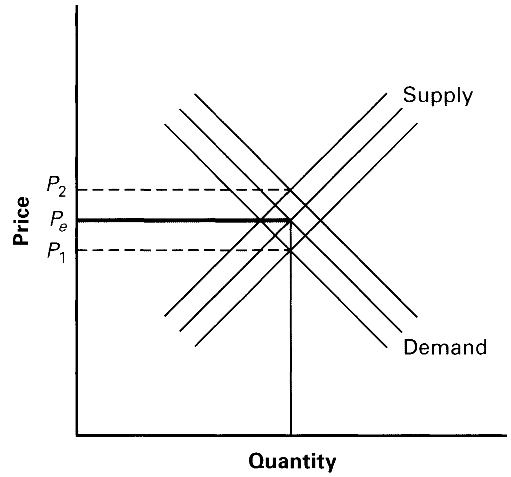


FIGURE 3.1
Demonstration of Supply and Demand and a Single Equilibrium Price

FIGURE 3.2
Range of Prices Due to Varying Estimates of Supply and Demand



ply and demand curves, with some tendency toward more frequent estimates near the middle of the distribution. In Figure 3.2, actual transaction prices can occur in a range of P_1 to P_2, with some tendency for them to concentrate around P_e, the equilibrium price. The extent to which prices do concentrate around P_e and the size of the range between P_1 and P_2 will depend primarily on how complete and accurate the underlying information is at any point in time and how easy it is to interpret that information.

On a particular day, therefore, the prices in the futures markets for cattle, corn, interest rates, or any other commodity or instrument are being discovered by buyers and sellers who have varying impressions of what the price level should be. During the day, if there is no significant influx of new information to shock the market, a consensus will tend to develop. For that day, the closing or settlement price is the best representation of that consensus and is the best single indication of the price expectation for the future time period.

Figure 3.3 demonstrates. For each trading day, we see the trading range for a futures contract represented by a vertical bar. The horizontal "dash" represents the closing or settlement price. The typical format in daily newspapers, the *Wall Street Journal*, electronic market news wires, and so on, is as follows, using soybeans to illustrate in cents per bushel:

Futures Month	Open	High	Low	Close	Change
May	590.5	594.75	590.0	593.25	+ 2.25
July	605.0	608.5	613.5	607.00	+ 2.25
Aug.	609.0	613.0	608.5	611.25	+ 1.50
Sept.	609.0	613.0	608.0	611.50	+ 2.00
Nov.	614.5	618.0	613.0	615.50	+.50
Jan.	625.0	627.5	624.0	625.25	+.25
Mar.	635.5	637.5	634.0	636.00	−.25

The "change" entry shows the change relative to the closing price for the previous trading day. The terms *close* (or *closing price*) and *settle* (or *settlement price*) are used interchangeably and mean essentially the same thing. If there is a useful distinc-

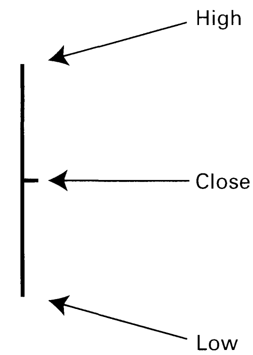


FIGURE 3.3
Daily High, Low, and Closing Prices for Futures

tion, it is that the closing price often shows a price range, and the settlement price is a price in that range designated by the exchanges as the official price for accounting purposes.

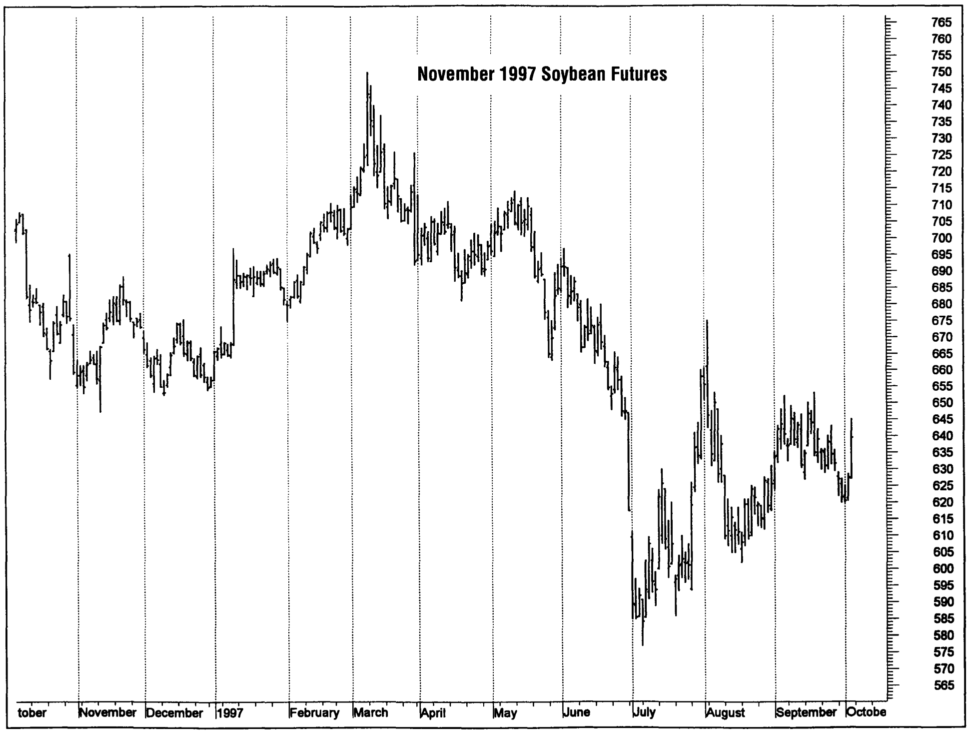
During the trading session, the consensus floats in a price range much like the range P_1 to P_2 in Figure 3.2. If new information enters the price discovery process, the range established early in the day may be expanded as the new information is received and incorporated. Across a number of days, the market probes into new higher prices, new lower prices, or both, as information enters the marketplace and is subjected to varying and imprecise interpretations by the traders. The fact that there is a trading range during the trading day is thus demonstrating the same thing that is demonstrated in Figure 3.2. *The information being used by futures traders is not perfect, it varies across traders in terms of access, and will never be interpreted exactly the same way by any two traders.* There is, therefore, a price range within the day and prices can and do move significantly up or down over time as the information on supply and/or demand changes and is interpreted in different ways.

Figure 3.4 shows the bar chart for a recent soybean futures contract to demonstrate changing prices within the year. The purpose here is to demonstrate that prices *do* vary a great deal within the year as the flow of information changes. The discovered prices for 1997 soybeans traded across a fairly wide range. In drought-stricken years, the price range within the year will be much wider. The price-discovery process is not an exact science, and the discovered prices do react to new information and do move on a seasonal basis as harvest approaches or as weather threatens the crop.

It is clearly important for you, as a decision maker, to be able to formulate a usefully accurate estimate of what the price range is likely to be across a decision period. And it is important that you be able to anticipate, with a useful degree of accuracy, the direction and magnitude of the price response to a new "shock" of information on supply and demand. To do that requires a basic understanding of the important economic forces that shift supply and/or demand. That basic understanding will require the decision maker to master a few simple tools of fundamental analysis.

The equilibrium price is the single price that would balance supply and demand and clear the market. But the levels of supply and demand for a future time period are never known with certainty. The prices discovered in the futures market will reflect that uncertainty and will trace out some distribution over time as new information on supply and demand enters the market and prices adjust to reflect the change in the information.

FIGURE 3.4 Demonstration of Changing Futures Prices within a Year for Soybeans



THE SUPPLY SIDE: CROPS

For the important crops, the monitoring of the supply situation should start with the stocks that are carried into the year. Table 3.1 demonstrates, showing the widely used supply–demand balance sheet format for corn.

The ending stocks for one crop year become the beginning stocks for the next crop year. The crop year runs from September 1 to the following August 31. In the table, 426 million bushels are carried forward from the 1995/96 crop year to the 1996/97 crop year. To the beginning stocks, add production and we have the total supply for the 1996/97 crop year which started on September 1, 1996. During the year, that total supply must be used in some way or it ends up in ending stocks and must be carried forward to the next crop year.

Before harvest, the production for the current crop year is, of course, an estimate. The USDA generates those estimates using information on planted acres, estimates of harvested acres, and estimates of yields.

Early in the year, the market is attempting to anticipate both the acreage and yield figures. The government programs prior to 1996 had a set-aside requirement that obviously influenced how many acres were planted. The USDA typically releases a Prospective Plantings report relatively early in the year, in late March in recent years. This report gives the first publicly available information on the acreage that is likely to be planted. Such information gets reflected in the early-year efforts to project the upcoming crop year. The June 12, 1997, estimates shown in Table 3.1 use the available information on planting intentions to generate the estimate of an 8.8-billion-bushel crop for the 1997 growing season.

TABLE 3.1
Supply–Demand Balance: Corn

	Crop Year		
Category	**1995/96**	**1996/97**	**1997/98**
		(million bu.)	
Beginning stocks	1,558	426	909
Production	7,374	9,293	9,840
Imports	16	10	10
Total supply	8,948	9,729	10,759
Feed, residual	4,696	5,325	5,600
Food, seed, ind.	1,598	1,670	1,760
Exports	2,228	1,825	2,050
Total use	8,522	8,820	9,410
Ending stocks	426	909	1,349
Average price	$3.24	$2.70–2.75*	$2.25–2.65*

*Estimate as of June 12,1997.

A bit later in the year, on August 1 in recent years, the planted acreage estimates are refined via surveys of producers, and this information is made available later in August. It is thus midsummer before the planted acreage is known with reasonable accuracy, and yields have to be estimated during this period to allow generation of production estimates. The first yield estimate that is based on survey data comes in the August *Crop Production* report, reflecting conditions of August 1. ***At best, the information is imprecise, is subject to sampling errors when the surveys are conducted, and can be radically changed by weather developments.***

Table 3.2 illustrates a calendar of major reports for agricultural commodities during a representative calendar year. The information base can and obviously does change during the year for any and all of the commodities.

TABLE 3.2
Illustrative Calendar of Major Agricultural Commodity Reports

Date	**Report**
January 7	Poultry Slaughter
January 11	Crop Production
January 14	Crop Production—Annual Grain Stocks, Winter Wheat Seedings, World Agricultural Supply and Demand
January 22	Cattle on Feed, Cold Storage, Livestock Slaughter
January 29	Eggs, Chickens, and Turkeys
February 3	Poultry Slaughter
February 5	Cattle (January 1 Inventory)
February 9	Crop Production, World Agricultural Supply and Demand
February 16	Cattle on Feed
February 22	Livestock Slaughter, Cold Storage
February 24	Eggs, Chickens, and Turkeys
March 3	Poultry Slaughter
March 9	Crop Production, World Agricultural Supply and Demand
March 11	Livestock Slaughter
March 18	Cattle on Feed, Cold Storage—Annual
March 21	Cold Storage

Continues

TABLE 3.2
Continued

Date	Report
March 23	Eggs, Chickens, and Turkeys
March 25	Livestock Slaughter
March 31	Grain Stocks, Prospective Plantings, Hogs and Pigs
April 1	Poultry Slaughter
April 11	Crop Production, World Agricultural Supply and Demand
April 21	Eggs, Chickens, and Turkeys
April 22	Cattle on Feed, Cold Storage, Livestock Slaughter
May 3	Poultry Slaughter
May 10	Crop Production, World Agricultural Supply and Demand
May 16	Cattle on Feed
May 20	Cold Storage, Livestock Slaughter
May 23	Eggs, Chickens, and Turkeys
June 1	Poultry Slaughter
June 9	Crop Production, World Agricultural Supply and Demand
June 17	Cattle on Feed
June 23	Eggs, Chickens, and Turkeys
June 24	Livestock Slaughter
June 30	Grain Stocks, Hogs and Pigs
July 1	Poultry Slaughter
July 12	Crop Production, World Agricultural Supply and Demand
July 22	Cattle on Feed, Cold Storage, Livestock Slaughter
July 25	Eggs, Chickens, and Turkeys
July 29	Cattle (July 1 Inventory)
August 2	Poultry Slaughter
August 11	Crop Production, World Agricultural Supply and Demand
August 15	Cattle on Feed
August 19	Livestock Slaughter
August 22	Cold Storage
August 24	Eggs, Chickens, and Turkeys
September 2	Poultry Slaughter
September 12	Crop Production, World Agricultural Supply and Demand
September 16	Cattle on Feed
September 23	Cold Storage, Eggs, Chickens, and Turkeys, Livestock Slaughter
September 30	Grain Stocks, Hogs and Pigs
October 3	Poultry Slaughter
October 12	Crop Production, World Agricultural Supply and Demand
October 21	Cattle on Feed, Livestock Slaughter, Cold Storage
October 24	Eggs, Chickens, and Turkeys
November 2	Poultry Slaughter
November 9	Crop Production, World Agricultural Supply and Demand
November 18	Cattle on Feed
November 21	Cold Storage
November 23	Eggs, Chickens, and Turkeys
November 28	Livestock Slaughter
December 2	Poultry Slaughter
December 12	Crop Production, World Agricultural Supply and Demand
December 16	Cattle on Feed
December 21	Cold Storage
December 22	Eggs, Chickens, and Turkeys, Livestock Slaughter

Source: USDA, Economic Research Service, National Agricultural Statistics Service, World Agricultural Outlook Board.

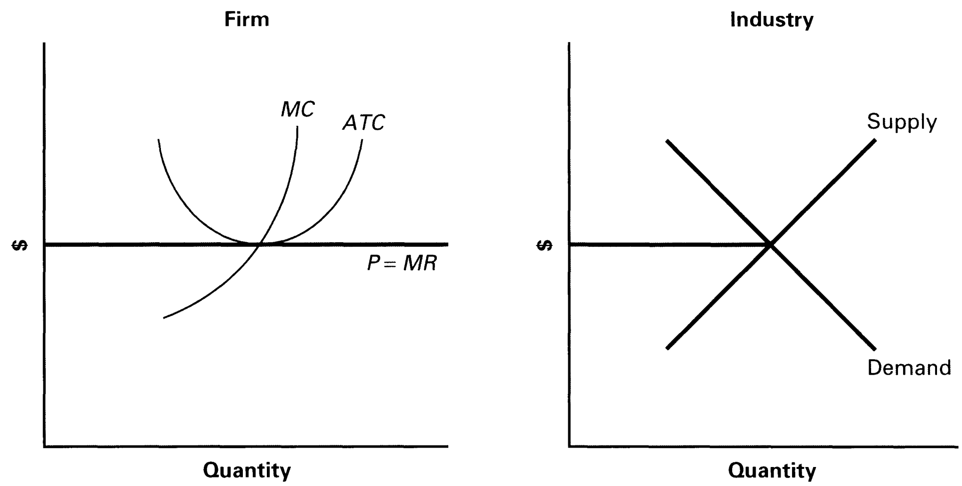


FIGURE 3.5
Profit Maximization for Individuals at the Industry Price

In general, therefore, the futures market reacts to changes in the available information on supply and demand throughout the year. But the process is more complex than it first appears, especially early in the year. Before the crops are planted, the futures market must anticipate how decision makers will react to the available price expectations given the current government programs and other factors that could influence decisions on what crops to plant. In the livestock commodities, the need is to anticipate how many cattle will be placed on feed and to anticipate how producers will react to a particular economic environment in deciding to expand or contract the breeding herd in hogs. To understand that process, we have to start with coverage of the economics of how producers decide.

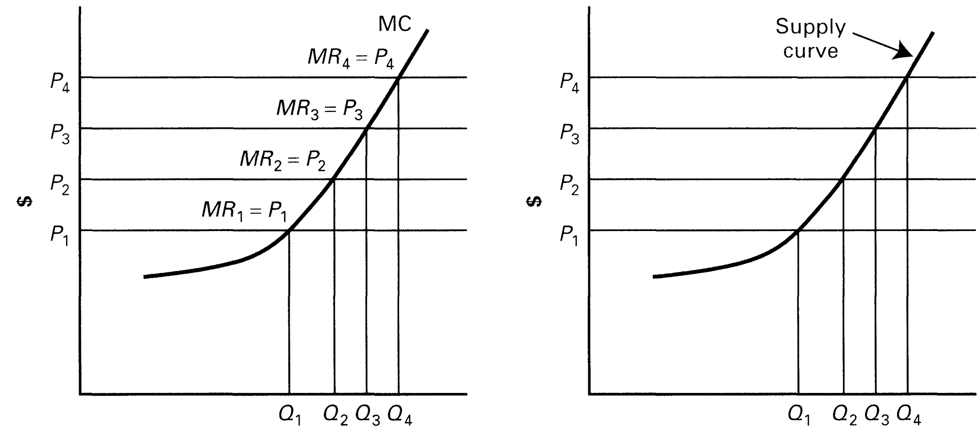
In the context of basic economics, it is easy to demonstrate how producers' decisions have to be made. Figure 3.5 shows the situation facing the individual decision maker at the producer level in agriculture. In an industry that approaches the textbook conditions for pure competition,[1] the individual decision maker has to react to expectations for the industry-determined price.

To maximize profit, the individual decision maker operates at the point at which marginal revenue (*MR*) equals marginal cost (*MC*) of production.[2] Since the demand curve facing the individual producer is completely elastic and is a horizontal line, the

[1]The product being produced is essentially homogeneous, there are no noneconomic barriers to entry, and there are many producers, each producer too small to exert significant influence on price. In some commodities, there are significant economies of size and/or initial investment requirements, but these do not block entry for the well-financed firm. The concept of pure competition is covered in most beginning economic texts, but the coverage seldom extends to the issue of implications to specific decision situations. The coverage here will help you in your attempts to grasp just how important this issue is to the individual producer.

[2]This type of marginal analysis is widely employed in basic economics. What the $MR = MC$ criterion says, in lay terms, is that the firm will expand output as long as what it gets back from an added bushel or hundredweight (the *MR*) exceeds what it costs to produce and offer that added unit (the *MC*). As output expands, *MC* will tend to move up as the physical capacity of the plant or the operation is stretched. By increasing production up to the point that the two marginal flows are equal, the firm maximizes its profits for that decision period.

FIGURE 3.6
Generation of the Supply Curve for the Individual Farm Firm



quantity offered will change as the price (which is *MR* to the firm) changes at the industry level.[3] If you visualize a large number of industry-determined prices and think of the *MR* = *MC* profit maximizing criterion for each, a schedule of the quantities that would be offered at alternative prices by an individual firm is generated. For a given level of technology, for given cost levels of the variable inputs, and for a given level of prices for the other commodities that could be produced, that schedule becomes the supply curve for the individual firm. That supply curve or schedule supply shows the quantities the firm would offer at each alternative price.

Figure 3.6 illustrates this generation of a supply curve for the individual farm firm as the industry-wide price and therefore *MR* to the firm changes. For a given level of technology and the related cost structure, the manager of the individual firm will adjust the level of the variable input employed and change output so that *MC* = *MR* at the various levels of the industry-determined price. If the industry-determined price drops below average variable cost (*AVC*) and remains there, the firm will eventually cease operations and be forced out of business.

The supply curve for the firm slopes up and to the right. It increases at an increasing rate, reflecting the basic economic fact that it is difficult to change production processes in the short run. As prices move higher, it is even more difficult to respond, and the short-run supply response of the typical firm is therefore very inelastic. Over time, it is easier to respond, and the curve will not be so steep. *The futures market has to handle all this*. If hog prices are high enough to elicit expansion, the futures market has to understand that prices for slaughter hogs will increase in the short run as the expansion is launched by withholding gilts (unbred females) from slaughter, but will decrease some 9 to 12 months later as the expanded numbers of pigs reach slaughter weights. The futures market is expected to offer prices that reflect that complex set of decisions by many thousands of producers.

The futures market thus discovers a price for the distant time period that gets brought into the firm's decision process as a price expectation. *That "price expecta-*

[3]In lay terms, again, this means the individual firm will sell whatever level of output they seek to sell at the industry-determined price. How much or how little the firm sells will have no impact on the price on that particular day; that is, the "price line" facing the individual producer is flat or horizontal at a particular industry-determined price. The individual producer is a price taker, not a price setter.

tion" is the expected industry-level price, discovered in the futures market, that the producer pulls down to the local market level and uses in decisions on level of production. As producers go through the decision process and employ the marginal analysis just discussed to varying degrees of sophistication, the aggregate supply of the particular crop for the U.S. is generated. Clearly, the same process is employed across all crops or products, and resources will be allocated or reallocated to the areas in which the price expectation is best given the costs of production.[4]

This discussion has used some economic jargon, and it is important that there be no confusion tied to terminology. What is being said, and what Figure 3.5 shows, is that the individual producer will respond to increased price expectations and will offer increased output at the higher prices. That pattern of responses is what generates the supply curve on the right-hand side of Figure 3.6. The response will not be the same across producers because their production programs and costs differ and because they will differ in attitudes and management abilities. Nonetheless, there is a basic consistency that spans differences in response. *Producers do have to use some type of price expectation and some type of estimate of costs to decide how much to produce, and the summation of all those decisions gives us the total quantity that will be available to the market at alternative price expectations.*

Having explained briefly how individual producers decide, it is then productive to deal with what is sometimes called the *micro–macro paradox* in production agriculture. This phenomenon is critically important to the futures market as it attempts to discover price, and brings much of the price variability to the markets. It is, therefore, important that the user of the futures markets understand what is involved.

At the "micro" level, what the individual producer does will not exert a significant influence on price. Remember, as an individual producer, you are a price taker. But the "macro" or aggregate impact, if many producers make the same adjustments, can be devastating. As was discussed in Chapter 1, it is important that the individual producer keep in mind that when soybeans look more profitable than corn, given the existing price expectations, other producers are looking at the same situation. A widespread response to the same initial set of price expectations can generate a big supply response and a major price change in the opposite direction. You need to keep this in mind. Remember: *It is the job of fundamental analysis to help identify the direction and probable range of price movement.* This possibility of an overreaction by many small producers may be tough to identify and accurately predict, but it is all part of the process. This uncertainty establishes the need for futures markets!

Before proceeding, you should again stop and review. The intent here is to simply document that producers *do* respond to price expectations. One important source

[4]The criterion

$$\frac{MVPx_{1(Y_1)}}{Px_1} = \frac{MVPx_{1(Y_2)}}{Px_1} = \frac{MVPx_{2(Y_1)}}{Px_2} = \ldots \frac{MVPx_{i(Y_j)}}{Px_i} = 1$$

allocates the i inputs to the j products so that profits are maximized to the entire firm. The symbolism *MVP* refers to the *marginal value product* of the particular input for a particular crop. If there are no capital restrictions so that all the ratios are equal to 1, then for each crop, the *MVP* (a measure of marginal revenue) is equal the cost of the input (a measure of marginal cost). This complex-looking "equation" may help you to understand how the various inputs (the X_i) are allocated across various crop possibilities (the Y_j). All it really says is that resources are allocated across alternatives such that the return to the last dollar spent in each alternative use is equal.

of price expectations is the futures market. If the distant futures quotes for corn, soybeans, hogs, cattle, and so on, are employed as price expectations, then the decision processes of the many small producers will bring an aggregate or macro response to the price expectations. Many producers have never heard of marginal revenue and marginal cost, but they all go through a similar mental process that involves revenue and cost flows as they make decisions on level of production and on redirecting their efforts and resources. All the complicated-looking developments in this chapter reveal is that at the industry-determined price or industry-determined price expectation (which can be the futures price), producers will offer a supply that varies with the efficiency and related costs of their operation. And, most important, producers *will* respond to changes in price expectations.

Table 3.3 may help drive the point home. Soybean-planted acreage has never been influenced directly by set-aside requirements in government programs. It is clear that acreage, and therefore production, tends to surge after years in which price was relatively high. Strong prices in the late 1970s brought rapid increases in acreage and the record 71.6 million acres in the 1979–80 crop year. Production nearly doubled relative to the mid-1970s. The drought-related increase in price in 1983–84 brought a rebound to 67.8 million acres in 1984–85. With prices dropping to and below the $5.00 level, acreage then trended below 60 million acres. The 1988 drought brought $7.42 prices and acreage jumped to 60.7 million acres in 1989–90, but was back below 58 million acres in 1990. The flood-ravaged crops of 1993 brought another set of adjustments, and the huge acreage (70.9 million acres) in 1997 came after near-

TABLE 3.3
Planted Acreage, Production, and Prices for Soybeans, 1975–76 to 1997–98 Crop Years

Crop Year	Planted Acreage (million acres)	Production (million bushels)	Average Farmer Price ($ per bushel)
1975–76	54.6	1,547	4.92
1976–77	50.2	1,288	6.81
1977–78	58.8	1,762	5.88
1978–79	64.4	1,870	6.66
1979–80	71.6	2,268	6.28
1980–81	70.0	1,792	7.57
1981–82	67.8	2,000	6.04
1982–83	70.9	2,190	5.69
1983–84	63.8	1,636	7.81
1984–85	67.8	1,861	5.78
1985–86	63.1	2,099	5.05
1986–87	60.4	1,940	4.78
1987–88	58.2	1,938	5.88
1988–89	58.8	1,549	7.42
1989–90	60.7	1,927	5.70
1990–91	57.8	1,926	5.74
1991–92	59.2	1,987	5.58
1992–93	59.2	2,190	5.56
1993–94	60.1	1,871	6.40
1994–95	61.7	2,517	5.48
1995–96	62.6	2,177	6.72
1996–97	64.2	2,382	7.35
1997–98	70.9	2,727	6.20–6.80*

*Estimate as of March 12, 1998.

record prices in 1995 and 1996. *In soybeans and in other crops, producers respond to the presence of higher prices and to the expectation of high prices.*

Producers must decide how much to produce, and they are assumed to act so as to maximize profits. But the behavioral reaction of individual producers is impossible to predict accurately in terms of magnitude. As a result, estimates of the total supply vary prior to and during a crop year. Add the weather and related yield uncertainty and it is clear why the prices being discovered in the futures markets will have to change and adjust during the year.

Having stressed the importance of monitoring developments on the supply side, it is important that you understand that the process is not impossible. The USDA releases supply–demand reports throughout the year. Table 3.2 lists these reports as the *World Agricultural Supply and Demand Estimates*. The reports are available by subscription, and Appendix 3A provides a broad listing of the available reports and how they can be ordered. Appendix 3A also shows an Internet address at which the reports can be accessed.

Private advisory services are available by subscription to assist the user in keeping up with developments and in interpreting what they mean. The extension services at most land grant universities offer advisory letters by mail, by electronic networks, and by satellite TV presentations.

The market news wires play a particularly important role in this process. Examples are Commodity News Service, Reuters, Globalink offered by Profession Farmers of America, and DTN. Costs range from $30 per month to $300–400 depending on the services requested. Transmissions range from FM band to satellite, which requires a small dish-type receiver.

Most of the wire services offer a survey of analysts' expectations for important USDA reports prior to the release of the reports. These surveys are especially interesting to the beginner because they help clarify what constitutes a "shock" to the markets and they also help to clarify just what constitutes new information to the futures markets. To illustrate, assume a monthly grain stocks report shows the following as a percent of the previous year:

Corn	95%
Wheat	95%
Soybeans	94%

The casual observer would then expect to see corn futures, for example, go sharply higher. After all, the stocks are down 5 percent! This is often the interpretation given by the newspapers and other media coverage. Prices are expected to increase, and talk of what it will mean to food costs to consumers is almost sure to follow. But this is all wrong and overly naive. The fact that the numbers are down is not the important point.

What matters is what the report says relative to prereport expectations. Coming into the report, the traders in corn futures are employing a base of information, a set of expectations, in terms of what the stocks are. Let's assume the prereport survey suggested that the discovered prices for corn just prior to the report were based on this set of expectations relative to year-ago numbers:

	Average	Range
Corn Stocks	92%	89.5–94.0%

After the report, the corn futures will almost assuredly trade lower, not higher. The top end of the range of estimates on the stocks (94%) relative to year-ago levels is below the report number (95%). *This report is a surprise and will be a shock to the market.* Because it was not correctly anticipated, the report has a great deal of informational value. There is a basic rule here: It is not the numbers in the reports, but the numbers relative to prereport expectations that will influence the markets.

It is important to monitor the supply side of the markets. That monitoring is not difficult given the many reports offered publicly by the USDA and by state extension services. Private advisory services also assist in this process, and an electronic market news wire is available to virtually everyone at a nominal to modest cost. The release of prereport estimates by professional analysts helps clarify why some reports elicit major price responses and some reports do not.

THE DEMAND SIDE: CROPS

The demand or "disappearance" components are also demonstrated in Table 3.1. Depending on the crop, the type of domestic usage will vary, but the export volume is always the big unknown and is the toughest component of demand to predict.

In corn, for example, the domestic feed usage is very important, but this number is not impossible to predict with reasonable accuracy. We know how many cattle, hogs, chickens, and so forth, we have on January 1, and that gives a base upon which to estimate feed usage during the year. The number of cattle on feed or the number of hogs kept for breeding can change within the year, of course, and that brings a degree of imprecision to the estimates of feed usage.

The USDA has developed models to predict feed usage of corn and total feedgrains. Decision makers can reap the benefits of those analytical efforts by monitoring the supply–demand reports that are released periodically throughout the crop year. The same reports that bring the basic supply-side information also provide estimates of the demand or usage levels throughout the year.

The export side brings much of the uncertainty. Table 3.4 records the quantity of corn, wheat, and soybeans exported since the late 1970s. It is clear that both the quantity exported and the exports as a percent of production vary considerably over time. For wheat, for example, the percentage of production that is exported has ranged from 37.7 to 78.3 percent. Within the year, much the same thing can happen. The estimates of exports within the year will vary significantly, reflecting developing crop conditions in other producing countries, changes in the level of the U.S. dollar which affects the costs of U.S.-produced grain, economic conditions in buying countries, and many other factors. In other important crops, such as soybeans and corn, the relative importance of exports varies, but export demand still tends to be the volatile component.

For all the crops, exports are often the most variable of the "disappearance" components. The level of exports varies with crop conditions in other countries, the trading level of the U.S. dollar against other curren-

TABLE 3.4
Exports, Production, Exports/Production for Corn, Wheat, and Soybeans, 1977–78 to 1997–98 Crop Years

	Exports			Production			Exports/Production		
Crop Year	Corn	Wheat	Soy	Corn	Wheat	Soy	Corn	Wheat	Soy
	(million bushels)			(million bushels)			(%)		
1977–78	1,948	1,124	700	6,425	2,036	1,762	30.3	55.2	39.7
78–79	2,133	1,194	739	7,078	1,776	1,870	30.1	67.2	39.5
79–80	2,433	1,375	875	7,939	2,134	2,268	30.6	64.4	38.6
80–81	2,355	1,514	724	6,645	2,374	1,792	35.4	63.8	40.4
81–82	1,967	1,773	929	8,202	2,799	2,000	24.0	63.3	46.5
82–83	1,870	1,509	905	8,235	2,765	2,190	22.7	54.6	41.3
83–84	1,835	1,429	740	4,166	2,420	1,567	44.0	59.0	47.2
84–85	1,865	1,424	598	7,674	2,595	1,861	24.3	54.9	32.1
85–86	1,241	915	741	8,877	2,425	2,099	14.0	37.7	35.3
86–87	1,504	1,004	757	8,250	2,092	1,940	18.2	48.0	39.0
87–88	1,725	1,592	785	7,064	2,105	1,905	24.1	75.8	41.4
88–89	1,650	1,450	550	4,352	1,810	1,472	41.1	78.3	34.0
89–90	2,275	1,300	590	7,527	2,036	1,927	30.2	63.9	30.6
90–91	1,725	1,068	557	7,934	2,736	1,926	21.7	39.0	28.9
91–92	1,584	1,280	684	7,475	1,981	1,987	21.2	64.6	34.4
92–93	1,663	1,354	770	9,477	2,467	2,190	17.5	54.9	35.2
93–94	1,328	1,228	589	6,336	2,396	1,871	21.0	51.3	31.5
94–95	2,177	1,188	838	10,103	2,321	2,517	21.5	51.2	33.3
95–96	2,228	1,241	851	7,374	2,183	2,177	30.2	56.8	39.1
96–97	1,795	1,001	882	9,293	2,285	2,382	19.3	43.8	37.0
*97–98	1,625	1,075	950	9,366	2,527	2,727	17.3	42.5	34.8

*Estimate as of March 12, 1998.

cies, the presence or absence of government programs to subsidize exports, and other sources of uncertainty. The uncertainty on the demand side adds to the uncertainty on the supply side and makes efforts to discover the correct equilibrium or market-clearing prices for future time periods difficult.

ENDING STOCKS

The *ending stocks* figure is perhaps the single most important entry in the supply–demand tables. It measures the surplus or leftover stocks that must be carried forward to the next crop year.

Figures 3.7, 3.8, and 3.9 show plots of prices and ending stocks as a percent of total usage for the same crop year for corn, wheat, and soybeans. An algebraic function has been fitted to the data through the 1997–98 crop year. This simple approach becomes a useful framework in generating an initial estimate of what the price level for the upcoming crop year will be. The procedures involved in fitting the functions are presented in Appendix 3B to this chapter, and the algebraic models for each crop

FIGURE 3.7
Corn Price versus Ending Stocks as Percent of Use, 1975–1998

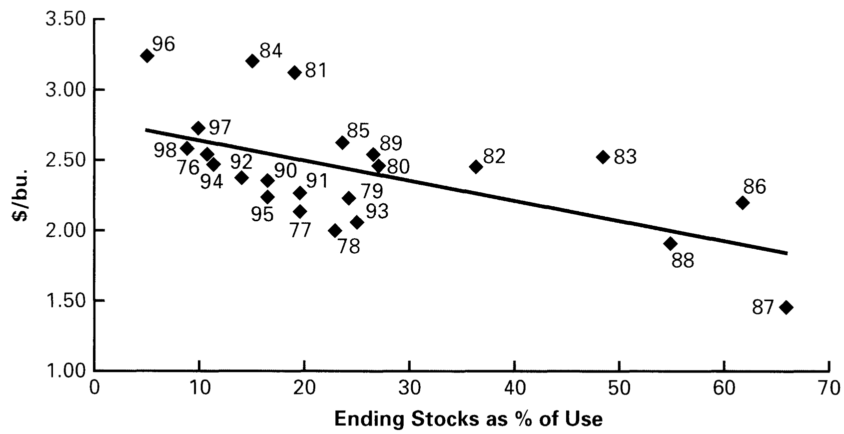


FIGURE 3.8
Wheat Price versus Ending Stocks as Percent of Use, 1975–1998

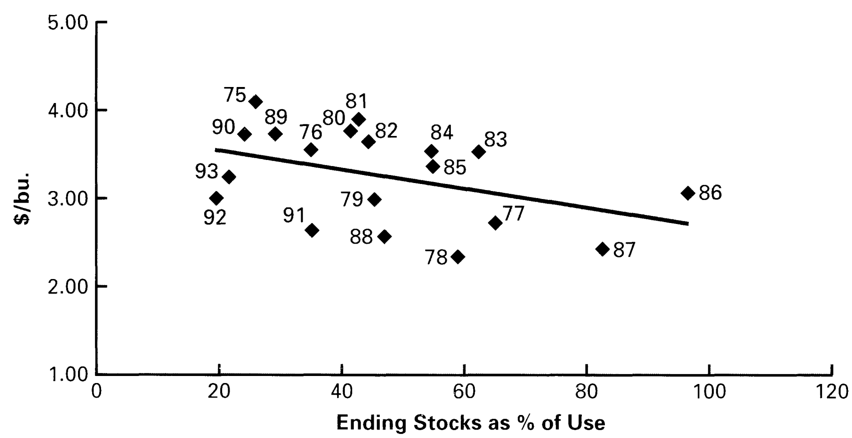
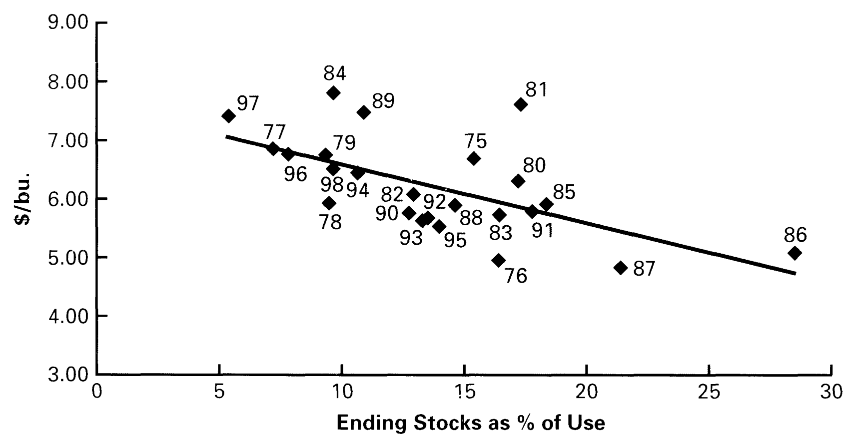


FIGURE 3.9
Soybean Price versus Ending Stocks as Percent of Use, 1975–1998



are also provided. Added detail on how the algebraic models can be used most effectively is also included. If you would prefer not to deal with the math you need not worry—there are simplistic approaches that will still be very effective; they will be discussed in this section.

As estimates of *total usage and ending stocks* are generated during the crop year, and prior to the planting season, it is possible to generate an initial estimate of price for the year. Using corn to illustrate, the steps are as follows:

1. Calculate ending stocks as a percent of usage and locate the point on the horizontal axis.
2. Move vertically up to the fitted curve, and then extend a horizontal line to the vertical axis.
3. Read off an estimate of the price on the vertical axis given the fitted relationship between price and ending stocks as a percent of usage.

One possible modification of steps 1 to 3 is to *force* the line to go through the point for the most recent complete crop year. In other words, just sketch a curve parallel to the fitted line and *draw it through the observation for the most recent complete crop year*. Then, use the estimates of ending stocks as a percent of use for the current year and generate an estimate of price from your new curve. This modification is demonstrated in detail in the appendix using the algebraic functions, and essentially shifts the curve to make sure it "fits" the most recent observation. Over time, it will be important to continue reestimating the curve to make sure it is representative of recent years. This is especially important when the relationship between price and ending stocks as a percent of use appears to be changing as is the case in recent years.

The result is a useful beginning estimate of the average price for the year, and it offers important perspective to the decision maker. It makes little sense, for example, to sit and wait for a chance to forward-price corn at $3.50 if your initial estimate suggests an average price for the crop year of $2.60. Sure, there can be and will be lots of variation around your initial estimate over time, *but the approach gives you a good idea of the general price level that will be observed during the year if no major shocks to the information base, especially to the crop production estimates, emerge.*

To the user of the futures, this ability to formulate an educated estimate of probable price levels is important. Consider the corn producer, to illustrate, who is trying during March to decide (1) whether to hedge corn, and (2) how much to hedge as the December corn futures approach contract highs in the mid-$2.60s. The producer works through the price-ending stocks either graphically or using the algebraic equation (see Appendix 3B) and generates a producer-level average cash price for the crop year of $2.70. There is now a reason to expect higher futures prices since the cash-futures basis at harvest is negative in the producing areas, and that expectation can be brought into the hedging decision. Clearly, such basic fundamental analysis is important to an effective hedging program.

A moment's reflection shows why the ending stock figures are so important. They are the residual after accounting for total supply and all the components that make up total demand or usage. In the context of Figure 3.2, the relationship between ending stocks and price attempts to capture the impact of estimates of both supply and demand and to generate a price estimate from an approach that is simple and easy to use.

There is no attempt here to reproduce the analytical developments that are provided in detail in books focusing on agricultural price analysis or elementary econometrics. Rather, the approach is to identify the key issues and discuss how they have impact. The USDA's sophisticated analytical models are used to develop the estimates in each supply–demand report, and these reports provide the information base that drives the futures markets. The appendices provide detail on how to get the reports, and references on analytical procedures are shown at the end of the chapter. The simple two-dimensional graphs are very revealing and will help you generate a useful forecast of price, a forecast that can be updated during the year as the USDA periodically releases supply–demand reports.

Analysis of the relationship between ending stocks and price attempts to capture the impact of estimates of both supply and demand. During the year, as estimates of supply and demand are changed, the ending-stocks framework can be used to generate updated estimates of average price for the year. This simple procedure helps to determine the probable direction of price movement on a year-to-year basis, and helps to establish a price range within which price variations are likely to occur. It provides important input to the user of the futures markets.

THE SUPPLY SIDE: LIVESTOCK

In the livestock sector, supply for the year is directly related to the inventory at the beginning of the year. Within the year, the supply response is limited to what can be changed within the time framework of one year.

Table 3.5 shows January 1 inventory numbers for all cattle and the beef cow herd. Figure 3.10 provides a scatter plot of beef production against the inventory numbers from the table, the "total cattle" numbers.

The relationship in Figure 3.10 is not perfect, but there *is* a positive relationship. Deviations from the linear relationship that has been fitted to the data occur primarily due to cyclical developments, percentage of cattle being fed, and changes in cattle type. During 1973–75, the herd was being expanded by holding back heifers. Consequently, production was less in those years relative to the January 1 inventories, and

FIGURE 3.10
Cattle Inventory Numbers and Beef Production, 1960–1997

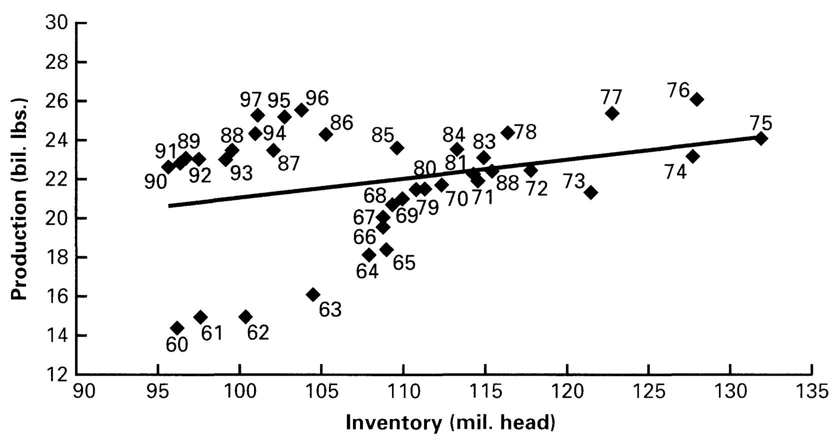


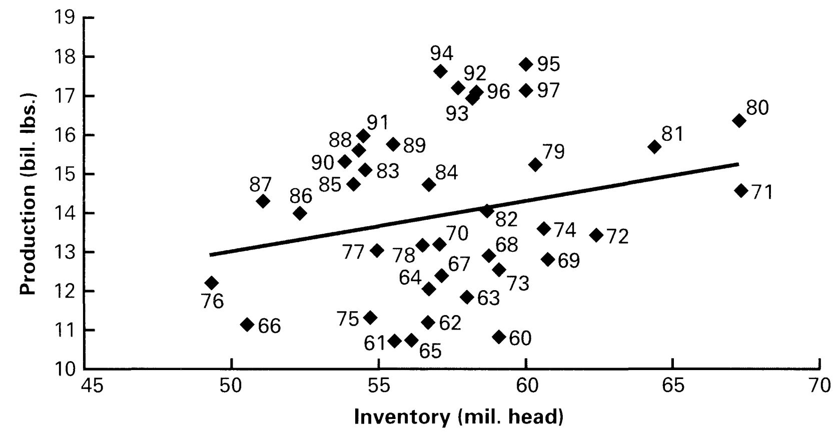
TABLE 3.5
Total Cattle Inventory and the Beef Cow Herd, U.S., 1950–1998

Year	Total Cattle Numbers	Beef Cow Herd
	(1,000 head)	
1950	77,963	16,743
1955	95,592	25,659
1960	96,236	26,344
1965	109,000	34,238
1970	112,369	36,689
1971	114,578	37,878
1972	117,862	38,810
1973	121,539	40,932
1974	127,788	43,182
1975	132,028	45,712
1976	127,980	43,901
1977	122,810	41,443
1978	116,375	38,738
1979	110,864	37,062
1980	111,242	37,107
1981	114,351	38,773
1982	115,444	39,230
1983	115,001	37,940
1984	113,360	37,494
1985	109,582	35,393
1986	105,378	33,633
1987	102,118	33,945
1988	99,622	33,183
1989	96,740	32,488
1990	95,816	32,454
1991	96,393	32,520
1992	97,556	33,007
1993	99,176	33,365
1994	100,988	34,650
1995	102,775	35,156
1996	103,487	35,228
1997	101,460	34,271
1998	99,501	33,683

the estimate of production, generated by the algebraic model fitted to the data, will be too large. Deviations on the other side of the expectations occur when the herd was still being liquidated in the 1985–87 period and a high percentage of the cattle were being fed. Also, the increased use of crossbreeding programs with the larger breeds has increased production per head. The model that was fitted to the data is shown in Appendix 3B, but there is no need to get deeply involved in the mathematics. *The need is to recognize that the January 1 inventory will be a major factor in determining beef production for the year.*

The same approach can be employed in hogs, sheep, and poultry. What is brought into the year will set the stage for production within the year. Figure 3.11 shows a scatter plot between December 1 inventories and commercial production during the following calendar year for the pork sector. When the breeding herd is being expanded as it was in the early 1970s, production looks unusually low. When the herd is being liquidated as it was in 1984 through 1987, production looks unusually high. It is also

FIGURE 3.11
December 1 (of Previous Year) Hog Numbers and Pork Production, 1960–1997



apparent that production for a given herd size is increasing in recent years, reflecting the increase in pigs per sow and the increases in production efficiency. Some well-managed programs are now producing well over 20 slaughter hogs per sow per year. Over two litters per year are being produced on average, and the average litter size and number of pigs saved are both increasing. Compare the points for 1979 and 1988, for example. Production levels in the two years are comparable, but the inventory for 1979 was 60 million head compared to approximately 54 million head for 1988. Production increases in recent years are more modest but are still recognizable.

> **Beginning inventories for the year will be an important determinant of production in the year. In recent years, production levels for a given cattle or hog inventory are being increased by technological advances in production and by more effective management.**

Seasonal Patterns: Cattle

Within the year, there can be significant variations in production tied to producers' decisions. In cattle, the key is the number of cattle placed on feed.

FIGURE 3.12
Beef Production as a Function of January 1 Cattle-on-Feed Numbers, 1970–1997

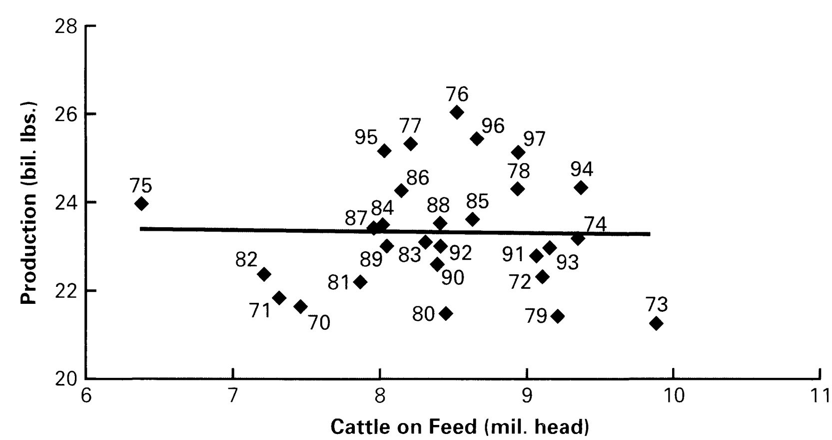


TABLE 3.6
Content and Format of April 1997 Monthly 7-State* Cattle-on-Feed Report

	Number			1997 as % of	
	1995	1996	1997	1995	1996
	(1,000 head)			(percent)	
On feed, Mar. 1	8,227	8,152	8,769	107	108
Placed on feed during Mar.	1,681	1,666	1,694	101	102
Fed cattle marketed during Mar.	1,513	1,476	1,497	99	101
Other disappearance during Mar.	67	56	62	93	111
On feed, Apr. 1	8,328	8,286	8,904	107	107
Number on feed by class, Apr. 1					
Steers and steer calves	5,530	5,375	5,417	98	101
Heifers and heifer calves	2,762	2,877	3,431	124	119
Cows and bulls	36	34	56	156	165
Number on feed by weight groups, Mar. 1**					
Less than 600 lbs.		262	321		
600–699 lbs.		544	538		
700–799 lbs.		772	721		
800 Plus		370	386		
Total		1,948	1,966		

*The 7 states include AZ, CA, CO, IA, KS, NE, and TX; all numbers are 1,000+ capacity feedlots.
**All states, 1,000+ capacity feedlots.
Source: *Cattle on Feed*, USDA-NASS, April 1997.

Steers and heifers coming out of the feedlots produce carcasses with heavier weights than cow or nonfed slaughter of other types. Figure 3.12 shows a scatter plot of the relationship between the number of cattle on feed on January 1 and beef production. The statistically weak and negative relationship is a bit surprising at first glance, but it essentially confirms the significant increase in production per head in recent years. The high levels of production in 1976–78 reflect the rapid rate of herd liquidation during that period. In the 1979–1981 period, there was a short-lived turn to herd building, and the decreased slaughter of cows and nonfed heifers pulls production below expected levels compared to the fitted relationship.

Table 3.6 shows the format for the 7-state monthly cattle on feed report. The reports are closely watched and widely employed by traders in live cattle and feeder cattle futures.

A 13-state report historically provided information on the number of cattle on feed by weight groupings.[5] By applying an average daily gain of 2.5 to 3.5 pounds per day, depending on cattle type and the season of the year, it was possible to project how many fed cattle would be coming to market in a future quarter or even a future month. The USDA provides frequent estimates of beef production for future calendar quarters in its *Livestock, Dairy, and Poultry Situation and Outlook Report.* Relatively sophisticated analytical models are employed in the forecasts and decision makers can take

[5]In the early 1990s, the weight groupings were dropped from the 13-state reports. Responding to industry concerns, weight groups were later reinstated and are now shown in the monthly 7-state report, which covers feedlots above 1,000-head capacity.

advantage of that expertise by subscribing to the reports. Estimates of production are released periodically to electronic market news services for immediate access by decision makers, eliminating the time lag involved in waiting on the written reports. Decision makers can thus take advantage of the USDA's publicly available forecasts and need not try to do the projections personally unless there is a reason to believe more accurate estimates can be generated.

Table 3.7 shows beef production for 32 recent quarters compared to the USDA estimate from two quarters earlier. The estimates are reasonably accurate with a tendency to underestimate production. It is possible that the USDA models have not yet captured the increased production per head from a genetically improved herd in recent years.

The large errors can often be explained, and those explanations will help to drive home the importance of the micro-macro paradox in production agriculture and of information shocks to the market. Clearly, a reason is needed when the models miss by as much as 5 to 7 percent. A micro–macro trap is set for you when this happens, and you need to be alert to it.

In 1989, cattle feeders were very optimistic on prices in the first quarter. Prices started to decline, and the feedlots held the cattle, waiting for prices to recover. Average slaughter weights started to climb dramatically. Corn costs were going down, making it cheaper to continue feeding the cattle. By the end of the second quarter and into the third quarter, the overfed cattle had to be sold, and beef production jumped. Prices of choice steers on the Omaha market declined sharply relative to expectations, and the USDA estimated cattle being sold in the early summer months were losing over $100 per head. *The macro or aggregate impact of individual decisions to hold the cattle for a hoped-for price recovery was devastating.*

In early 1996, a major drought was prompting accelerated slaughter of cattle in Texas, and corn prices were increasing rapidly on the way to record highs in the summer months. Production surged early in the year, but by the fourth quarter, actual production was 5.19 percent below USDA forecasts. The record corn prices and the early-year weak selling prices for cattle prompted cattle feeders to cut back on production plans. When forecasting only two quarters into the future, it is difficult to correctly anticipate all these risk factors.

After the slaughter numbers are projected using the inventory and cattle-on-feed data, average weights become very important. Traders monitor these data daily, and market news and market information systems record daily average weights in some live cattle markets and report average slaughter weights.

Changes in weights become very important determinants of price for a number of reasons. Obviously, a significant increase in average weights increases the tonnage of beef, and that moves the short-run supply curve for the beef sector to the right. If the own-price demand elasticity for beef is around –0.65,[6] suggesting an elasticity for live cattle at the producer level of around –0.5, each 1 percent increase in tonnage will cause a 2 percent decrease in cattle prices, other factors being equal. But the impact on the distribution of grades for cattle coming out of the feedlot and the desirability of the cattle is perhaps even more important than the price pressure from the increased tonnage.

[6]Kuo S. Hang and Richard C. Haidacher, "An Assessment of Price and Income Effects on Changes in Meat Consumption," in Reuben C. Buse, ed., *The Economics of Demand*, University of Wisconsin, October 1989.

TABLE 3.7
USDA Beef Production Forecasts for Two Quarters in the Future Compared to Actual Production, 1989–1996

Quarter (Year)	Actual Beef Production	USDA Prediction	Prediction Error	Percent Prediction Error
	(million lbs.)		(lbs.)	(%)
1 (1989)	5,529	5,475	–54	–0.98%
2	5,777	5,400	–377	–6.53%
3	5,892	5,475	–417	–7.08%
4	5,775	5,500	–275	–4.76%
1 (1990)	5,508	5,450	–58	–1.05%
2	5,736	5,775	39	0.68%
3	5,823	6,050	227	3.90%
4	5,567	5,675	108	1.94%
1 (1991)	5,385	5,500	115	2.14%
2	5,693	5,725	32	0.56%
3	6,013	6,000	–13	–0.22%
4	5,709	5,775	66	1.16%
1 (1992)	5,597	5,450	–147	–2.63%
2	5,726	5,900	174	3.04%
3	5,991	6,100	109	1.82%
4	5,654	5,725	71	1.26%
1 (1993)	5,357	5,500	143	2.67%
2	5,690	5,825	135	2.37%
3	6,076	6,125	49	0.81%
4	5,819	5,800	–19	–0.33%
1 (1994)	5,745	5,675	–70	–1.22%
2	6,042	5,925	–117	–1.94%
3	6,377	6,225	–152	–2.38%
4	6,114	5,900	–214	–3.50%
1 (1995)	5,877	5,950	73	1.24%
2	6,312	6,100	–212	–3.36%
3	6,602	6,400	–202	–3.06%
4	6,252	6,225	–27	–0.43%
1 (1996)	6,303	6,125	–178	–2.82%
2	6,642	6,425	–217	–3.27%
3	6,390	6,700	310	4.85%
4	6,084	6,400	316	5.19%

When cattle get held in the feedlots for longer than normal periods for any reason, an increased percentage starts to move into the yield grade 4 category.[7] Estimates of the difference in weight of lean cuts range up to the USDA's 4.6 percent difference per yield grade, but the price impact can sometimes be much greater than even the 4.6 percent differentials would suggest.

[7]The yield grades for cattle range from 1 to 5 with yield grade 1 showing the highest ratio of lean cuts to total carcass weight, grade 5 the lowest. Over 95 percent of cattle coming from the feedlots fall in the 2–4 range, with yield grade 3 having become the "par" grade or norm in cash market trade in cattle. Yield grade 4 cattle face sharp price discounts.

The market for yield grade 4 cattle is narrow, and the demand appears to be very inelastic. Any significant increase in yield grade 4 cattle in the flow of cattle to market can drive the price for yield grade 4 carcasses sharply lower. Prices for yield 4 Choice carcasses have dropped as much as $20 per hundredweight below the price of yield grade 3 Choice carcasses. That $20 difference clearly exceeds the estimated differences due to different yields of lean cuts.

Employed as a visible indicator that cattle are "backing up" in the feedlots, a surge in the percent of yield 4 cattle strengthens the packers' bargaining position. They know that the cattle are getting too heavy in the lots, that feed conversion efficiency starts to deteriorate rapidly as the cattle get heavy, and that feedlots will be forced to sell the cattle within a matter of days. Since they keep a close watch on the showlists of cattle at all the major feedlots, the packer buyers know when they are in the driver's seat, and they will attempt to take advantage of the situation by buying as low as possible and improving their profit margins.

The period from quarter 4 of 1984 through quarter 3 of 1985 provides an excellent case study. Table 3.8 records average weights plus carcass and live cattle prices by months during the period. The live prices are for Choice slaughter steers at Omaha, and the carcass prices are for yield grade 3 Choice steer carcasses in the central U.S. market area. Total beef production is also shown, so it is easy to recognize a price impact over and above what we would have expected due solely to a change in production. There is a combination of increased supply, a shift in the balance of market power to the packer related to the overfed cattle, and a move to a "bearish" sentiment that feeds on itself as the prices dip lower.

The dramatic price reactions shown in Table 3.8 appear to be inconsistent with the basic supply–demand framework, but they are not. That framework has to be extended to include the behavioral dimension of the markets. *This type of reaction (typically an overreaction) generates transaction prices in the extremes of the price distribution shown back in Figure 3.2 and extends the price range within which transactions are seen to occur.* From the viewpoint of the trader in futures, especially the hedger, it is important to get the price moves prompted by a short-run holdback of cattle (or other short-run shocks to the supply side) in proper perspective.

The moves *are* typically short-run in nature, and the moves do often tend to run too far before correcting back to some intermediate price level. Decision makers must guard against getting caught up in the emotion of the markets on supply-prompted moves in price that are destined to be short-run in nature. The biggest mistake, and the one commonly seen, is to panic and set short hedges on the cattle, or whatever is experiencing the price dip, down near the low prices. The futures market will correct at least part of the price move. During 1985, the cash market improved dramatically during October as the average weights started to stabilize and eventually moved back toward normal. In most instances, the futures market will anticipate the stabilization, and the futures market will start its correction before the cash prices start to improve. In 1985, the futures markets moved sharply higher during September, anticipating the improved situation prior to the better cash prices in October.

The 1985 experience was largely repeated in 1994. Choice slaughter steer prices were above $75 in March, but were down to the $63 level by June. Average steer slaughter weights increased by 4 percent during the period, pushing an unusually large percentage of the choice cattle into the yield grade 4 category. The USDA estimated losses to cattle feeders ranging from $11.67 to $16.66 per hundredweight during May to October of 1994—up to $180 per head or more for 1100-lb steers. This was a case of the *micro–macro trap* at its worst.

TABLE 3.8 Average Weights, Prices for Choice Steers and Choice Carcass Beef, November 1984–October 1985

Month	Carcass Weights (year earlier) (lbs.)	Total Production (year earlier) (million lbs.)	Average Price ($ per cwt.) Live	Average Price ($ per cwt.) Carcass
November 1984	718 (720)	1924 (1935)	64.29	99.08
December 1984	712 (703)	1830 (1965)	65.32	101.22
January 1985	707 (689)	2066 (1914)	64.35	99.50
February 1985	710 (691)	1768 (1859)	62.80	97.42
March 1985	728 (693)	1858 (1937)	58.58	89.52
April 1985	724 (689)	1936 (1776)	58.72	89.20
May 1985	728 (693)	2089 (2060)	58.58	89.52
June 1985	728 (694)	1898 (1984)	56.69	88.48
July 1985	728 (694)	2059 (1936)	53.26	82.22
August 1985	734 (698)	2123 (2112)	51.94	80.02
September 1985	739 (698)	1985 (1904)	51.94	80.02
October 1985	739 (712)	2108 (2182)	58.02	91.11

Source: *Livestock and Poultry: Situation and Outlook Report*, ERS, USDA.

What we saw in 1985 and again in 1994 is not unusual in the livestock markets. Each producer or cattle feeder is too small to exert influence on price, but the same reaction by many producers can and will move the price. We have a micro–macro paradox, a *micro–macro trap*, paralleling that covered earlier for the crops and in the discussion of the USDA beef production statistics in which the individual firms (micro level) get hurt by the aggregate (macro level) actions of their peers. *Since no obvious way exists to eliminate the possibility of such developments, it is important to try to ease their influence.* You should try to counter the tendency to follow the crowd, and industry leaders and analysts should keep constant reminders in front of producers that the feedlots must stay current and not get caught holding the cattle. And, of course, the futures markets are available to the hedger to get protection against just such a catastrophic development.[8]

Seasonal price patterns in cattle emerge from forage-based production programs that tend to focus sales in the fall months and from increases or decreases in placements of cattle on feed. Cattle-on-feed reports are available to subscribers and the USDA incorporates the impact of the cattle-on-feed reports in its estimates of quarterly beef production. There is significant potential for price variation within the year and for given levels of January inventories, and potential hedgers must stay informed and be aware of developing changes in the supply–demand balance. You must be aware of the micro–macro trap.

[8]It is interesting to think about the impact of hedging during such periods. If the cattle that are ready to be sold during the price break are hedged, the seller is interested primarily in the performance of the basis and not the absolute level of either cash or futures prices. It would therefore be easy to build an argument that having a larger percentage of the cattle hedged would help to guard against holding cattle to excessive weights. There is no strong incentive to hold the cattle and hope the price will come back up if they are hedged.

Seasonal Patterns: Hogs

The supply side on hogs is more difficult for most market analysts to handle than for cattle. Dramatic price moves after the release of quarterly *Hogs and Pigs* reports by the USDA are the norm rather than the exception. Both cash and futures prices frequently show major price reactions to the reports. The futures market is particularly vulnerable since it is often discovering prices for a future time period using a base of information that turns out to be in error when the reports are released. It is important to remember that the reports are often the surprises to the market that cause major price adjustments.

There are two possible and related reasons for the large postreport price moves. First, the futures market could be performing poorly in its assigned task of price discovery and not be "efficient." Second, the information base being employed by the futures market could be deficient in some important respect.

The concept of market efficiency and the way it gets measured will not be covered in detail here. The article by Purcell and Hudson, listed at the end of the chapter, discusses the concept and provides additional references for the reader who wishes to pursue this interesting issue.

In very simple terms, the market is considered efficient if all the publicly available information on supply and demand is being incorporated and registered in the discovered price. The hypothesis to be tested usually revolves around the notion that since the information tends to hit the market in a random fashion, the efficient market will generate a price path such that day-to-day price changes are independent of each other.

Day-to-day changes in price following the release of *Hogs and Pigs* reports are often *not* independent but are highly correlated. The futures market sometimes has to move to a new price plane that requires a $4- to $5-per-hundredweight total change to fully reflect the new information. A series of *related* day-to-day price changes will be necessary to complete the needed price adjustment. The *limit moves* on the lean hog futures ($2 per hundredweight from the previous day's close) dictate that several days will be required to make such an adjustment.

The June 1997 lean hog futures demonstrates (Figure 3.13). The close on December 27, 1996 was $75.22. After the close, the report showed little of the widely anticipated expansion—and expectations of supply for mid-1997 had to be adjusted. The closes for the next two days were $77.22 and $79.22, respectively, and surely the limit-up move to $77.22 the day after the report was related to the subsequent limit-up move to $79.22! *This is a most uncertain market.*

The problem is both the frequency and content of publicly released reports dealing with the hog sector. A typical quarterly report is shown in Table 3.9. Total numbers, hogs kept for breeding, market hogs, farrowings, and farrowing intentions are provided. The market hog category is divided into weight groupings, but most analysts consider the accuracy of the weight groupings a bit suspect. The major categories have a sampling error of at least 2–3 percent in either direction, and the sampling error in the weight groupings may be even larger.

There are always some analysts and market observers who question the accuracy of the reports, but there is no doubt that the hog futures market responds to the reports. Prior to the release of the report, the major market news services conduct a survey of a number of market analysts and release an average and a range of the prerelease estimates. *It is not unusual to see the actual numbers in the Hogs and Pigs reports fall completely outside the range of estimates, and that type of surprising*

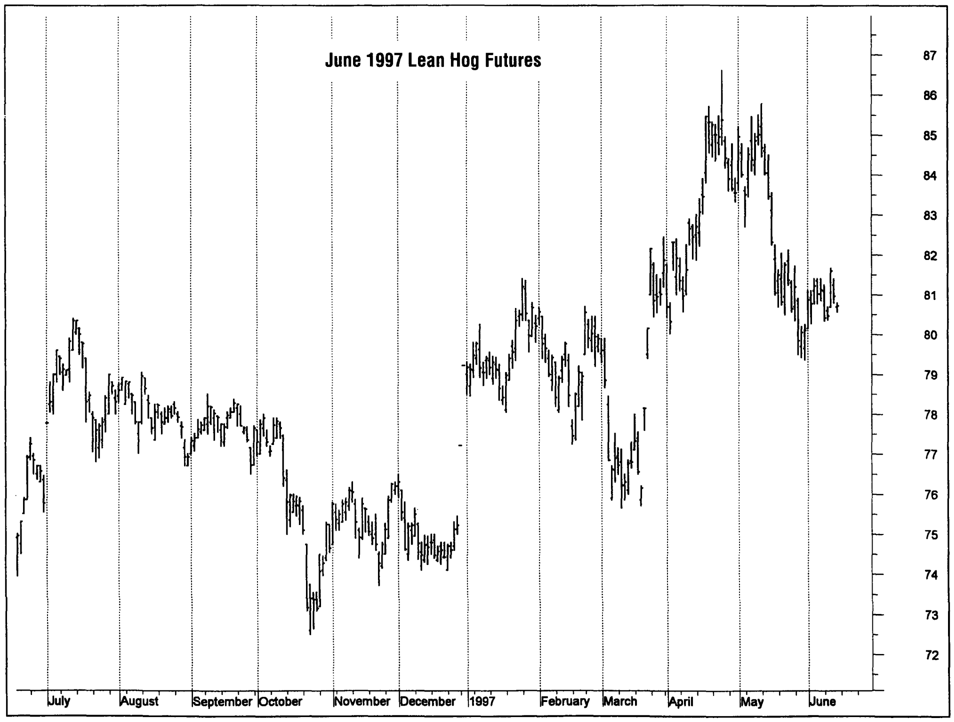


FIGURE 3.13
Futures Chart for June 1997 Lean Hogs

report will always elicit a major price adjustment. The quarterly reports are the primary supply-side information base used by the market in the price-discovery process, and no publicly or privately released information provides a useful alternative or more detailed information.

Abstracting from the question of the accuracy of the reports, the major concerns are the frequency of the releases and the detail provided. The bulk of the slaughter volume in hogs is barrows and gilts, but the slaughter data are not disaggregated into barrows and gilts. The difficulty, then, is being able to track what is happening in the breeding herd. The only indication of female slaughter is sow slaughter, and this data series can be influenced by producer holding of gilts for breeding and for herd expansion. If sow slaughter increases, to illustrate the problem, is it due to a net liquidation of the herd or is it merely replacing aging sows with gilts to renovate the herd? If gilts are being retained at a rate exceeding the normal replacement requirements, ***herd expansion can be occurring during periods in which sow slaughter appears to be high*** as a percent of total slaughter.

Figure 3.14 relates sow slaughter to the breeding herd with a two-quarter time lag across a recent time period. That is, the breeding herd (in the December–February quarter, for example) is a function of sow slaughter as a percent of total slaughter two quarters earlier, (the June–August quarter, for example). There is clearly substantial variability in the relationship, suggesting that analysts will in fact have problems projecting the breeding herd when we do not know what is happening to gilt slaughter and, related, whether gilts are being retained for the breeding herd. Any attempt to model the relationship shown in Figure 3.14 would give very poor results. The relationship appears to be essentially random.

TABLE 3.9
Content and Format of the December 1996 Hogs and Pigs Report

	1994	1995	1996	1996 as % of 1994	1996 as % of 1995
		(1,000 head)		(percent)	
March 1 inventory					
All hogs and pigs	57,350	58,465	56,340	98	96
Kept for breeding	7,210	6,998	6,765	94	97
Market	50,140	51,467	49,575	99	96
Market hogs and pigs					
Under 60 pounds	18,780	19,251	18,790	100	98
60–119 pounds	12,190	12,498	11,980	98	96
120–179 pounds	10,430	10,594	10,095	97	95
180 pounds and over	8,740	9,124	8,710	100	95
June 1 inventory					
All hogs and pigs	60,715	59,560	57,200	94	96
Kept for breeding	7,565	7,180	6,870	91	96
Market	53,150	52,380	50,330	95	96
Market hogs and pigs					
Under 60 pounds	22,125	21,270	20,265	92	95
60–119 pounds	13,145	13,060	12,700	97	97
120–179 pounds	9,825	9,865	9,800	100	99
180 pounds and over	8,055	8,185	7,565	94	92
September 1 inventory					
All hogs and pigs	62,320	60,540	58,200	93	96
Kept for breeding	7,415	6,898	6,770	91	98
Market	54,905	53,642	51,430	94	96
Market hogs and pigs					
Under 60 pounds	20,790	20,235	19,330	93	96
60–119 pounds	13,960	13,532	12,800	92	95
120–179 pounds	11,170	10,985	10,600	95	96
180 pounds and over	8,985	8,890	8,700	97	98
December 1 inventory					
All hogs and pigs	59,990	58,264	56,171	94	96
Kept for breeding	7,060	6,839	6,663	94	97
Market	52,930	51,425	49,507	94	96
Market hogs and pigs					
Under 60 pounds	19,556	18,881	18,411	94	98
60–119 pounds	13,087	12,808	12,239	94	96
120–179 pounds	10,941	10,702	10,313	94	96
180 pounds and over	9,346	9,034	8,544	91	95

Source: *Hogs and Pigs*, NASS, USDA, December 27, 1996.

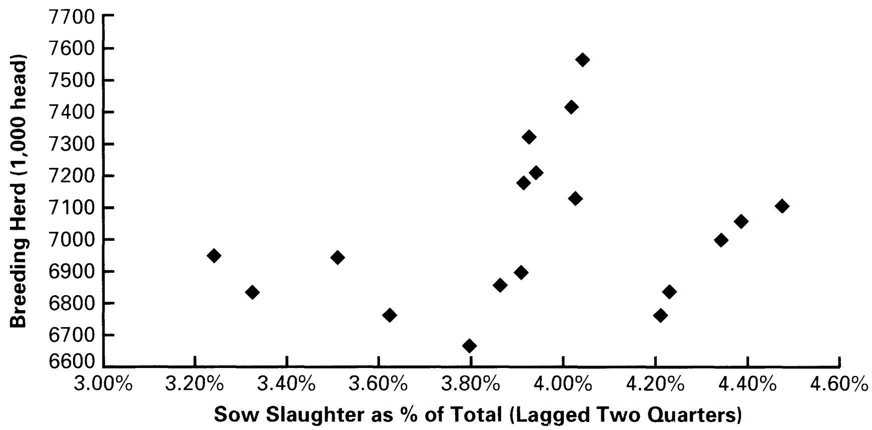


FIGURE 3.14
Breeding Herd as a Function of Sow Slaughter/Total Lagged Two Quarters

If you accept the essence of this discussion, you have to conclude that more information is needed. The immediate question is: Why is this information not provided? Information will be collected when its marginal return (*MR*) is greater than the marginal cost (*MC*) of collecting the data. It appears that neither the public sector (USDA) nor the private sector (brokerage firms, advisory services) feels the *MR* of either more frequent reports or more detailed data in the current quarterly reports exceeds the *MC* of the added information. If we look at the often dramatic moves following release of the quarterly reports, it is difficult to argue that the *MR* is low. Volatile changes in supply and the extreme price changes that come with them are costly not only to producers and to potential investors, but also to society in the form of variable product supplies and variable prices. But the information base is not improving, and there is an important message for you here: It is difficult to predict accurately the supply of hogs that will be available to the market in a future time period given available data. The live hog futures market will have difficulty discovering the correct price because of the lack of information, and will continue to be characterized by major postreport adjustments in price.

In this area, the user of the futures markets will need to prepare for a volatile market. The USDA provides quarterly predictions of pork production, per capita consumption, and prices in its *Livestock, Dairy, and Poultry Situation and Outlook* reports. But they will have some of the same difficulties private analysts experience, and the percentage errors in their predictions tend to be larger than those shown earlier for beef. In terms of impact on strategies, the supply-side problem in hogs suggests the hedger should be aggressive in taking profitable prices whenever the futures market offers them.

Supply fluctuations in hogs can be significant within the year. With only quarterly reports to track producers' decisions on herd expansion or contraction, the supply of hogs in quarters 3 and 4 can be influenced by decisions in quarters 1 and 2, and these decisions are very difficult to anticipate correctly. It appears the often volatile price moves in the live hog futures markets after the release of the quarterly reports could be due to a limited information base, and are not necessarily evidence of inefficiencies in the futures markets.

FIGURE 3.15
Typical Downward-Sloping Demand Curve

THE DEMAND SIDE: LIVESTOCK AND POULTRY

In dealing with the supply issues for livestock, poultry was not included. The poultry industry is vertically integrated with no obvious exposure to market-determined prices. The level of price-risk exposure has not justified trade in broiler or other poultry-related futures contracts in recent years. On the demand side, however, poultry is a major competitor for market share with pork and beef and must be included.

Technically, demand is a schedule of the quantities that will be taken by consumers at alternative prices. In the livestock and meats, there has been much confusion and misunderstanding about what demand is and is not, and what constitutes a change in demand.

Figure 3.15 illustrates a typical downward-sloping demand curve. Any price–quantity combination that falls on the curve is on the same level of demand. It is only when the entire curve (the entire schedule) changes that demand has changed. Per capita supply, and therefore per capita consumption, can change significantly but that does not mean demand has changed. It is consistent with the law of demand discussed in most beginning economics texts that consumers, at any point in time, will take an increase in supply only at lower prices. *To draw conclusions about what has happened to the level of demand we have to look at both quantity and price.* Scatter plots for beef, pork, and broilers illustrate the issue.

Figure 3.16 shows deflated prices of Choice beef at retail plotted against per capita consumption. The years are identified in the body of the figure. The prices are deflated using the Consumer Price Index (CPI, 1982–84 = 100) to remove the influence of overall price inflation and to allow legitimate year-to-year comparisons.[9]

[9]The price series is divided by the CPI to remove the influence of overall price inflation. This process of "deflating" the price series converts them to a common denominator in dollar terms and ensures that year-to-year price comparisons are not being distorted by overall price inflation.

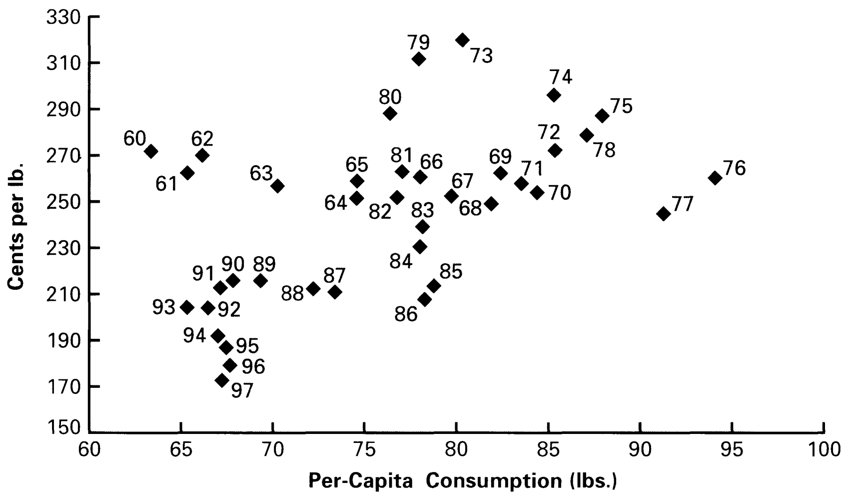


FIGURE 3.16
Per Capita Consumption and Deflated Retail Prices for Beef (CPI, 1982–84=100), 1960–1997

It is easy to find year-to-year changes that suggest demand was increasing. From 1971 to 1972, for example, an increased per capita quantity was taken at significant increases in the inflation-adjusted price. That change indicates demand has increased. We do not know why demand increased, but it is clear that 1972 was on a higher level of demand than was the case in 1971. You should visualize negatively sloping demand curves similar to that shown in Figure 3.16 through each of the points for 1971 and 1972. The price–quantity coordinate for 1972 cannot be on a negatively sloping demand curve that passed through the price–quantity coordinate for 1971.

This type of simple analysis proves very revealing. If we start with 1979, a most negative pattern starts to emerge for beef. Each year, from 1979 through 1986, a reduction in the inflation-adjusted price was required to move essentially a constant per capita supply into consumption. From 1979 through 1986, *a price reduction of over 30 percent in inflation-adjusted prices was required to keep the consumer at the beef counter to buy and consume a largely constant per capita quantity.*

Earlier, in Table 3.5, the total U.S. cattle herd was presented. From 1975 through January 1 of 1990, there was a net liquidation of over 32 million head. It is clear at this point that the liquidation could have been forced at least in part by decreases in demand for beef. *The decision maker trying to anticipate prices for beef and make intelligent use of the futures markets must take the possibility of significant changes in demand into account.*

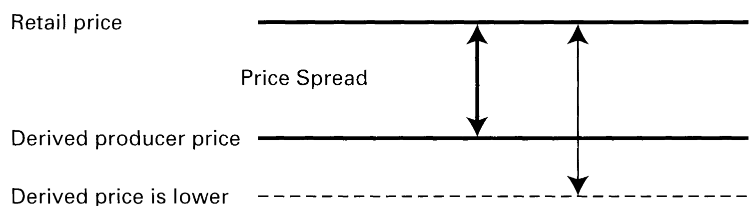
The essence of the problem is revealed in Table 3.10. Inflation-adjusted (Deflated Retail Price) prices for Choice beef at retail decreased significantly during the 1980s, and the nominal (Retail Price) price was not able to increase during that period.[10] The consumer simply would not pay higher prices. With middleman margins expanding during the period by over 25 percent, the result was severe pressure on calf and stocker

[10]The term *nominal* is used to refer to price, income, or other economic series before they are adjusted for the influence of general price inflation. As implied earlier, the term *deflated* (sometimes called "real") is used to refer to price or income series that have been adjusted for general price inflation.

cattle prices at the producer level. Prices were simply too low to keep the cattle herc intact, and many producers and resources were forced to exit the industry. From 197 through 1990, the U.S. beef cow herd dropped from 45.7 million head to 33.1 millior head (Table 3.5). The average cow herd in the U.S. is less than 50 head. Using 50 heac for illustrative purposes, the liquidation of 12.6 million beef cows involves the equiva lent of 252,000 producers of average size being forced out of business.

What happened in the industry is a vivid demonstration of derived demand a work. The demand for cattle, the original input or raw material, is derived from th demand at retail. The price for cattle is, accordingly, a derived price.

The concept is important and is worthy of further explanation. In Table 3.10, th nominal prices from 1979 through 1986 were relatively constant. The range was $2.2 to $2.42. For illustrative purposes, assume the retail price *was* constant. During th period, the price spread or margin between the producer and the retailer increase over 20 percent as the packers' and processors' costs went up with overall price infl tion. The derived price at the producer level had to go down. The situation can b demonstrated as follows:



As the price spread expanded, with a largely constant retail price, the produce level price had to go down (to the dashed line) unless the packer/processor sect increased efficiencies enough to offset the pressures. The increased efficiencies durin the period were not enough to eliminate all the pressure at the producer level, and the derived prices were forced lower, producers were forced out of business. Steer ca prices that had averaged $93.10 per hundredweight in Kansas City in 1979 were in th high $60s during 1982–85 and averaged $69.67 in 1986, and were pushed periodical below $50 during the record-high corn prices in 1996. Budgets show the average tot cost of producing calves is $85 to $95 per hundredweight for the typical producer.

It appears the situation started to stabilize in the early 1990s. We could argu from an examination of Figure 3.16, that the 1993 price–quantity coordinate is ne the demand curve that passed through the 1995 price-quantity coordinate. The 19 and 1997 data suggest the level of demand decreased again, however. It may take se eral years for the long-term problems to disappear and the demand side of the pri equation to start to look more positive. *During the past 15 years, the demand si has been a major cause of price moves to the downside, and it will not suffice f the hedger or the speculator to look only at the supply numbers and implicit assume demand is constant.*

This latter point is extremely important. Prior to the 1980s, "price analysis" in t cattle markets was heavily supply-side oriented. Changes in cattle on feed and pr jected supply changes were converted to price changes, with the implicit assumpti that demand was constant. But changing lifestyles and related changes in preferen patterns changed all that in the 1980s. Trying to just count the supply-side numbe during the 1980s and trade accordingly was difficult for speculators, and the failure account for decreases in demand left many would-be short hedgers on the sidelines and hurting financially. Techniques for analyzing short-run changes in demand will

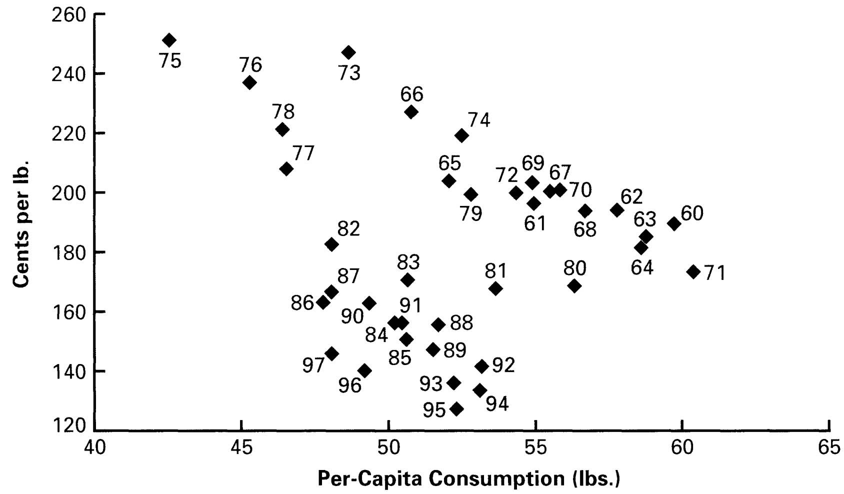
Year	Per Capita Consumption	Retail Price	Deflated Retail Price
	(lbs.)	(cents/lb.)	
1960	63.3	80.2	270.9
1961	65.4	78.4	262.2
1962	66.1	81.7	269.6
1963	70.2	78.5	256.5
1964	74.7	77.8	251.0
1965	74.6	81.4	258.4
1966	78.1	84.6	260.3
1967	79.8	84.1	251.8
1968	82.0	86.6	248.9
1969	82.5	96.2	262.1
1970	84.4	98.6	254.1
1971	83.7	104.3	257.5
1972	85.5	113.8	272.2
1973	80.5	142.1	320.0
1974	85.4	146.3	296.8
1975	88.0	154.8	287.7
1976	94.2	148.2	260.5
1977	91.4	148.4	244.9
1978	87.2	181.9	279.0
1979	78.0	226.3	311.7
1980	76.4	237.6	288.3
1981	77.1	238.7	262.6
1982	76.8	242.5	251.3
1983	78.2	238.1	239.1
1984	78.1	239.6	231.3
1985	78.8	228.6	212.7
1986	78.4	226.8	206.9
1987	73.4	238.4	209.9
1988	72.3	250.3	211.6
1989	69.3	265.7	214.3
1990	67.8	281.0	214.5
1991	67.2	288.3	212.0
1992	66.4	284.6	203.3
1993	65.4	293.4	203.1
1994	67.0	282.9	190.9
1995	67.4	284.3	186.6
1996	67.6	279.6	178.2
1997	67.2	280.0	174.5

TABLE 3.10
Per Capita Consumption and Price of Choice Beef at Retail, Actual and Deflated (CPI, 1982–84 = 100), 1970–1997

presented later in the chapter and emphasized. *It could be forcefully argued that the dominant shortcoming of the ability of the futures market to discover the correct prices for cattle quickly and efficiently in the 1980s and 1990s was the inability to recognize and account for decreases in demand.*

Figure 3.17 provides a scatter plot for pork. The pattern for pork suggests problems starting in 1980, but the 1987 coordinate looked positive compared to 1986. Note the increase in per capita supplies moving at a significantly higher inflation-adjusted price in 1987 compared to 1986. Demand appears to have increased in 1988 before faltering again in 1989. The 1990s has been largely a period of consoli-

FIGURE 3.17
Per Capita Consumption and Deflated Retail Prices for Pork (CPI, 1982–84=100), 1960–1997



dation, with no compelling evidence to date that demand for pork has started tc increase.

To illustrate the importance to producers, let's look at the 1986–88 period. Pe: capita supplies of pork were up 1.0 percent in 1987 compared to 1986. Using a retai level demand elasticity of –0.67, that would suggest the inflation-adjusted price: would be down 1.5 percent. But pork prices were actually up 2.0 percent. If the mid dlemen's margins were constant, that swing from a 1.5 percent decrease to a 2.0 pei cent increase in pork prices would make a big difference in derived hog prices. Price: at the producer level fluctuate more in percentage terms than the changes at retail, s(hog prices in 1987 were 5–6 percent higher than they would have been if demand ha(been constant. Instead of averaging $50.88 at Omaha, the price would have beei $48.46. For a 240-pound slaughter hog, that translates to $5.81 per hog—and a big dil ference for producers.

The other side of the coin is present. Per capita consumption of pork for 199(and 1996 was essentially constant, but inflation adjusted prices were 162.3 and 140.: for 1990 and 1996, a 13.6 percent decline. Overall, demand is decreasing in th 1990s, and the obvious demand problems are an important reason why slaughter ho; prices dipped below $30 in the fourth quarter of 1994 and were back down to th $30 level in the first quarter of 1998. (It *is* true that much of the price weakness i1 early 1998 can be traced to the supply side with pork production running 12 percen above 1997 levels.)

Any problems may have been less dramatic in pork than in beef, but they *wer and are* important. Table 3.11 provides data paralleling that for beef in Table 3.1C Retail prices were under pressure, and the pressure was relieved primarily in the forr of lower prices for hogs to producers prior to 1987. Many producers, especially thos that were smaller and less efficient, were driven out of business. At the national leve hog numbers recorded a post-1970 peak at 67.3 million head in 1979, dropped to 50.: million in 1986, were at 53.8 million head on December 1, 1989, and stood at 59.9 mi lion on December 1, 1997. Supply–demand dynamics are always important in price received by producers.

The plot for broilers in Figure 3.18 is revealing. Prior to the early 1980s, cos reducing technology allowed the industry to offer more product at lower and lowe

TABLE 3.11
Per-Capita Consumption and Price of Pork at Retail, Actual and Deflated (CPI, 1982–84 = 100), 1970–1997

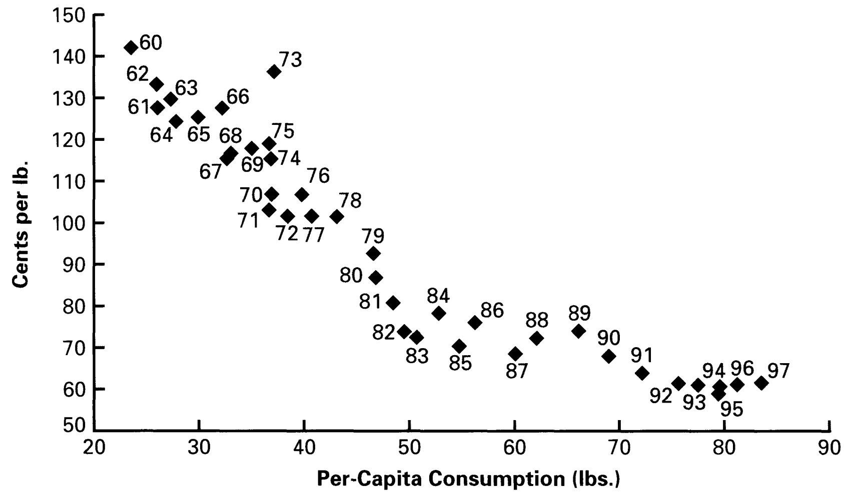
Year	Per-Capita Consumption (lbs.)	Retail Price	Deflated Retail Price
		(cents/lb.)	
1970	55.9	78.0	201.0
1971	60.4	70.3	173.6
1972	54.4	83.2	199.0
1973	48.7	109.2	245.9
1974	52.6	107.8	218.7
1975	42.6	134.6	250.2
1976	45.3	134.0	235.5
1977	46.6	125.4	206.9
1978	46.4	143.6	220.2
1979	52.9	144.1	198.5
1980	56.4	139.4	169.2
1981	53.7	152.4	167.7
1982	48.1	175.4	181.8
1983	50.7	169.8	170.5
1984	50.3	162.0	156.4
1985	50.7	162.0	150.7
1986	47.8	178.4	162.8
1987	48.1	188.4	165.8
1988	51.7	183.4	155.0
1989	51.6	182.9	147.5
1990	49.4	212.6	162.3
1991	50.5	211.9	155.8
1992	53.2	198.0	141.4
1993	52.3	197.6	136.8
1994	53.2	198.0	133.6
1995	52.4	194.8	127.8
1996	49.2	220.0	140.2
1997	48.0	231.5	144.2

inflation-adjusted prices. But during the 1980s, and paralleling what were apparently preference-related problems in red meats, the demand for broilers started to increase. There is clear indication of increases in demand from 1983 to 1984, from 1985 to 1986, and again from 1987 to 1988 and from 1988 to 1989. Note the ability to sell increased per capita supplies at higher inflation-adjusted prices. It appears that during the 1980s, poultry was starting to be seen in a more positive light by consumers. Further processing and new product development may have been the primary catalysts. Since 1989, the pattern has been one of increased per capita supplies at roughly constant deflated prices.

The result has been a larger market share for poultry as per capita supplies and therefore per capita consumption have continued to increase. Figure 3.19 provides a plot of per capita consumption for beef, pork, and broilers through 1997.

The surging acceptance of poultry by consumers in the 1980s and 1990s brought new competition for beef and pork. At a minimum, anyone using the cattle and hog futures must keep an eye on developments in poultry. If that sector is expecting a 10 percent increase in production, there will be some pressure on poultry prices in spite

FIGURE 3.18
Per Capita Consumption and Deflated Retail Prices for Broilers (CPI, 1982–84=100), 1960–1997



of strong demand and lower poultry prices will decrease demand for pork and beef. The USDA offers production and price projections for broilers and turkeys in the *Livestock, Dairy, and Poultry Situation and Outlook* reports.

Demand for both beef and pork declined significantly during the 1980s and 1990s. Lower derived prices at the producer level forced producers out of business, especially in beef. Across the same time period, the demand for broilers was stable to increasing. The longer run result of the developments in demand has been an increased market share for broilers versus beef and pork. When demand is not stable, analysis of shifts in demand must be incorporated in the fundamental analysis of the markets.

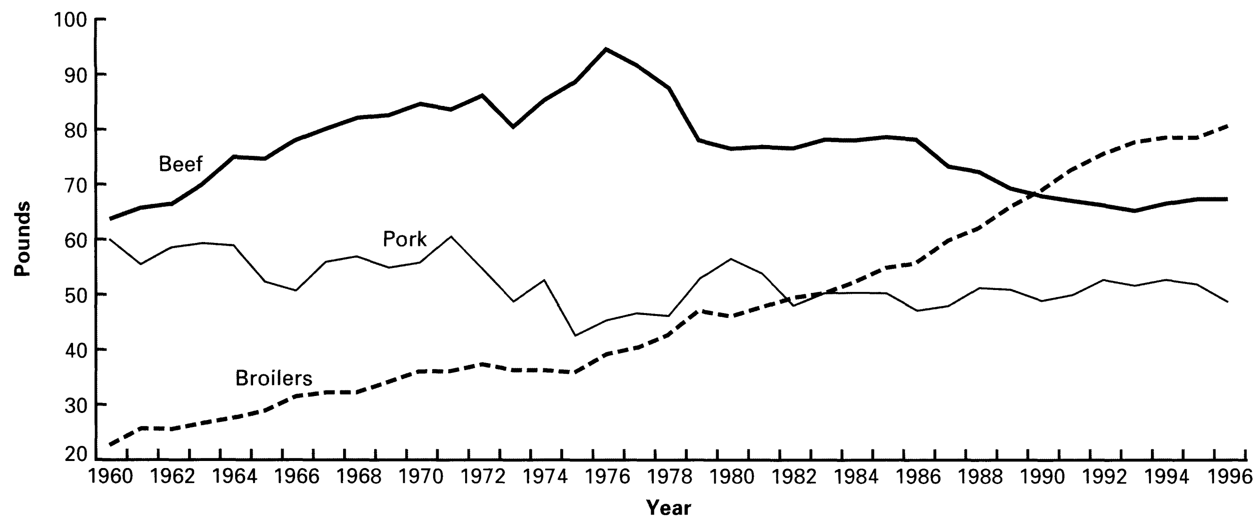


FIGURE 3.19
Per Capita Consumption of Beef, Pork, and Broilers, 1960–1997

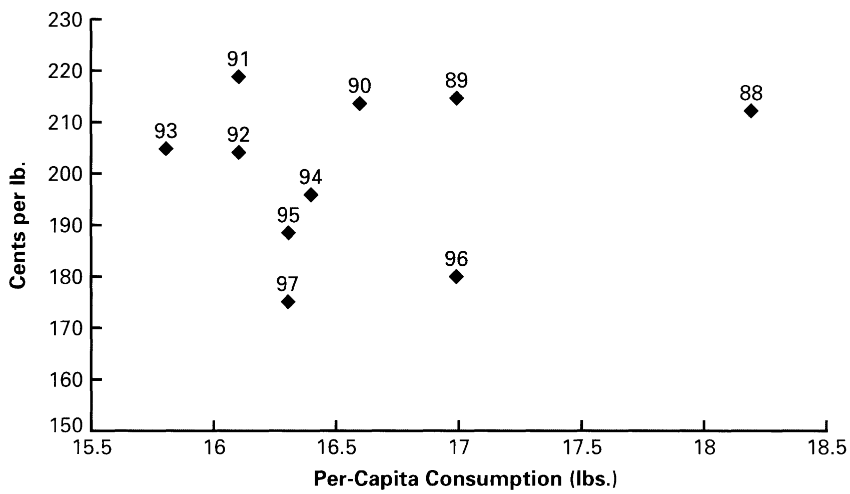


FIGURE 3.20
Quarter 4 Retail Deflated Beef Price (1982–84=100), Per-Capita Consumption, 1988–1997

MONITORING SHORT-RUN DEMAND

Obviously, demand for meats changed during the 1980s. To document changes in demand is not sufficient to estimate the importance of all this to the futures markets and to marketing strategies, however. Recognizing the relevancy of demand analysis should be no problem. What is happening on the demand side is critical. The futures trader, whether a hedger or a speculator, needs a way to get a short-term look at the underlying demand surface. Figure 3.20 offers one approach.

To remove the seasonality from the data, quarterly price-quantity combinations for the same quarter are plotted for the last 10 years. The pattern in recent years for Choice beef looks much like the yearly plots, but that is not surprising.

As a quarter approaches, it is useful to plug in the current retail price, estimate the per capita supply (remember that the USDA projects quarterly supplies *and* per capita consumption in its *Livestock, Dairy, and Poultry Situation and Outlook* reports), extrapolate the current level of inflation in the CPI index, deflate the retail price, and plot the price–quantity coordinate that emerges for the upcoming quarter with the data from recent years. Once a price estimate is generated, the retail price can be reinflated, and estimated farm-to-retail price spreads can be used to generate a live animal price.

An estimate of cattle, hog, or broiler prices generated using such a procedure is a current and useful place to start as a pricing strategy is laid out. As an example, *it makes little sense to sit and wait on a cattle price that would require the retail price series to move to new highs, the price spreads to move to record small levels, or some combination of the two.* Keep in mind that the function of the fundamental analysis is to discover the general price level that should emerge and to identify the probable direction of year-to-year price changes. And keep in mind that the USDA and many private consulting firms provide projections that are based on sophisticated modeling techniques. What we are doing here is making sure you understand the basic economic relationships that are involved and what the USDA and other entities are attempting to model. We need an idea of price direction for the upcoming production or decision period.

A second and widely used approach to monitoring short-run demand employs the concept of demand elasticity, introduced earlier, in a more substantive way. Demand elasticity provides a simple and convenient but very powerful analytical framework to measure changes from year to year or from one quarter to the next. To illustrate its application in determining what is happening to demand, let's use a coefficient of –0.67 and generate the expected year-to-year price change in retail beef prices from quarter 2 of 1996 to quarter 2 of 1997. Beef production changed from 6.642 billion pounds in 1996 to a projected 6.450 billion pounds in 1997, a decrease of 2.8 percent. Plugging this change into the elasticity framework, the expected price for quarter 2 of 1997 can be generated as follows:

$$-0.67 = \frac{-0.028}{X} \quad X = \text{Price Change} = \frac{-0.028}{-0.67} = 0.042$$

Price for quarter 2 of 1997 would be expected to be up 4.2 percent from quarter 2 of 1996 *if the level of demand in 1997 was the same as in 1996*. Since elasticity is a *property* of a demand curve, the framework estimates the price change in response to a given or predicted quantity change, assuming that the level of demand is constant, and assuming therefore that the demand curve has not shifted. The arithmetic would suggest a price of \$2.89 for quarter 2 of 1997, up from \$2.77 in quarter 2 of 1996.

In application then, the elasticity framework can be used in several ways. It is used here to get an initial impression of whether the level of demand appears to be changing. In the example, the price of Choice beef at retail was \$2.77 for quarter 2 of 1996. If the level of demand had been the same, the price in quarter 2 of 1997 should have been \$2.89 (1.042 × \$2.77). The price for quarter 2 of 1997 was actually \$2.79, suggesting that the level of demand during late 1997 was down compared to the level of demand in late 1996. *This is very valuable information*. This information can then be factored into the outlook for early 1997, and the process can be repeated over time to give useful indications of what is happening to the level of demand. *In recent years, the demand for beef and pork have changed enough to make the demand side an important determinant of price levels and of short-term price changes.*

You should be aware that inflation-adjusted or deflated prices are usually employed in the elasticity framework. When the time period is quite brief, such as a quarter-to-quarter or even a year-to-year change, as we show here, using the nominal or observed retail prices would give useful results unless the rate of overall price inflation is unusually high.

Procedurally, the USDA's forecast of beef production for the next quarter can be used to calculate a quarter-to-quarter percentage change. That percentage change is then used in the elasticity framework (coefficient = –0.67) to predict the next quarterly price. For example, the USDA estimated beef production in quarter 2 of 1997 at 6.419 billion pounds. Assume they are forecasting that production in quarter 3 will be up to 6.595 billion pounds given the number of cattle scheduled to come out of the feedlots. This is a 2.75 percent increase. To calculate the expected change in price, use

$$-0.67 = \frac{-0.0275}{X} \quad X = -0.0410$$

where X is the expected change in price from quarter 2, 1997, to quarter 3, 1997. This result can be applied to the quarter 2 price to predict a quarter 3 price. Errors, especially if price predictions are consistently too high, suggest:

1. The impact of declining retail-level demand,
2. The reluctance of retailers to change beef prices in the short run until they are sure some significant change in the supply demand picture has changed, and
3. The elasticity framework will be more effective on year-to-year changes when the time period is long enough to get over retailers' resistance to price changes and for all the supply-side changes to work their way through the system.

Remember, the elasticity framework assumes demand is constant. *When the framework consistently overpredicts price, that is indirect evidence that demand is in fact declining. There is, therefore, much information to be gleaned from the analysis.*

If the framework is used directly at the live animal level, research results show the demand elasticity coefficient to be around –0.5 for hogs and for cattle. If pork production, for example, is projected to be up 8 percent in 1997 compared to 1996, prices for live hogs would be expected to be down a whopping 16 percent! *Clearly, this type of information is useful to the decision maker in establishing a price range within which hog or cattle futures might be expected to trade during coming time periods and in determining the likely direction of price trends during the future time period.*

A few restrictions deserve emphasis.

1. The elasticity coefficients used here are consistent with research results, but elasticity coefficients can change over time.
2. The elasticity framework assumes the level of demand is constant and examines the price implications of a change in supply or a move along the demand curve. If price estimates are higher or lower than those observed, that departure may be evidence that the level of demand has shifted, but you will not necessarily know *why* demand has changed. The short-run analysis of beef prices, for example, suggested demand for beef was declining but it did not reveal why the demand problems were present.

Short-run analysis of demand can be conducted by direct application of the demand elasticity framework. This approach can be very useful in establishing the general price level around which prices would be expected to develop during future time periods and in identifying the probable direction of period-to-period price changes.

SUMMARY

Price is established over time by the interaction of supply and demand. *Fundamental analysis*, involving analysis of the interactions of supply and demand forces, is important to help determine the probable direction of price trends and to provide an idea of the general range within which price will be discovered in the cash and futures markets.

Commodity futures prices are discovered within a supply–demand framework. The observed variability in those prices occurs because information on the levels of supply and demand is imperfect and is subjected to analysis with varying degrees of sophistication.

The supply–demand reports that are released by the USDA for grains, oilseeds, cotton, and other commodities are important in monitoring the fundamental supply–demand picture during the year. Discovered prices change as the estimates of the components of supply or the components of demand change due to changes in crop conditions in the U.S. or around the world and due to macroeconomic changes such as changes in the trading level of the U.S. dollar. The relationship between price and ending stocks, the residual component of the supply–demand table, is *an especially useful place to start in anticipating overall price patterns for the coming crop year*. The data and the projections of supply and demand components are provided by the USDA, and you need only interpret these data and add relatively simple graphical analyses to generate useful price projections.

In livestock, the beginning inventory levels will exert a major influence on probable price levels for the year. Within the year, supply can be adjusted to varying degrees across beef, pork, and poultry, but will not depart in a dramatic way from the general level set by the beginning inventories. Publicly available reports allow the decision maker to monitor possible intrayear changes in supply.

In cattle, the *cattle-on-feed reports* are important indicators of possible changes in intrayear beef supplies. In hogs, the quarterly *hogs and pigs reports* are essentially the only source of information, and some analysts would argue they are both too infrequent and lacking in detail. The USDA employs the cattle and hog data to project estimates of beef and pork production and the *Livestock, Dairy, and Poultry Situation and Outlook* reports are available by subscription.

Across recent years, changes in demand for beef and pork appear to have been increasingly important influences on prices. The evidence suggests significant decreases in demand for the red meats, especially beef from 1979 or 1980 to date. During the same period, there were periodic increases in the demand for poultry. Those *changes in demand appear to have prompted significant changes in inventories and related changes in production* for red meats and poultry. The *demand elasticity framework* provides a useful analytical approach to estimating period-to-period changes and in determining whether the level of demand has changed. If there is evidence that the level of demand is changing, that information can be integrated into the decision process in terms of probable price departures from the price generated from the elasticity framework.

High levels of sophistication and detailed quantitative analysis are not necessary for you to be able to conduct effective fundamental analysis. The need is for recognition and understanding of the supply–demand forces at work in the marketplace. *If the direction of changes in the balance of supply and demand and therefore direction of price during the coming production period or decision period can be accurately anticipated, the individual decision maker has a big advantage in developing an effective hedging plan.*

KEY POINTS

- *Fundamental and technical analysis* of the markets can be *complementary*.
- The *price-discovery process* generates highly variable prices over time because the information base on supply–demand levels is *imprecise* and is subjected to interpretation that *varies in the level of sophistication.*
- The *World Agricultural Supply and Demand Estimates* are the most important periodic releases on supply and demand information for the grains, oilseeds, and other storable commodities.

- The *ending stocks* are perhaps the *most important single entry* in the supply–demand reports for the grains and oilseeds. The relationship between *price* and *ending stocks* is a simple but powerful framework for *generating estimates of expected price levels*.
- In livestock, the *beginning inventories* set the *general supply* for the year. Unless *demand* changes significantly within the year, the general price level will be directly related to beginning inventories.
- Supplies of beef and pork can and do *vary within the year* due to *short-run supply responses* by producers as the number of livestock placed on feed varies. *Changing weights* of cattle and hogs can also be important determinants of intrayear price levels.
- Periodic estimates and forecasts of production, prices, and per capita consumption of meats are released in the USDA's *Livestock, Dairy, and Poultry Situation and Outlook* reports. These reports are *available to individual decision makers* and assist in establishing a price outlook and a price range.
- During the 1980s and 1990s, significant *decreases in demand* for the *red meats* were a primary force in industry changes toward smaller inventories and smaller levels of total production. The market share for poultry increased during the period as per capita supplies of the red meats, especially beef, declined.
- The *demand elasticity framework* is very useful in *predicting period-to-period price changes* and in *determining whether the level of demand has changed*.
- The need is for *understanding* of the *basic forces of supply and demand* and the related ability to *anticipate the direction of price trends*. Highly sophisticated quantitative analysis is not essential.

USEFUL REFERENCES

Jack D. Schwager, *Fundamental Analysis*, John Wiley and Sons, New York, 1997. A massive 639-page effort that explores fundamental analysis in detail.

Dale C. Dahl and Jerome W. Hammond, *Market and Price Analysis: The Agricultural Industries*, McGraw-Hill, New York, 1977. This is one of several very useful references on price analysis for agricultural commodities.

Wayne D. Purcell and Michael A. Hudson, "The Economic Roles and Implications of Trade in Livestock Futures," in Anne Peck, ed., *Futures Markets: Regulatory Issues*, American Enterprise Institutes for Public Policy Research, Washington, D.C., 1985. The authors discuss the price-discovery functions of livestock futures and deal with the issue of inadequate information in the livestock futures markets.

Walter Spilka, Jr., "The USDA Crop and Livestock Information System" in *Handbook of Futures Markets: Commodity, Financial, Stock Index, and Options,* Perry J. Kaufman, ed., John Wiley and Sons, New York, 1991. This reference describes the types of reports released by the USDA and explains the nature and use of the data in the reports. It will be a very useful reference for the beginner who seeks to explore fundamental analysis of commodity prices.

APPENDIX 3A. USDA INFORMATION SERVICES

Presented in this appendix is a list of some reports and periodicals that are available from the USDA Economic Research Service (ERS) and National Agricultural Statistics Service (NASS). Some reports are briefly described and subscription information is provided. The following are ERS Research and Analysis reports:

Agricultural Outlook. ERS subscription. 10 issues. Stock #ERS-AGO. $50.00. Main source for USDA's farm and food price forecasts; short-term outlook for all major areas of the agricultural economy; long-term issue analyses of US agricultural policy, trade forecasts, export-market development, food safety, the environment, farm financial institutions. Includes data on individual commodities, the general economy, US farm trade, farm income, production expenses, input use, prices received and paid, per-capita food consumption, etc.

Farm Business Economics Report. Annual report. 236 pp. September 1997. Stock # ECI-1996. $21.00.

Combines the information from three former separate publications of the series Economic Indicators of the Farm Sector: 1) National Financial Summary, 2) State Financial Summary, and 3) Costs of Production, Major Field Crops and Livestock and Dairy. Includes national and state farm income estimates, farm sector balance sheet, government payments, farm sector debt, and costs of production by commodity. The farm sector remained financially strong in 1995, even though farm sector income was lower than in 1994. NOTE: This publication was formerly called *Economic Indicators of the Farm Sector.*

Foreign Agricultural Trade of the United States (FATUS)/U.S. Agricultural Trade Update. 1998 subscription includes 12 issues of Agricultural Trade Update, plus two annual FATUS supplements. Stock #ERS-FAT. $41.00. Updates the quantity and value of U.S. farm exports and imports, plus price trends. Concise articles analyze specific aspects of the export/import picture. Keeps readers abreast of how U.S. trade stacks up in a global market.

FoodReview. Subscription. 3 issues. Stock # ERS-NFR. $21.00. Featuring the latest data and analyses, FoodReview explores the rapidly changing U.S. food system. Trends in food consumption, food assistance, nutrition, food product development, food safety, and food product trade are analyzed in depth for those who manage, monitor, or depend on the food system. Also includes key indicators of the food sector and updates on Federal policies and programs affecting food.

Rural Development Perspectives. Subscription. 3 issues. Stock # ERS-RDP. $19.00. Non-technical articles on the results of new rural research and what those results mean. Shows the practical application of research in rural banking, aging, housing, the non-metro labor force, poverty, and the effect of farm policies on rural areas. Besides feature articles, each issue also brings you: Rural Indicators—geographic snapshots of trends affecting rural communities; Book Reviews—critical appraisals to keep you abreast of new thinking and theories on rural and small town topics; and Announcements—brief summaries of newly published research on rural areas.

ERS-NASS Products and Services Catalog. This free catalog describes the latest in ERS research reports. It is designed to help you keep up to date in all areas related to food, the farm, the rural economy, foreign trade, and the environment.

Following is a list of ERS *Situation and Outlook* reports and their stock numbers and prices:

Title/number of issues	Stock #	Price
Agricultural Income & Finance (4)	AIS	$27.00
Agriculture & Trade Regionals (4)	WRS	$34.00
Fruit & Tree Nuts (3)	FTS	$27.00
Outlook for U.S. Agricultural Exports (4)	AES	$24.00
Livestock, Dairy, Poultry Outlook (6)	LDP-M	$32.00
Aquaculture (2)	LDP-AQS	$21.00
Sugar & Sweetener (2)	SSS	$22.00
Tobacco (2)	TBS	$22.00
Vegetables and Specialties (3)	VGS	$27.00

This is a list of NASS Statistical Data, stock numbers, and prices:

Title/number of issues	Stock #	Price
Agricultural Chemical Usage (3)	PCU	$35.00
Agricultural Prices (12)	PAP	$61.00
Broiler Hatchery (54)	PBH	$98.00
Catfish Processing (16)	PCF	$43.00
Cattle (14)	PCT	$36.00
Chickens and Eggs (15)	PEC	$45.00
Cold Storage (14)	PCS	$45.00
Cotton Ginnings (14)	PCG	$45.00
Crop Production (17)	PCP	$61.00
Crop Progress (36)	PCR	$74.00
Dairy Products (13)	PDP	$41.00
Egg Products (12)	PEP	$36.00
Farm Labor (4)	PFL	$24.00
Grain Stocks (4)	PGS	$24.00
Hogs and Pigs (4)	PHP	$24.00
Hop Stocks (2)	PHS	$20.00
Livestock Slaughter (13)	PLS	$45.00
Milk Production (13)	PMP	$33.00
Noncitrus Fruits & Nuts (2)	PNF	$24.00
Peanut Stocks & Processing (12)	PPS	$36.00
Potatoes (7)	PPO	$29.00
Poultry Slaughter (12)	PPY	$36.00
Rice Stocks (4)	PRS	$24.00
Sheep and Goats (5)	PGG	$27.00
Turkey Hatchery (16)	PTH	$36.00
Vegetables (6)	PVG	$28.00

Also available from the World Agricultural Outlook Board (WAOB) is *World Agricultural Supply and Demand Estimates*, 12 issues for $40, stock number WASDE. This can be ordered through ERS as well.

The *ERS-NASS Products and Services Catalog* is a valuable source of information about all products and services offered by the USDA and is free of charge.

ERS Ordering Information:

By Phone:	1-800-999-6779
By Fax:	(703) 321-8547
By Mail:	5285 Port Royal Road
	Springfield, VA 22161

Some reports and periodicals are available on the Internet. Cornell University's Mann Library offers many USDA reports at the following site:

http://www.mannlib.cornell.edu/usda/

Other reports and periodicals as well as electronic data may be downloaded from either the ERS website:

http://www.econ.ag.gov/

the NASS website:

http://www.usda.gov/nass/

or the World Agricultural Outlook Board website:

http://www.usda.gov/oce/waob/waob.htm

Private services are, of course, available on a fee basis. The list would include Professional Farmers of America, Top Farmer, Brock and Associates, Doanes, the Helming Group, Sparks Commodities, and others. Services and costs vary. Many will advertise in

Futures Magazine
P. O. Box 850765
Braintree, MA 02185-9801
1-888-898-5514
Fax: 1-781-848-6450
($39.00 per year)

APPENDIX 3B. MODELS AND APPLICATIONS

A brief explanation of procedure and the fitted algebraic models for the various figures in this chapter are presented in this appendix. In some instances, you may find it more convenient to use the algebraic models than to use the graphs directly. An example would be the price-ending stocks relationships presented in Figures 3.7, 3.8, and 3.9. The application, use, and interpretation of the model results are shown for corn, soybeans, and wheat. This appendix will be most valuable to the reader with some prior exposure to simple statistical models. It is presented as a supplement and is not essential to the succeeding chapters for readers with no statistical background.

Figures 3.7, 3.8, and 3.9

Algebraic models were fitted to the date plotted in Figures 3.7 through 3.9. In each case, a negative relationship exists between price and ending stocks as a percent of total use for the same crop year. Such a relationship would be expected. When stocks are small relative to usage or needs, price will tend to increase to ration usage.

It is also apparent that there is considerable variability around the curves. This too would be expected. A model that expresses price as a function of a measure of ending stocks is a very simple model of a complex set of relationships. Nonetheless, the models serve their intended purpose very well and provide a useful initial estimate of price for the upcoming crop year.

The algebraic model for corn (Figure 3.7) is a simple linear model. A quadratic term, ES^2, was tried as an explanatory or independent variable, but it was not statistically significant. The final model took the following form:

$$PRICE = 2.79 - 0.0139\ (ES)$$

where:

$PRICE$ = Average price to farmers by crop year ($ per bushel), and
ES = Ending stocks as a percent of total use for the same crop year

Statistical properties of the model were

N = 23
(R^2) = .347
$F(1, 21)$ = 11.16

For 1996–97, the most recent complete crop year, ending stocks were 883 million bushels, and total use for the crop year was 8.849 billion bushels. The variable ES would therefore be 9.98. Generating a price estimate for the 1996–97 crop year, we get

$$PRICE = 2.79 - 0.0139\ (9.98)$$
$$= \$2.65$$

The price is below the observed 1996–97 price of $2.71, suggesting the simple linear model is forecasting slightly too low in the most recent years. One possible adjustment, mentioned in the text, is to force the model to fit the price-stock relationship for the most recent year. Graphically, what we need is to "move" the curve so that it will go through a price of \$2.71 in 1996–97.

The forecast error was \$.06 (\$2.71 minus 2.65). By adding the \$.06 to the intercept term (the 2.79), the model is adjusted to fit the 1996–97 scenario and will be

$$PRICE = 2.85 - 0.0139\ (ES)$$

This changes the level of the model, but leaves the relationship between price and ending stocks (the –0.0139 coefficient on ES) unchanged.

Using the revised analytical model and the latest (February 1998) estimates of ending stocks and total use for the 1997–98 crop year (949 million bushels and 9.310 billion bushels), the predicted price for the 1997–98 crop year is

$$\begin{aligned} PRICE &= 2.85 - 0.0139\ (10.2) \\ &= \$2.71 \end{aligned}$$

The 10.2 is, of course, the latest possible (February 11, 1998) estimate of ES when ending stocks are being estimated at 949 million bushels and the total use for the 1997–98 crop year is being estimated at a very large 9.310 billion bushels. This same adjustment process can be used for soybeans or wheat if the model is missing the most recent yearly price by a significant amount. It is demonstrated for corn, but will not be repeated for wheat or for soybeans.

At the time the February 11 USDA estimates were released, the December 1998 corn futures were near \$2.85. Since the model forecast is for farm-level cash prices, the results suggest corn futures could trade slightly higher since Midwest basis levels are closer to –\$.20 than the –\$.14 implied by a \$2.85 futures price and a \$2.71 cash price. *To the corn producer trying to decide whether to forward price in the \$2.60s or carry the risk and look for higher prices, this is very important information.* The producer will feel more comfortable waiting to price, or starting a modest program of pricing, with the expectation of adding more protection later at higher prices. To the user of corn interested in protection against higher prices, the analysis suggests the need for protection. To the speculator, the results suggest a strategy that enters the market from the long side on any price dip.

A caution is in order at this point. Since the model is a linear model, care should be used in applying it to levels of ES that are outside the range of *ES* in the data set used to fit the model. In other words, if stocks relative to total use move to record high or record low levels, the model should be used with care.

The model for soybeans (Figure 3.9) is also a simple linear model. The quadratic component (ES^2) was not statistically significant when included in the model. The final model was as follows:

$$PRICE = 7.53 - 0.0982\ (ES)$$

Statistical properties of the model were:

$$\begin{aligned} N &= 24 \\ (R^2) &= .370 \\ F(1,22) &= 12.90 \end{aligned}$$

In applying this model, the same caution is needed that was discussed for the corn model. There is a real danger in applying the model to any measure of ES that is outside the range of ES used in estimating the model. It is a linear model, and does not have the quadratic component to bring curvature to the function and to block extreme estimates of PRICE for unusually small or large values of ES.

The latest estimates of ending stocks and total use for the 1997–1998 crop year are 245 million and 2.619 billion bushels, respectively. The variable ES is therefore 9.35.

$$\begin{aligned} PRICE &= 7.53 - 0.0982\,(9.35) \\ &= \$6.61 \end{aligned}$$

During early 1998, the November soybean futures traded in a range of \$6.40 to \$6.85, with the more recent observations in the \$6.50 area. Since harvest period basis levels in most producing areas would be –\$.30 to –\$.50, the futures market is pricing 1998 soybeans below the model prediction. The hedger or speculator should expect price rallies unless some new and negative information shock hits the market. Strategies should reflect the likelihood that November 1998 soybeans will not exceed \$7.00 given the model prediction, and short hedges should be placed aggressively on any price rallies toward \$6.75 to \$7.00.

In wheat, the model does not show a statistically significant quadratic term and is a linear model as shown by the plot in Figure 3.8. The model is:

$$PRICE = 3.96 - 0.0141\,(ES)$$

Statistical properties of the model were:

$$\begin{aligned} N &= 24 \\ (R^2) &= .269 \\ F(2,22) &= 8.11 \end{aligned}$$

The latest estimates of ending stocks and total use for the 1997–98 crop year (which ends May 31, 1998) are 581 million and 2.386 billion bushels respectively. The variable ES is therefore 24.4. The estimated price would be:

$$\begin{aligned} PRICE &= 3.96 - 0.0141\,(24.4) \\ &= \$3.62 \end{aligned}$$

The \$3.62 estimate is above the recent \$3.35–3.65 trading levels of the July Chicago wheat futures. This demonstrates the problems that emerge when the variables approach extreme levels. The 581 million bushels in ending stocks is the smallest in an historical context.

In this instance, the user draws two conclusions that help in developing perspective:

1. Wheat prices are likely to be volatile due to the small buffer stocks and the market is vulnerable to any surprise in the weather or surprise development in the export arena.
2. If there is a reason to expect the futures market to move from current levels, the expectation would be for an increase given the model prediction for cash prices.

This provides useful information for the producer. If the cash-futures basis is weak during the upcoming June–July harvest, holding wheat in storage as a cash market speculator has a better chance of being profitable than in normal years. Conversely, if basis is more favorable (as it could be, given the relatively small stocks) the producer should pursue a basis contract, a deferred pricing plan, or even sell cash and buy futures with an expectation for upward trending prices. The speculator in wheat futures should be looking for opportunities to buy or go long on price dips.

Figure 3.10

The model for Figure 3.10, showing the relationship between beef production and January 1 inventories, is

$$BEEFPR = 11.49 + 0.0952 \text{ INV}$$

where

$BEEFPR$ = beef production during the calendar year in billions of pounds, and
INV = January 1 total cattle inventories in millions of head.

An inventory of 100 million head would generate, to illustrate,

$$11.49 + 0.0952 = 21.01 \text{ billion pounds.}$$

This estimate would be too low given production levels of recent years, but application of the relationship is informative. In recent years, with a relatively high percentage of the inventory in feedlots and in the presence of increased production per head of inventory due to technological advancements in breeding, the historical relationship is no longer totally representative. For a given herd size, we can expect even more production during the year than has historically been the case. The R^2 for the model was only .092, indicating that inventories explain only 9 percent of the variation in beef production across the years shown.

Figure 3.11

Figure 3.11 shows a similar plot for pork production relative to December 1 (for previous year) hog inventories. As was the case with beef, it is clear that the production per sow is increasing in recent years. The actual observations are well above the fitted line in recent years. The equation employed to plot the fitted line was of the same general form as the equation used for beef in Figure 3.10 and took the form

$$PORKPR = 6.57 + 0.1294 \text{ (INV)}.$$

Here, the R^2 was only 0.06, indicating many other factors are influencing pork production.

Figure 3.12

Examination of Figure 3.12 suggests increasing production per head in recent years *and* suggests that the January 1 cattle-on-feed numbers are not effective predictors of beef production during the year. Not only is the relationship negative, but the fit is not very effective. The (R^2) for the equation underlying the line shown in the figure is only 0.003, and the equation is not provided due to the poor statistical properties. More detailed and intrayear analyses will clearly be required to explain the variations in beef production in recent years. At a simplistic and beginning level, the relationship shown earlier between January 1 inventory numbers and beef production would be much more effective. What this relationship *does* reveal is how much production can change due to changes in cattle-on-feed numbers *within the year*. It thus supports the need for effective intrayear monitoring of placement patterns in the feedlots as a major determinant of changes in beef production.