Potential Long Run Impacts of Captive Supplies on Producer Prices in Fed Cattle Markets

by

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Introduction

Market concentration in beef packing has increased dramatically over the past two decades, reaching the point where about 80% of U.S. boxed beef sales are controlled by the four largest beef packing firms (Packers and Stockyards Administration, 1992). The three largest processors (IBP, ConAgra, and Excel) have increased market share through both horizontal mergers and through the construction of new large slaughtering/fabrication facilities that capture economies of size (Barkley and Schroeder). Along with the horizontal integration, and of particular interest for this paper, vertical integration has also occurred. Packers have integrated downstream into the cattle feeding sector by gaining control of supplies of fed cattle well in advance of slaughter dates. Industry participants and analysts have coined the term "captive supplies" to refer to fed cattle which are controlled by the beef packers prior to slaughter. Captive supplies can be in the form of packer owned cattle in the feedlot, cattle which have been forward contracted for delivery to a specific packer weeks or months in advance of actual slaughter date, or cattle which are fed under explicit formula price arrangements for an individual packer. Of these three categories, forward pricing contracts account for the majority of captive supplies (Ward and Bliss).

Forward pricing contracts have thus become an integral part of the vertical relationship between cattle feeders and beef processing companies. In 1990, for example, the largest 15 packers contracted nearly 14 percent of total slaughter (Barkley and Schroeder). During certain weeks as much as 50% of the procurement needs of an individual firm for a given week has been contracted for delivery well in advance (Ward and Bliss). During the late 1980's and into the early 1990's, concerns began to surface among cattle producers and industry analysts that these vertical relationships could have adverse effects on fed cattle prices (Lambert). In response to this concern, Purcell (1990) outlined two areas for further research regarding the impact of captive supplies on fed cattle markets.

The first call was for theoretical and empirical research to determine the impact of captive supplies on the short-run demand for fed cattle. The second was for research focusing on the longer term impacts of captive supplies on the level and variability of fed cattle prices over time. Several researchers have responded by pursuing research regarding the first of these two broad areas. Recent empirical work by Schroeder et al. and Elam found that captive supplies had a small negative and statistically significant influence on short-run cash fed cattle prices. The magnitude was not necessarily significant from a practical or economic standpoint, however, amounting to less than $.40 per cwt. Hayenga and O'Brien found mixed positive and negative price influences, also of relatively small magnitudes, and Ward (1990a) found a statistically insignificant impact.

Barkley and Schroeder developed a conceptual equilibrium model of the use of forward

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contracts in fed cattle markets. The model provides insights into the reasons for the growth in forward contracting as a marketing phenomenon, and serves as an aid in predicting how changes in market conditions and industry structure can affect prices in both cash markets and forward markets. Specifically, the model predicts that an increase in the spot market price variability will lead to a decreased contract price and an increased spot price. The model also predicts that an increase in the number of feedlots will lead to decreases in both contract and spot prices, and an increase in the number of packers will lead to increases in both contract and spot prices.

The second area cited by Purcell as a needed research agenda, the longer term impacts of captive supplies on fed cattle markets, has yet to receive research attention. In 1992, Purcell again made a plea for research into this important aspect of captive supplies. The purpose of this paper is to develop a framework for research investigating this heretofore neglected dimension of the captive supply issue. This paper will also provide additional insight regarding the motivation for packers to demand contracts of various forms and to "capture" supplies of fed cattle. It will be shown that this is a potentially important issue relating to either producer prices of beef, to consumer prices of beef products, or to both. The long-run consequences of captive supplies could affect the industry's ability to efficiently provide a competitively priced product to consumers.

Theoretical Considerations

As early as 1990 at a conference coordinated by the Research Institute on Livestock Pricing, researchers raised the possibility that the economies of large size plants had been positive to the cattle industry in terms of long run prices paid for fed cattle (Purcell 1990). In the short-run studies concerning captive supplies cited earlier, the price being modeled was a measure of the cash price paid for the cattle procured through the normal direct trade cash market. In contrast, Purcell (1992) argues convincingly that the long run price to be considered should be some aggregate measure of prices paid for all cattle, cash and contracted, if the analyst is to obtain a true measure of the long-run impacts of captive supplies on cattle producers. If contracting stabilizes flows of cattle into slaughtering facilities and thereby reduces per head costs, prices paid for all cattle could be higher because of the cost reductions.

Using this reasoning, it is not difficult to make a conceptual argument in support of higher average prices in the presence of captive supplies. The short-run supply of this crucial input into the beef packing sector is very inelastic. There is essentially a fixed number of fed cattle ready for slaughter in a given area during a particular time period, such as a given week. There has not been a great deal of previous research concerning a firm's reaction to input quantity risk. It is clear that one of the primary reasons for entering into captive supply arrangements from the packers perspective is to reduce this input quantity variation (Ward and Bliss). Given this empirically confirmed motivation, an argument for a higher long-run level of producer prices in the presence of captive supplies can be made as follows: If contracting and other means of scheduling cattle into the plant permits the plant to operate closer to the designed low-cost capacity level, then packers have more dollars to bid into the price of cattle (Purcell 1992). As will be pointed out later, other cost savings could come from a reduction in the variance of weekly slaughter. In general, firms that operate larger plants, or firms that operate plants at higher levels of utilization, are capable of paying more for livestock (Ward 1990b).

Two assumptions need to hold in order for the described higher overall price scenario to occur. First, there must be economies of size in beef packing. In other words the average total cost curve of a given plant must be downward sloping. This issue will be discussed in the next section of the paper. Second, there must be significant competition in the procurement markets. If competition is not adequate, then firms with lower costs may not bid the savings into livestock and could either pass the cost savings on to meat and by-product consumers or extract a larger margin and maintain higher profits (Ward 1990b). Which of these would occur would depend on the amount of market power the individual firm could exert on the selling side of the market. Since beef is sold in a nationwide market, it is generally accepted that individual beefpacking firms possess relatively less market power on the selling side than on the procurement side. With regard to procurement market competition, Ward (1990b) found that at least throughout 1987 and 1988, significant excess capacity existed in beef slaughtering and fabrication. He determined that, during times of tight livestock supplies relative to capacity, packers were competing vigorously for supplies.

In the following section, estimates of industry cost structure are combined with actual variations in captive supplies and slaughter levels. This allows the examination of possible scenarios regarding price impacts of captive supplies.

Estimates of Industry Cost Structure

Economies of size can be a basis for examination of industry efficiency (Ward 1988) and can play an important role in analyzing the market structure of firms and industries. Size economies are typically studied by examining the relationship between average total cost and plant output. The presence of economies of size is indicated when average total cost per unit decreases as total output increases.

There is both a rate and time dimension of output and the two are interrelated when considering meatpacking plant capacity and utilization (Ward 1990b). Plants have a maximum rate of output or maximum "line speed" but utilization may be below that maximum possible level. Utilization can also be related to the number of hours worked in a given period relative to the number that could be worked. For instance, it is not uncommon for plants to operate 8 hour shifts when 10 hour shifts are possible. Therefore, differing per unit slaughter costs can represent two plants of different sizes, or two plants of equal size but different utilization levels (Ward 1990b).

Exact measures of the cost structure of the beef packing industry at varying output levels are difficult to obtain due to the confidential nature of the data needed to obtain exact estimates. Industry participants and researchers have provided some information which yields an indication of the present cost structure of the industry. For instance, Iowa Beef Processors Incorporated recently indicated that it can reduce beef slaughter and fabrication costs by nearly $15.00 per head when it kills 210,000 head or more per week compared to lesser kill numbers (Cattle Buyers Weekly). Other packers report that they could realize similar savings if they operate at full capacity. This $15.00 number is probably at the high end of the per head savings range, but does give an indication that there are significant economies of size in beef packing.

Ward (1988) used two different methods to obtain empirical estimates of the magnitude of economies of size in beefpacking. First, by simply noting the number of plants of different size categories over time, an indication of those plant sizes able to survive can be garnered. Nationwide, the number of plants in all categories killing under 500,000 head per year had declined while the number killing over 500,000 head per year had gone from 3 to 17 in a 14-year period. This survivor analysis is considered evidence that the large plants have some cost advantage over the smaller plant sizes.

In the same study Ward reports the results of a statistical cost analysis performed by Sersland. The analysis was based on a survey of beef packing plant managers. Table 1 provides estimated average costs for steer and heifer slaughtering and fabrication from the Sersland analysis.

The important thing to notice from Table 1 is not the actual magnitudes of the cost estimates, but rather the evidence that as you move from 205 head per hour to 265 head per hour (about a 29% increase) the industry can achieve a cost savings of around $3.41 per head. Likewise, when you move from 265 head per hour to 325 head per hour (an additional 23% increase) the industry can obtain an additional cost savings of roughly $3.40 per head.

Table 1. Estimated Average Cost for Steer and Heifer Slaughtering and Carcass Fabrication by Plant Size.

Head Per hour	Head Per Year	Average Cost/Head
205	462,400	75.81
265	551,200	72.40
325	676,000	69.00

Source: Sersland (complete citation found in references).

An additional source of information regarding the magnitude of size economies in beef packing is provided by the accounting/engineering-type cost analyzer developed by Duewer and Nelson. This computer program simulates the per head costs of operating various sizes of beef slaughtering and processing facilities at different utilization levels. Table 2 reports the results of simulations run on the Duewer and Nelson computer program.

Three things are important to notice from Table 2. First the average cost in general deceases as one moves to larger plant sizes, consistent with the findings of Ward. Second, moving from 1 to 2 shifts per day in the same size plant reduces costs. Third, within a given size and shift category, a reduction in utilization dramatically increases costs. Specifically, these estimates reveal that the cost increase associated with a 10% less than optimal utilization ranges from $1.47 per head to $6.64 per head depending on the plant category. Estimates of cost increases associated with a 20% less than optimal utilization range from $6.41 to $9.27 per head.

Table 2. Estimated Average Cost for Steer and Heifer Slaughtering and Carcass Fabrication by Plant Size and Utilization.*

Head Per hour	Head Per Year	Average Cost/Head
210 / 1 shift	315,000	83.28
	354,375	76.64
	393,750	74.01
210 / 2 shifts	630,000	71.14
	708,750	65.85
	787,500	64.25
300 / 1 shift	450,000	78.79
	506,250	72.65
	562,500	70.26
300 / 2 shifts	900,000	67.99
	1,012,500	63.05
	1,125,000	61.58

* These values were generated using the computer program developed by Duewer and Nelson.

The cost reduction estimates from the Ward/Sersland study are of smaller magnitude than the numbers obtained using the Duewer and Nelson algorithm. The Ward/Sersland estimates are between plant sizes and could perhaps be thought of as a measure of the steepness of the long run industry envelope average total cost curve. The estimates from the computer simulation reflect utilization rates within each size category and are perhaps more representative of the steepness of the short run average total cost curves within each size category. These estimates, while far from perfect, are the best available at this time.

Data

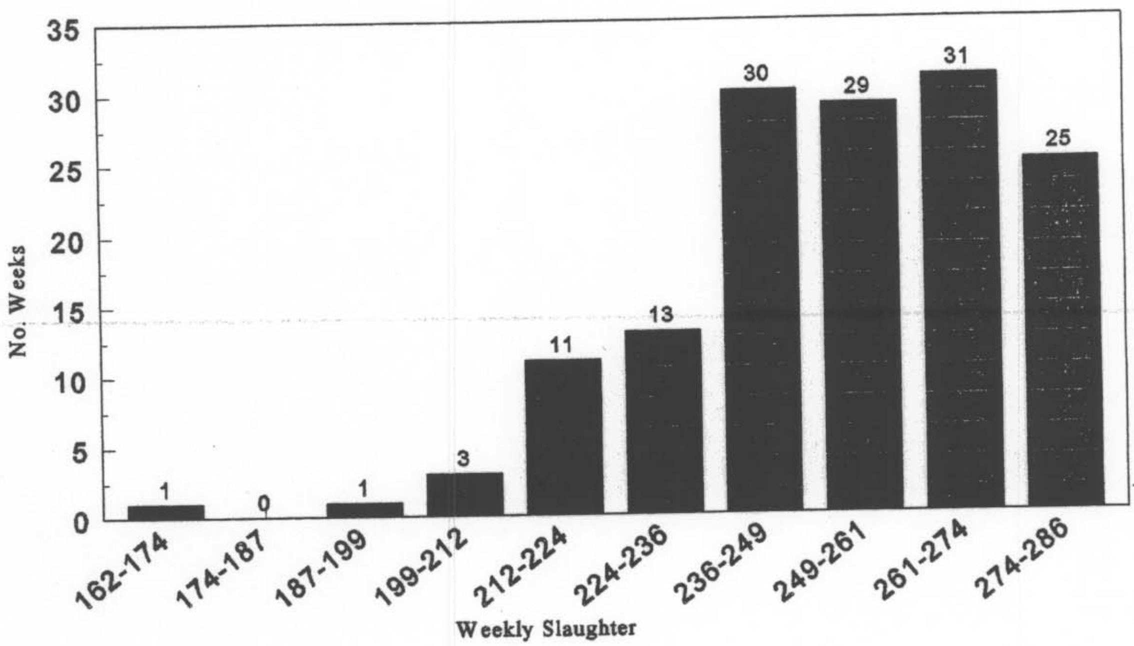
Data were collected on weekly slaughter numbers for the Texas-Kansas-Colorado marketing area. The time frame covered was from April 1988 through the last week of December 1990, or 144 weekly observations.[2] This geographic area was selected because it is normally considered to be one large southern plains cattle feeding and slaughtering region, and it is fairly isolated from the rest of the country as far as procurement is concerned. Figure 1 shows the frequency distribution of weekly slaughter rates in this data set with a range of from 162,000 head per week to a maximum of 286,300 head per week.

For the same time period, data regarding the number of cattle slaughtered in the region procured under captive supply arrangements was collected. Figure 2 provides the frequency distribution of these data with a range of from 4,700 head per week to 57,700 head per week. The

[2]Source, United States Department of Agriculture, Agricultural Marketing Service, Livestock Meat and Wool Market News, Weekly Summary and Statistics. Various weekly issues.

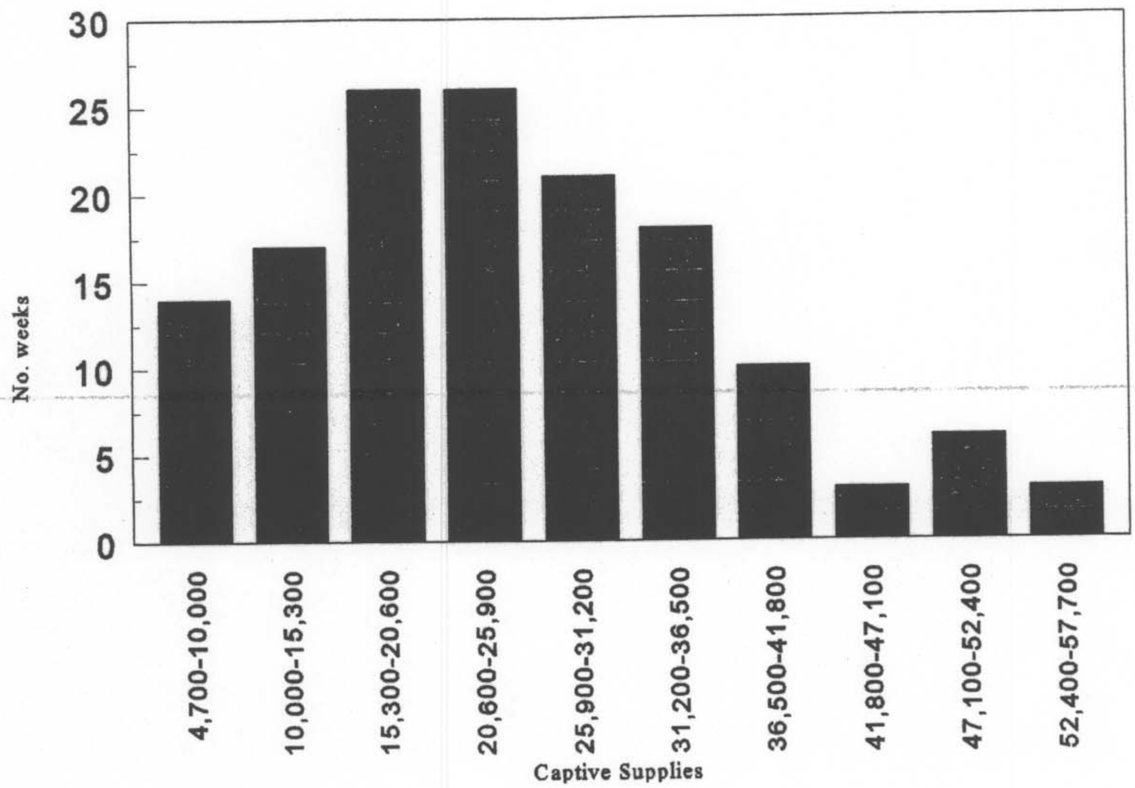
average of about 25,000 head per week amounts to roughly 10% of the average slaughter per week (252,000).[3]

Figure 1. Distribution of Weekly Slaughter (Thousand Head).



[3]These data were provided by the Agricultural Marketing Service field offices in each individual state.

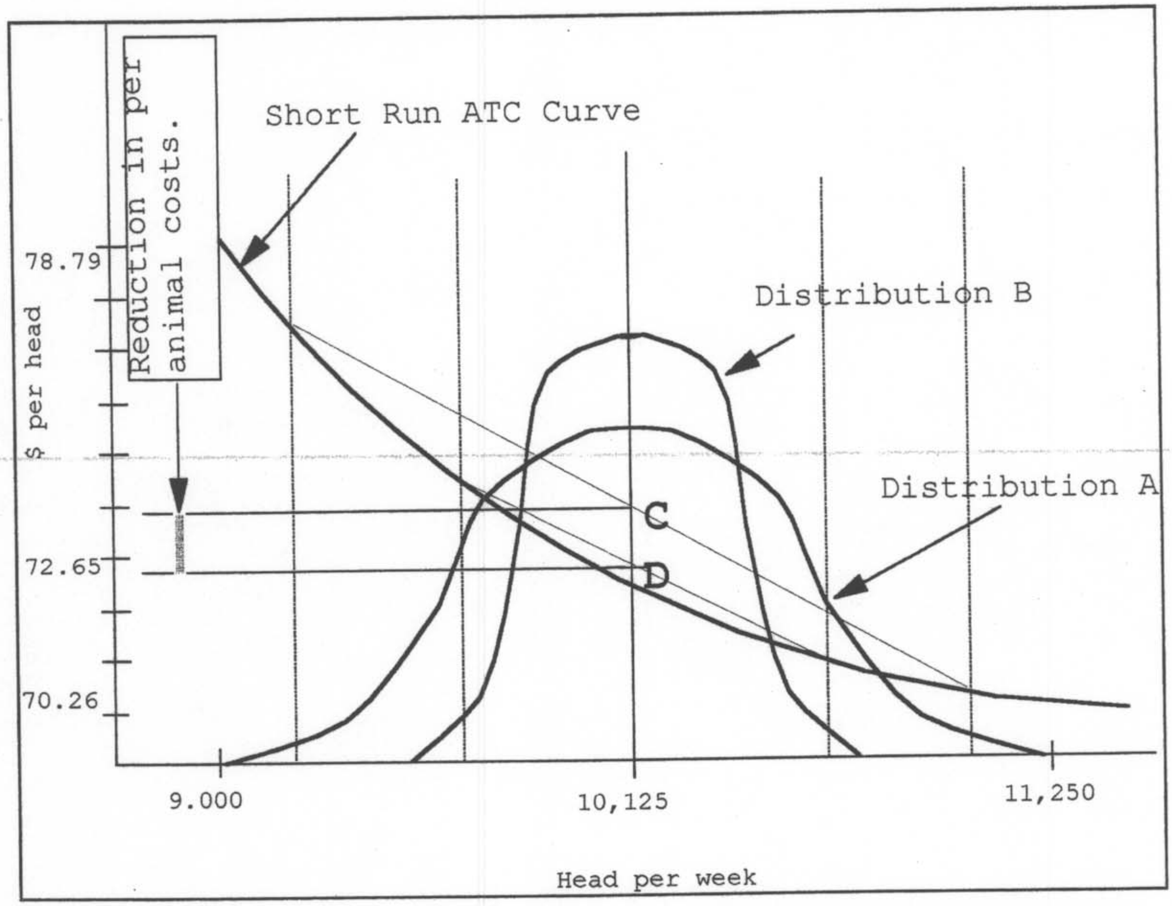
Figure 2. Distribution of Captive Supplies (Head).



Possible Impacts

Figure 3 shows a potential source of efficiency gains from captive supplies. If this procurement tool allows a less-variable slaughter distribution over time, because packers have more control over when the cattle are called for delivery and/or control over when the cattle are placed on feed in the case of formula priced cattle and packer owned cattle, this could lead to an average cost savings over time. For illustrative purposes the average total cost curve shown in Figure 3 was developed using the cost estimates obtained from the Duewer and Nelson program and the 300 head per hour/1 shift plant category reported in Table 2. The head per week figures were obtained by dividing the head per year figures by 50 weeks of plant operation per year.

Figure 3. Short Run Potential Cost Reducing Impacts.

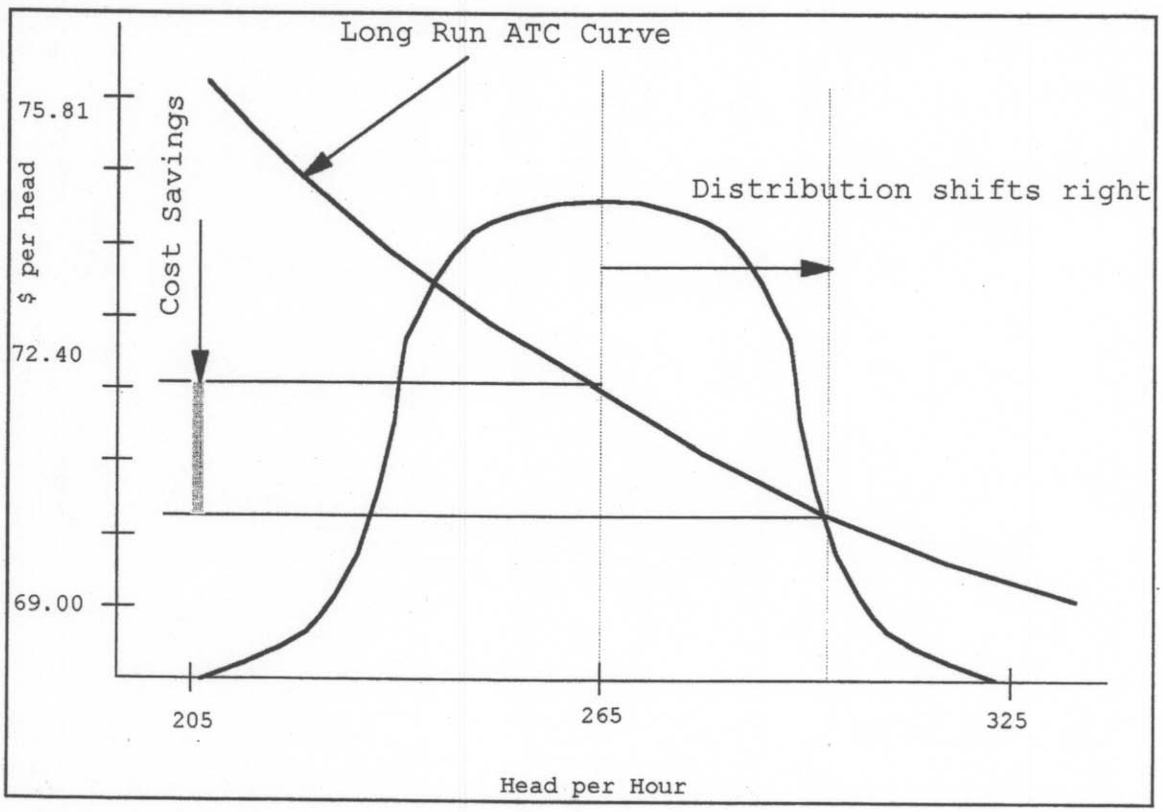


Assume that without the use of captive supplies the firm faces a distribution of cattle ready for slaughter in the region represented by Distribution A. Over the long run, the average total cost of slaughtering and processing for this firm will be a weighted average of the costs for each given week, and could be at a point like C. If the use of captive supplies helps to reduce the variability of this distribution to something more like Distribution B, then the weighted average of weekly average total costs would be lower, for instance point D. Overall industry per animal cost could be reduced by some amount such as indicated on Figure 3.

Given the data and research results presently available this potential costs savings is hard to quantify; however, it is very likely that it exists. A second source of overall cost reduction could stem from the fact that certain plants may shut down or work fewer days during a given week because of management directive. Other plants (perhaps in the same multi-plant firm) would have more cattle to slaughter, allowing the distribution of slaughter shown in Figure 3 to shift to the right, thus moving the industry to a lower cost structure in the short run. It is well known that this type of behavior is present in the industry. It is not yet known whether it has become more common along with the increased use of captive supplies.

Potential longer run impacts are demonstrated in Figure 4. The long run average total cost curve shown here was generated using the cost estimates from the Ward/Sersland studies reported in Table 1. If over time smaller, less cost-competitive, plants are forced out of business and the available supplies of cattle are processed by fewer, more fully utilized plants, or if over time the supply of cattle is larger than it would otherwise have been, then the cost structure of the industry is lowered due to the shift in the distribution to the right in Figure 4. Captive supplies may assist in this movement in two ways. First, if the use of captive supplies by the large plants over time leaves so few cattle for other smaller plants that they must operate at a sub-optimal point in their cost structure, the smaller plants may go out of business sooner than they otherwise would have. Secondly, many studies have shown that risk-averse agricultural producers have a tendency to increase production as marketing risk is reduced (Just, Chavas and Holt, Thraen and Hammond, and Seale and Shonkwiler, among others). Since captive supplies are considered a risk-reducing tool by producers of fed cattle (Ward and Bliss), then it is entirely possible that the industry as a whole has increased production over time to levels higher than they would be without the risk-reducing benefits of the captive supply arrangements.

Figure 4. Potential Long Run Cost Reducing Impacts



An example of the potential magnitude of these cost savings can be calculated from Ward's estimates. If, for example, some combination of these potential cost saving components can move the average processor from 265 head per hour to 325 head per hour, a 23% increase, then the cost per head could be reduced by $3.40. This figure is in the middle of the Duewer and Nelson estimates for similar quantity shifts. The cost savings could translate into an additional $0.28 per cwt. on a 1200 pound steer if all savings were bid back into the price of fed cattle. Of course, a portion of the savings would likely be passed on to consumers of meat products, especially in the long-run. In either case, society benefits.

Direction for Future Research

Several areas have been outlined in this paper which require further investigation. First, there is a need to obtain better estimates of the cost structure of individual packing plants of the size categories commonly seen today. In addition, as pointed out in the discussion of Figure 3, there is a need to determine if the distribution of weekly slaughter has changed (become less variable) with the increased use of captive supplies.

A more careful investigation of individual plant utilization levels needs to be performed. During times of tight supplies, do some plants shut down temporarily, allowing other plants to operate more efficiently, or do most plants simply operate at lower capacities? What are the implications for overall cost structure, and how has this been influenced by captive supplies? These are questions which need to be addressed by further research. There is also a need to determine whether or not the use of captive supplies as a risk reducing tool has had an impact on the supply of fed cattle. Any impact on supply has implications for capacity utilization in the packing sector.

At the present time there is significant interest and discussion regarding policy directions concerning the beef packing industry. Alternatives such as tougher anti-trust enforcement have received attention. In regard to the issue of captive supplies Purcell (1992) argues that the unknown long-run impact on cattle prices must be thoroughly investigated before policy moves to control captive supplies are seriously discussed. The potential sources of cattle price impacts reported in this manuscript would support the need for additional research and should also help to guide the directions that research might take.

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