

Lecture VI: Numeric Integrals - Adena Springs

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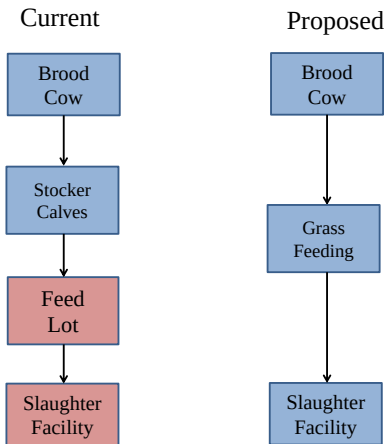
Problem Formulation

From my understanding, the Adena Springs controversy grows out of a proposal of a rancher to change his operation from the supply of calves to feedlots out of state to producing and processing grass-fat beef. The problem is that the additional pasture to feed the cattle to weight and the packing facility will require up to 13.2 million gallons of day.

Marketing Channels

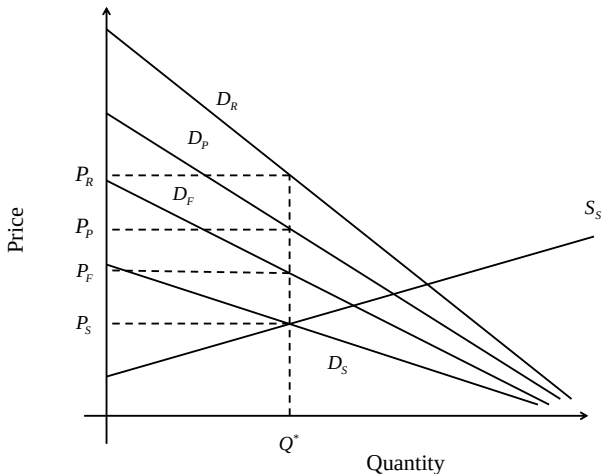
We are dealing with a change in the marketing channel and the production process. Figure 1 depicts the **current** marketing channel where Cow-Calf operators keep cattle on grass until they reach feedlot weight and then sell them to feedlots either in Kansas or Corn Belt. The new structure involves keeping the cattle on grass.

Market Channel Comparison



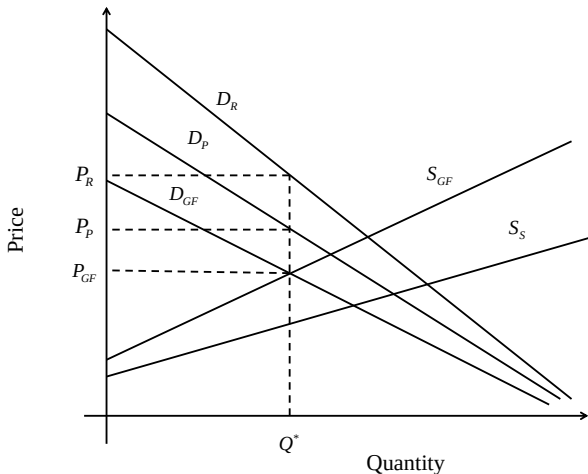
Another way to view the problem is in a marketing channel. Figure 1 derives the farm level demand for stocker cattle D_S from the retail demand for beef. To derive the farm level demand we start with the retail demand for beef (D_R) less the marginal cost of retailing to yield the demand for processed beef D_P . The demand for fat cattle (D_F) is then the demand for processed beef less the marginal cost of warehouse operations. The demand for stockers (D_S) is then the demand for fat cattle less the marginal cost of feeding cattle.

Current Marketing Channel



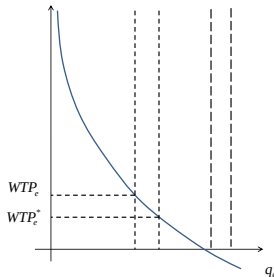
The new marketing channel removes some of the levels as depicted in Figure 1. The trick is to find a point of comparison. In this study, I will look at the derived demand for stocker cattle in the current structure with the derived demand processed beef (differentiated grass-fat beef at the wholesale level D_P), the marginal cost of processing grass-fat beef, and the supply of grass-fat beef.

Proposed Marketing Channel



Externality

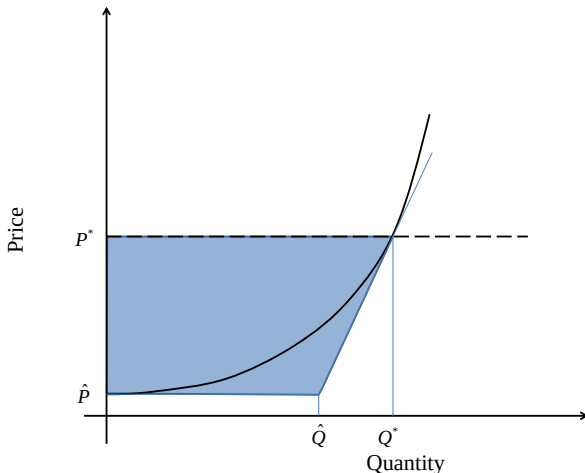
Of course the question in the news has to deal more with the externality generated by the additional water use as depicted in Figure 2



Our method of analysis will be applied welfare analysis. First, we need to compute the consumer and producer surplus for each channel. The producer and consumer surplus for the traditional marketing channel is rather straightforward as depicted in Figure 1. The linear approximation is typically

$$PS = \left[P^* - \hat{P} \right] \times \hat{Q} + \frac{1}{2} \left[P^* - \hat{P} \right] \times \left[Q^* - \hat{Q} \right]. \quad (1)$$

Value of Existing Channel



A more accurate formulation would be

$$PS = \int_0^{Q^*} [P^* - f(Q)] dQ = P^* Q^* - \int_0^{Q^*} f(Q) dQ \quad (2)$$

where $f(Q)$ is the “inverse supply function” for the production of stocker cattle.

Suppose that I wanted to approximate this profit.

- The ranch starts with 1,700 cows with a calving rate of 98 %.
- The sale weight for feeder cattle is 600 pounds – selling price of 1.35/pound for a value of \$ 810.00 – slope of the marginal cost curve at the optimal 0.30.
- The sale weight for fat cattle is 1,150 pounds – selling price of 1.05/pound for a value of \$ 1,207.50 – slope of the marginal cost curve at the optimal 0.40.

As a first approximation, assume that

$$f(q) = 100.0 + 95.0 \exp(0.00125q - 0.00000002q^2) \quad (3)$$

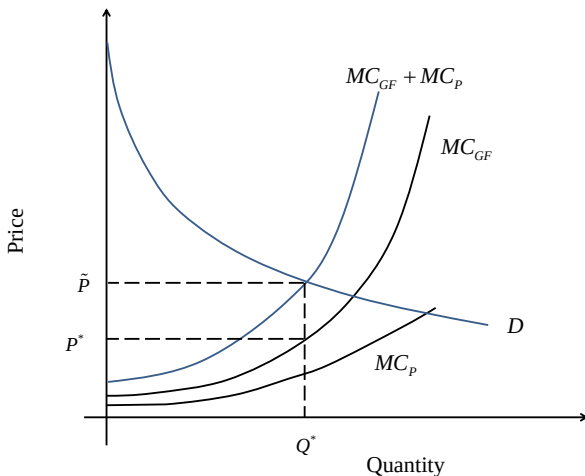
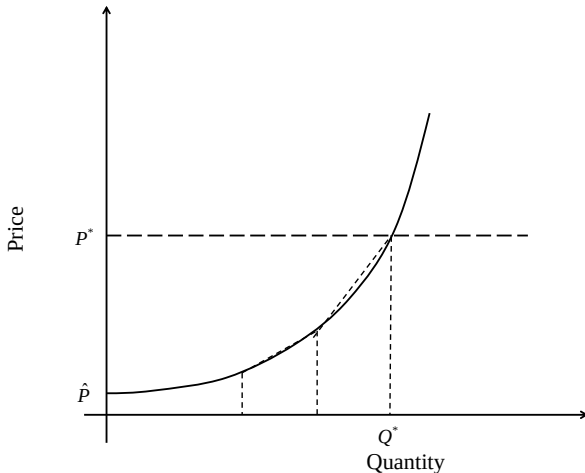


Figure: Value of Proposed Marketing Channel

Simpson's Rule

One vexing problem for the Simpson's rule is the implied convexity or concavity of functions. In the case of the marginal cost curve, we know that it is convex in output space. Graphically, the error introduced by Simpson's Rule is presented in Figure 3.

Error in Simpson's Rule



As a parting shot, consider the mean value theorem of the integral

$$\int_a^b f(x) dx = f(x^*) [b - a] \text{ for some } x^* \in [a, b] \quad (4)$$