THE PERMANENTLY INCREASING PRICE OF BEEF

by

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Both the supply and demand for beef have been increasing over time. The net result, however, has been a secular trend of rising beef prices due to the greater growth rate of demand. This paper concludes that if demand continues to grow at rates comparable to those of the past two decades, then supply will inevitably lag behind and, therefore, prices will continue to rise. That is, physical constraints on the growth of beef production are such that supply increases cannot match the growth in demand.

Beef consumption grew by an average yearly rate of 4.9 percent during the 1950's and 4.6 percent during the 1960's, while domestic beef production increased by only 4.2 percent and 4.4 percent during these periods, respectively.[1] Furthermore, it appears that demand will continue to grow at these rates, while the rate of increases in supply shows signs of tapering off.

The demand for beef has been growing at a relatively constant rate, as can be seen from Figure 1. On the other hand, Figure 2 indicates that the growth rate of beef supply has varied over time. Prior to 1952, production tended to coincide with herd size, with the slight upsurge in production during the 1940's being accounted for by the slaughter of cows. Following 1952, beef production grew at a faster rate than the number of cattle on farms due to the utilization of feedlot fattening

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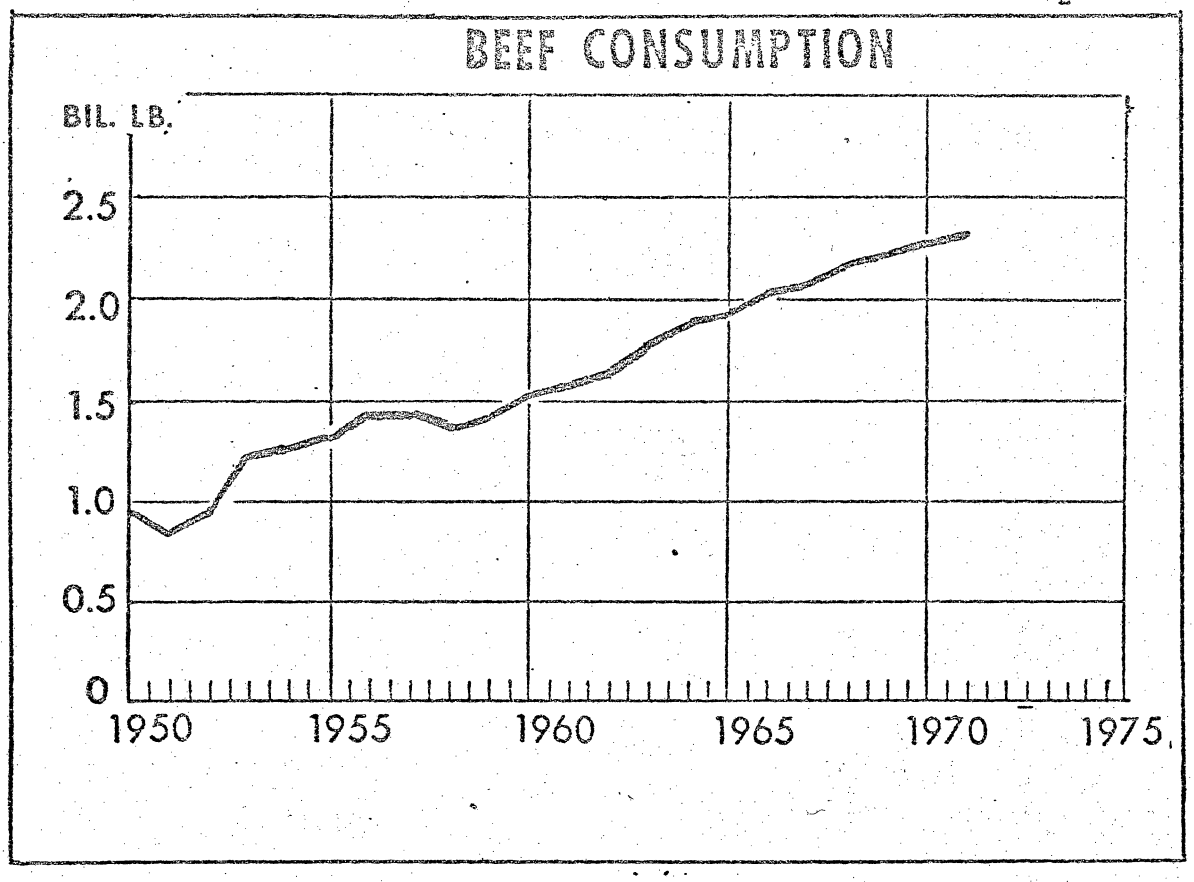

Figure 1

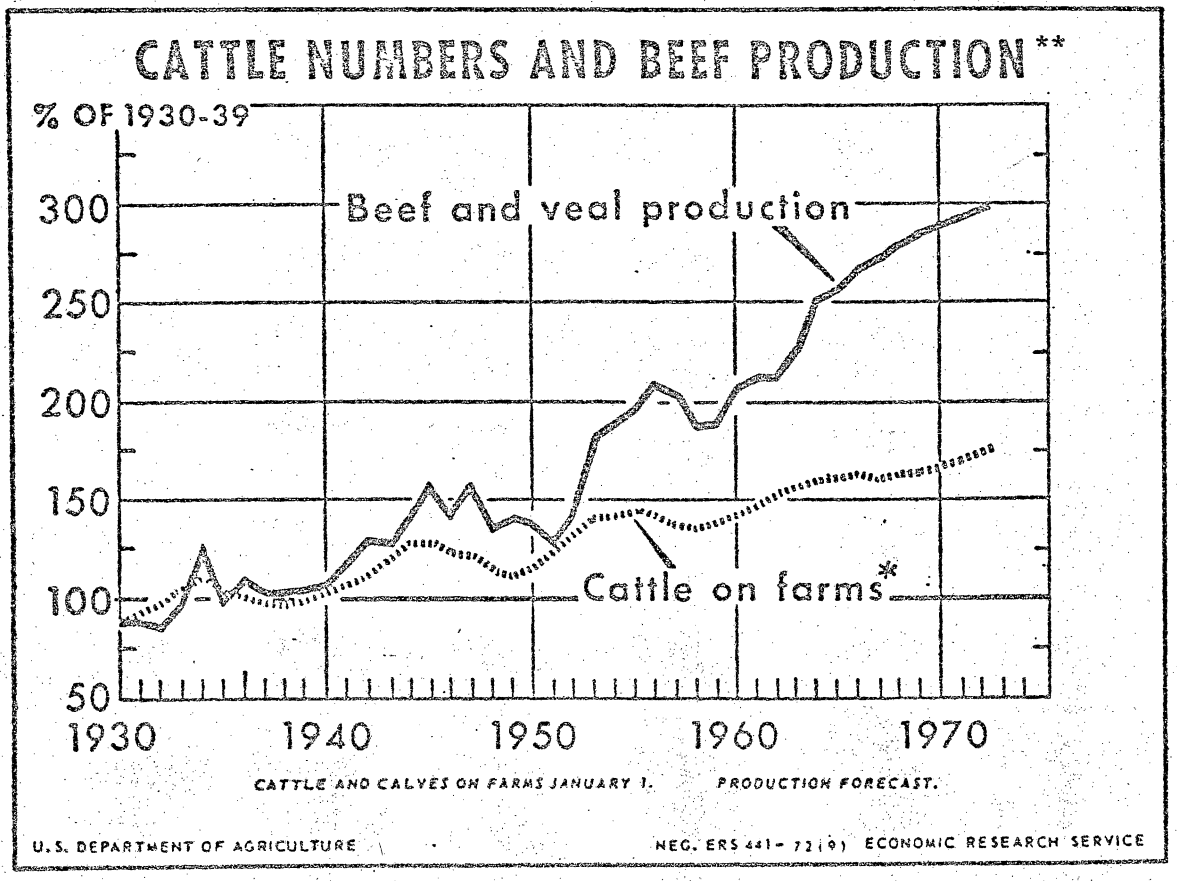

Figure 2

**Source: 1972 Handbook of Agricultural Charts, USDA Agricultural Handbook No. 439

methods. In recent years, however, the growth rates of beef production and herd size appear to again coincide.

Once complete conversion to cattle fattening in feedyards is accomplished, the upper limit on beef production is set by the rate of growth of cattle numbers. The upper limit on growth of cattle numbers is in turn set by biological and managerial factors. Table 1 illustrates one set of parameters yielding a zero population growth of cattle numbers - or a "stationary state". Once this is defined, a growing system, such as shown in Table 2, can be illustrated.

Table 1 shows a system which begins with 100 bred animals in the first year. By the end of that year, calves are weaned. The calf crop is 80 percent of the heifers retained for breeding, 20 percent of the cows are culled after their first calf and 15 percent thereafter to the seventh year (when the cows are 9 years old), when the remainder are fully culled. Death loss is 1 percent per year. Finally, 60.5 percent of the heifer calves are retained for breeding in their first year and to calve in their second year.[2] It takes about 20 years for such a system to settle down to a constant level of animal production.

Now that the stationary system is defined, it is possible to predict growth rates of the herd size for any given changes in cow culling rates, death rates and/or percent of heifers saved for breeding. For example, if instead of retaining 60.5 percent of the heifers for breeding, 70 percent are retained, the size of the herd will grow at 3.8 percent per annum.[3] This growing system is shown in Table 2.

The death, culling and birth-weaning rates assumed for the "growth system" represent close to the absolute best that a sophisticated, up-to-date cattle operation can achieve. Thus, even with excellent bloodlines, the best management and feedlot system, and no real land constraint,

cattle numbers can grow by at most 3.8 percent per year.

The growth in demand for beef, on the other hand, is approximately 4 to 5 percent per year in the United States and 3 to 4 percent per annum in the world. It follows that only under the best conditions can supply keep up with demand. The more likely result in the world as a whole is rapid depletion of beef herds, a growing deficit of beef supplies and increasing prices for beef.

Table 1. The Stationary System

Year	Years Since First Calf 1	2	3	4	5	6	7	Cows	Calves	Heifers	Heifer Bred	Heifer Death	Cow Death	Cows Culled
1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	80.0	40.0	24.2	.4	1.0	20.0
2	0.0	79.0	0.0	0.0	0.0	0.0	0.0	79.0	63.2	31.6	19.1	.3	.8	11.9
3	23.8	0.0	66.4	0.0	0.0	0.0	0.0	90.2	72.1	36.1	21.8	.4	.9	14.7
4	18.8	18.8	0.0	55.7	0.0	0.0	0.0	93.3	74.7	37.3	22.6	.4	.9	14.9
5	21.5	14.9	15.8	0.0	46.8	0.0	0.0	98.9	79.1	39.6	23.9	.4	1.0	15.9
6	22.2	17.0	12.5	13.3	0.0	39.3	0.0	104.2	83.4	41.7	25.2	.4	1.0	16.7
7	23.5	17.6	14.2	10.5	11.1	0.0	33.0	110.0	88.0	44.0	26.6	.4	1.1	45.8
8	24.8	18.6	14.7	12.0	8.8	9.4	0.0	88.3	70.6	35.3	21.4	.4	.9	14.5
9	26.2	19.6	15.6	12.4	10.0	7.4	7.9	99.1	79.3	39.6	24.0	.4	1.0	22.9
10	21.0	20.7	16.5	13.1	10.4	8.4	6.2	96.3	77.1	38.5	23.3	.4	1.0	20.8
11	23.6	16.6	17.4	13.8	11.0	8.7	7.1	98.2	78.6	39.3	23.8	.4	1.0	21.9
12	22.9	18.6	13.9	14.6	11.6	9.3	7.3	98.3	78.7	39.3	23.8	.4	1.0	22.1
13	23.4	18.1	15.7	11.7	12.3	9.8	7.8	98.7	78.9	39.5	23.9	.4	1.0	22.6
14	23.4	18.5	15.2	13.1	9.8	10.3	8.2	98.6	78.8	39.4	23.9	.4	1.0	22.9
15	23.5	18.5	15.5	12.8	11.0	8.3	8.6	98.2	78.6	39.3	23.8	.4	1.0	23.3
16	23.5	18.5	15.5	13.0	10.7	9.3	6.9	97.5	78.0	39.0	23.6	.4	1.0	21.7
17	23.4	18.5	15.6	13.0	10.9	9.0	7.8	98.3	78.6	39.3	23.8	.4	1.0	22.5
18	23.2	18.5	15.6	13.1	11.0	9.2	7.6	98.1	78.4	39.2	23.7	.4	1.0	22.3
19	23.4	18.3	15.5	13.1	11.0	9.2	7.7	98.2	78.6	39.3	23.8	.4	1.0	22.5
20	23.3	18.5	15.4	13.0	11.0	9.2	7.7	98.2	78.6	39.3	23.8	.4	1.0	22.5
21	23.4	18.4	15.5	12.9	10.9	9.2	7.8	98.2	78.6	39.3	23.8	.4	1.0	22.5
22	23.4	18.5	15.5	13.0	10.9	9.2	7.8	98.2	78.5	39.3	23.8	.4	1.0	22.5
23	23.4	18.5	15.5	13.0	11.0	9.1	7.7	98.2	78.5	39.3	23.8	.4	1.0	22.5
24	23.4	18.5	15.5	13.0	10.9	9.2	7.7	98.2	78.5	39.3	23.8	.4	1.0	22.4
25	23.4	18.5	15.5	13.0	10.9	9.2	7.7	98.2	78.6	39.3	23.8	.4	1.0	22.5
30	23.4	18.5	15.5	13.0	10.9	9.2	7.7	98.2	78.6	39.3	23.8	.4	1.0	22.5
40	23.4	18.5	15.5	13.0	11.0	9.2	7.7	98.3	78.6	39.3	23.8	.4	1.0	22.5
50	23.4	18.5	15.5	13.0	11.0	9.2	7.7	98.4	78.7	39.4	23.8	.4	1.0	22.5

Table 2. The Growth System

Year	Years Since First Calf 1	2	3	4	5	6	7	Cows	Calves	Heifers	Heifer Bred	Heifer Death	Cow Death	Cows Culled
1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	80.0	40.0	28.0	.4	1.0	20.0
2	0.0	79.0	0.0	0.0	0.0	0.0	0.0	79.0	63.2	31.6	22.1	.3	.8	11.9
3	27.6	0.0	66.4	0.0	0.0	0.0	0.0	94.0	75.2	37.6	26.3	.4	.9	15.5
4	21.8	21.8	0.0	55.7	0.0	0.0	0.0	99.4	79.5	39.7	27.8	.4	1.0	16.0
5	25.9	17.2	18.3	0.0	46.8	0.0	0.0	108.3	86.6	43.3	30.3	.4	1.1	17.5
6	27.4	20.5	14.5	15.4	0.0	39.3	0.0	117.1	93.7	46.8	32.8	.5	1.2	18.9
7	29.9	21.7	17.2	12.2	12.9	0.0	33.0	126.9	101.5	50.8	35.5	.5	1.3	48.6
8	32.3	23.6	18.2	14.5	10.2	10.9	0.0	109.6	87.7	43.9	30.7	.4	1.1	18.1
9	35.0	25.5	19.8	15.3	12.1	8.6	9.1	125.5	100.4	50.2	35.1	.5	1.3	28.3
10	30.3	27.7	21.4	16.7	12.8	10.2	7.2	126.3	101.0	50.5	35.4	.5	1.3	26.6
11	34.6	23.9	23.2	18.0	14.0	10.8	8.6	133.1	106.5	53.3	37.3	.5	1.3	29.0
12	34.9	27.4	20.1	19.5	15.1	11.8	9.1	137.8	110.2	55.1	38.6	.6	1.4	30.1
13	36.7	27.5	23.0	16.9	16.4	12.7	9.9	143.1	114.5	57.2	40.1	.6	1.4	31.7
14	38.0	29.0	23.1	19.3	14.2	13.8	10.7	148.1	118.5	59.2	41.5	.6	1.5	33.2
15	39.5	30.0	24.4	19.4	16.2	11.9	11.6	153.0	122.4	61.2	42.9	.6	1.5	34.8
16	40.9	31.2	25.2	20.5	16.3	13.6	10.0	157.7	126.2	63.1	44.2	.6	1.6	34.2
17	42.2	32.3	26.2	21.2	17.2	13.7	11.4	164.3	131.4	65.7	46.0	.7	1.6	36.5
18	43.5	33.4	27.1	22.0	17.8	14.5	11.5	169.8	135.9	67.9	47.6	.7	1.7	37.4
19	45.3	34.4	28.0	22.8	18.5	15.0	12.1	176.2	140.9	70.5	49.3	.7	1.8	39.0
20	46.9	35.8	28.9	23.5	19.1	15.5	12.6	182.4	145.9	73.0	51.1	.7	1.8	40.4
21	48.6	37.0	30.1	24.3	19.8	16.1	13.1	188.9	151.1	75.6	52.9	.8	1.9	41.9
22	50.3	38.4	31.1	25.3	20.4	16.6	13.5	195.6	156.5	78.3	54.8	.8	2.0	43.3
23	52.1	39.8	32.3	26.1	21.2	17.1	14.0	202.6	162.1	81.0	56.7	.8	2.0	44.9
24	54.0	41.2	33.4	27.1	21.9	17.8	14.4	209.9	167.9	83.9	58.8	.8	2.1	46.4
25	55.9	42.7	34.6	28.1	22.8	18.4	15.0	217.4	173.9	87.0	60.9	.9	2.2	48.1
30	66.7	50.9	41.2	33.4	27.1	22.0	17.8	259.2	207.3	103.7	72.6	1.0	2.6	57.4
40	94.8	72.3	58.6	47.5	38.6	31.3	25.4	368.4	294.7	147.4	103.1	1.5	3.7	81.5
50	134.7	102.7	83.3	67.6	54.8	44.4	36.0	523.6	418.9	209.4	146.6	2.1	5.2	115.9

FOOTNOTES

1. Calculated from statistics contained in Livestock and Meat Statistics 1962, USDA Statistical Bulletin No. 333 (July 1963), p. 289 and Livestock and Meat Statistics, USDA Supplement for 1971 to Statistical Bulletin No. 333 (June 1972), p. 136.

2. The general form of this model is:

$$h_t = \frac{p(s-r)}{2} \left[h_{t-2} + (1 - c_1 - r)h_{t-3} + (1 - c_1 - r)(1 - c_2 - r)h_{t-4} + (1 - c_1 - r)(1 - c_2 - r)^2 h_{t-5} + (1 - c_1 - r)(1 - c_2 - r)^3 h_{t-6} + (1 - c_1 - r)(1 - c_2 - r)^4 h_{t-7} + (1 - c_1 - r)(1 - c_2 - r)^5 h_{t-8} \right]$$

where: h_t = size of the heifer herd at time t (and $h_{t-i} = 0$ when $t < i$)

s = percent of heifers bred
p = percent of cows having calves
r = percentage death rate
c_1 = percent of heifers culled after first calf
c_2 = percent of heifers culled 2nd - 6th year after first calf

3. If the percent of heifers bred is changed from 60.5 percent to 70 percent, while other values remain constant, then:

$$\Delta h_t = \left[\frac{p(.70 - r)}{2} - \frac{p(.605 - r)}{2} \right] \left[h_{t-2} + (1 - c_1 - r)h_{t-3} + (1 - c_1 - r)(1 - c_2 - r)\, h_{t-4} + \ldots + (1 - c_1 - r)(1 - c_2 - r)^5 h_{t-8} \right]$$

Substituting $p = .80$ and $r = .01$,

$$\Delta h_t = \left[\frac{.80(.70 - .01)}{2} - \frac{.80(.605 - .01)}{2} \right] \left[h_{t-2} + (1 - c_1 - r)h_{t-3} + (1 - c_1 - r)\,(1 - c_2 - r)\, h_{t-4} + \ldots + (1 - c_1 - r)(1 - c_2 - r)^5 h_{t-8} \right]$$

$$= \left[.038 \right] \left[h_{t-2} + (1 - c_1 - r)h_{t-3} + (1 - c_1 - r)(1 - c_2 - r)\, h_{t-4} + \ldots + (1 - c_1 - r)(1 - c_2 - r)^5 h_{t-8} \right]$$