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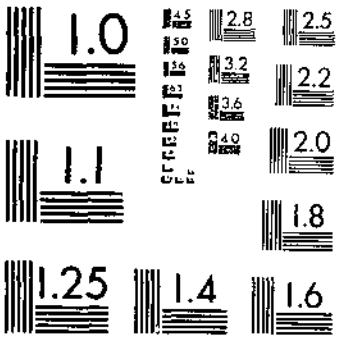

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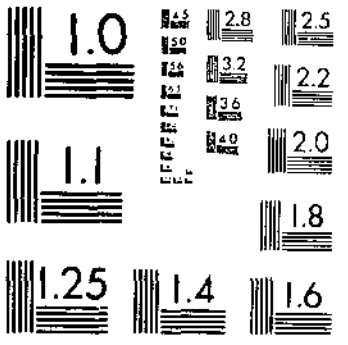

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DECEMBER 1961

Demand and Prices for

MEAT

Factors Influencing Their Historical Development

Growth Through Agricultural Progress

by **HAROLD F. BREIMYER**

ECONOMIC RESEARCH SERVICE · TECHNICAL BULLETIN No. 1253
UNITED STATES DEPARTMENT OF AGRICULTURE · WASHINGTON, D.C.

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington 25, D.C.—Price 35 cents

PREFACE

This bulletin records the trends in production, consumption, and price of the several meats and meat animals from 1921 to 1960. It seeks to ascertain values for economic factors affecting prices of meat such as supply of meat, income, and price level. The formulation for measuring the effect of these factors places primary emphasis on the record of growth during almost 4 decades—a growth that encompasses both economic and institutional forces always jointly at work and interacting. Benefits of the bulletin to farmers will come chiefly through its use by Federal and State Extension and other Government workers as well as officials of cooperatives and representatives of private firms who work directly with farmers. This study can be of value to producers and marketers in interpreting the past and in anticipating future trends in meat prices.

Factors affecting the demand and production of beef, pork, and lamb are analyzed for three subperiods as well as the total period. Changes and similarities among these shorter periods are compared for a better understanding of short-term developments. A cross-sectional analysis using data from the 1955 household food survey shows the effects of income, region, and urbanization on meat consumption in that year.

Information and assistance were obtained from many specialists of the United States Department of Agriculture. Special acknowledgment is made to Arthur A. Harlow and Anthony S. Rojko for their counsel on technique for analysis and for their critical review and preparation of the manuscript for publication. Data were assembled and statistical computations were made, for the most part, by Charlotte K. Tucker. Extensive use was made of both published and unpublished material in the files of the Economic Research Service.

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Demand and Prices for Meat—Factors Influencing Their Historical Development

By Harold F. Breimyer

HIGHLIGHTS

Meat is staff to the modern diet and meat animals are a mainstay of modern agriculture. Prominence of meat and meat animals has become a distinguishing feature of advanced society: the "underdeveloped" peoples of the world largely subsist on a starchy diet, but the industrial and more prosperous agrarian nations are meat eaters. In the United States meat and meat animals have set a creditable record of growth in status and value. First resource for their production was the natural bounty of native grasslands. As the plow advanced on the grasslands acre by acre, that boon was lost. For a time the livestock industry suffered a setback. It recovered quickly, however, and in the intensification of U.S. agriculture during the last 40 years it has played a major role. Its growth has been sped both by technological miracles in production and by the steadily rising esteem of livestock products in the minds of consumers.

In the highly industrial U.S. economy of today, consumers' expenditures for meat still approximate 5 percent of their total income (after income taxes). Sale of meat animals provides a third of all dollars earned by U.S. farmers.

Not every meat and meat animal has shared equally in this progress. Easily outdistancing others has been beef. Beef now holds place of honor in the family budget and at the dinner table. And if the lion is king of wild beasts, the steer reigns over domestic ones in the farmstead. Pork and the hog, by contrast, have become partially eclipsed. Their only modest gains during the last 30 or 40 years are traceable in part to growth lag on the demand side. Output and consumption of lamb have decreased, but in their case a shrinking productive resource is largely responsible.

Production of meat in the United States increased at a rate of only slightly over one-half of 1 percent per year between 1901 and the 1930's. Its increase accelerated to 2 percent per year from the 1930's to date. The earlier rate failed to keep pace with growth in population. The later rate outran population, and record highs in meat consumption per person were set during

the 1950's. The increase in meat production has been closely linked to the uptrend in production of feed. The relationship of feed to livestock production has not changed greatly. Most efficiency in livestock has appeared in use of labor and capital, not in feed conversion rates.

Although production of beef has gone up faster than that of pork, more impressive is the difference in trends in value of the two meats. The retail value of beef consumed, which is an approximation to expenditures, has increased 97 percent as fast as has disposable personal income after correction for influence of price level—a phenomenal rate of growth. The retail value of pork has increased only 18 percent as fast as disposable income. These data indicate how much greater a part of the growing national resources has been devoted to production of beef than of pork.

Quality of meat produced has been upgraded substantially. Demand for pork has shifted away from the fatter products of pork, and progress has been made toward producing leaner pork. Quality of beef has been improved even more, chiefly by means of feedlot feeding of cattle of beef breeding.

Shifts in distribution of population and changes in the meat-eating habits of farmers have added to demand for meat and especially to demand for beef. Migration both from East to West and from farm to city had these effects. Farm families once ate twice as much pork as beef, and they ate considerably less total meat than did city people. Farmers' meat diets are now scarcely different from those of city families. For example, in 1955 farm families ate 89 percent as much meat per person as nonfarm families, and almost as much beef as pork. Redistribution of population and changed meat diets of farmers are estimated to have added 1.2 billion pounds, or 5 percent, to consumption of all meat from 1920 to 1955. This increase was made up of a gain of 2 billion pounds or 15 percent in beef and a loss of 1 billion pounds or 9 percent in pork plus small increases in veal and lamb.

Several technological and institutional factors have contributed to enlarged demand for meat in general and beef in particular. These include expanded use of refrigeration in homes, increased retailing of meat in supermarkets and use of self-service in meat display, more advertising and promotion, and larger use of Federal grading for beef, veal, and lamb.

The effect of the various price-making forces on the retail price of meat can be analyzed statistically by means both of time series regressions and of family budget data. The two techniques differ in meaning and results. Time series analysis reveals how meat has participated in the growth of our economy. Family budget data indicate how a particular supply of meat was apportioned among various groups of consumers at a particular point in time.

Over the 40-year time-span covered in this study, changing supplies of beef had about a proportionate effect on the price of beef, for an approximately unitary elasticity of demand. The net regression for personal income (deflated) on price of beef was 0.58. These results are rather encouraging for the future

development of larger markets for beef; they indicate that expansion of the national economy would open up a market for beef at a rate three-fifths as fast as its own growth rate, while the filling of this market would not be hampered seriously by oversensitivity of beef prices to supply.

Despite a slow decline in supply per person, the price of pork has set an unimpressive record during the 40 years. Because changes in supply have not been great, the unitary demand coefficient reported for the entire period is not very reliable; it does not indicate whether a steady increase in supply of pork could be absorbed readily. Though analysis showed deflated consumer income to have influenced the price of pork materially, this positive effect of economic growth was offset by a long-term downtrend in consumer demand for pork. Statistically, there seems to be a contest between rising real income in increasing demand for pork, and passage of time in reducing it.

Sharply in contrast with the unitary elasticity of demand for both beef and pork in the long run was its inelasticity in the short run. Short-term demand for each meat has not only been inelastic, but it is becoming more so. Price consequences of short-term changes in supply are now severe.

Beef and pork are competitive. Coefficients show that the supply of a competitive meat affects the price of a given meat a fourth to a half as much as does the supply of that meat. It is likely that the more reliable range is a fourth to a third.

In terms of supply of meat, lamb is so minor that its price is influenced more—and, in later years, increasingly more—by the supply of beef, pork, and veal, than by its own supply. Long trends in demand for lamb, as revealed by net regression on time, appear to have swung from a slow increase in earlier years to a decrease more recently. But it is possible that the reduction in supply of lamb made available contributed a great deal to the apparent loss in demand.

Budget data from a 1955 household food consumption survey gave particular emphasis to the tendency of consumers having higher incomes to pay a higher price and, presumably, buy a better quality of meat than do lower income consumers. Income appeared to have less effect on total demand for meat as viewed in this static study than is found in the time series analysis. For purpose of prediction, the time series data are the more valid, provided overall economic growth in the future is of a dynamic character similar to that of the past.

Prices of beef, pork, and lamb were more responsive to the general price level during the depression of the 1930's than in other short-run periods. The price of pork was more sensitive to price level than were the other two meats. Over the entire period, prices of meat advanced more than proportionately with the general price level; however, this is attributable solely to the drastic adjustment in all commodity prices which took place just after World War II. In that adjustment, prices of meat and meat animals gained an advantage over other commodities.

The peculiar, and temporary, nature of postwar price adjustments bears especially on relationships between farm prices of meat animals and retail prices of meat. In those adjustments

the farm-to-retail price margin for meat increased much less than the price of meat, and, also, less than the general price level.

Due to its brief postwar lag, the marketing margin for meat for the entire 10 years of the study shows the same average rate of increase as does the general price level. Since 1948, however, the margin has outrun both the price of meat and the general price level. Consequently, the advantage producers of meat animals enjoyed immediately after World War II has gradually been lost. The apparent relentless tendency of the marketing margin to widen is a substantial factor in any estimation of the future economic position of meat and meat animals—indeed, the only truly discouraging one.

To some extent, more services are included in farm-to-retail margins now than heretofore. Although data for measurement are lacking, it may be that, to some extent, demand for services has increased. The higher prices that higher income families pay for meat doubtless reflect not only a better quality of meat but also more marketing service bought with it.

MEAT AND MEAT ANIMALS IN THE ECONOMY

Meat enjoys a high standing in consumer preferences and it also holds a high place in U.S. agriculture. These are facts of first importance.

Meat is a major item in the budget of most consumers. As an average for all families, the cost at retail of meat eaten in 1959 was the equivalent of 5 cents of each income dollar received, net of income taxes. For all consumers combined, the total retail value of meat consumed in that year was about $15.9 billion.[1] How large this is may be seen from the following comparison with actual expenditures for selected other goods and services, as reported for 1959 by the U.S. Department of Commerce: (*45*)[2]

	Billion dollars
Housing	40.5
All self-provided transportation	35.5
Furniture and household equipment	18.2
Medical care	18.2
Meat, retail value	15.9
Household utilities	12.0
Radios and television	3.5
Cleaning and laundering services	2.8

Expenditures for meat are close to a fourth of expenditures for all food.[3]

[1] Actual expenditures may have been more or less, as some meat is consumed at less than urban retail prices, some at more. The retail value series nevertheless is realistic and affords meaningful comparison. See page 46 for further explanation.

[2] Italic numbers in parentheses refer to Literature Cited, page 98.

[3] In the 1955 Household Food Consumption Survey (*40*), value of meat was 24.7 percent of all food used at home. Some other studies show a slightly lower percentage.

As meat is a substantial item in the total economy, its production ranks high in the farm economy; sale of meat animals is the largest single source of income to farmers.

Cash receipts to farmers from sale of products in 1959 were composed of the following:

	Million dollars	*Percentage of total*
Cattle and calves	7,893	23.8
Hogs	2,806	8.5
Sheep, lambs and wool	438	1.3
All meat animals and wool	11,137	33.6
Dairy products	4,617	13.9
Poultry and eggs	2,906	8.8
Other livestock and products	195	0.6
Total livestock	18,855	56.9
Wheat and other food grains	2,229	6.7
Corn and other feed grains	2,367	7.1
Cotton	2,576	7.8
All other crops	7,119	21.5
Total crops	14,291	43.1
Total receipts[1]	33,146	100.0

Of the total 1959 cash receipts of $33.1 billion, $11.1 billion or 34 percent was obtained from sale of meat animals and wool. This percentage is indicative of the high importance of meat animals to agriculture.

On the other hand, this percentage overstates the proportion of all farm resources utilized in the care and production of meat animals as such—their "husbandry." Meat animals and other livestock are the outlet for most of the feed grains, and all the forage, produced on U.S. farms. Meat animals, together with other livestock, are essentially a processing enterprise—they are a converter of raw materials. Cash receipts from meat animals are the sum of the value of feed used in their production and of the "value added" to that feed through the livestock enterprise.

Features of Meat as a Commodity

Meat and meat animals are predominantly domestic products. Their foreign trade, as an average for many years, is relatively small. During 1950–60, imports of meat were only 2.4 percent of U.S. meat supply. Imports of live animals, in meat equivalent, were an additional 0.5 percent of supply. Exports of meat were 0.7 percent of the U.S. supply (table 1).

These broad averages, to be sure, can hide the significance of foreign trade for some products at some times. Foreign trade in meat and meat animals has the following characteristic features:

(1) *Its cyclical character.* Imports of both meat and live animals are of highly cyclical nature, expanding to supplement U.S. supplies when those supplies are cyclically low, then contracting upon the expansion of U.S. production.

[1] Excludes government payments and value of home consumption.

TABLE 1.—*Meat and meat animals: Imports and exports relative to total U.S. supply, 1950–60* [1]

Year	United States meat supply							Exports and shipments of meat [4]
		By source						
	Total	Carryin stocks	Imports of meat	Produced from U.S. slaughter			Total from foreign source [3]	
				Total	From imported animals	From U.S. produced animals [2]		
	Million pounds	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*	*Million pounds*
1950	23,084	625	384	22,075	160	21,915	544	135
1951	23,110	670	542	21,898	92	21,806	634	157
1952	24,298	798	506	22,994	47	22,947	553	185
1953	25,923	797	438	24,688	65	24,623	503	196
1954	26,240	608	418	25,214	38	25,176	456	171
1955	27,962	661	406	26,895	94	26,801	500	195
1956	29,054	656	363	28,035	43	27,992	406	257
1957	27,958	556	543	26,859	222	26,637	765	269
1958	27,130	346	1,126	25,658	342	25,316	1,468	169
1959	29,030	405	1,306	27,319	194	27,125	1,500	198
1960	29,732	491	1,010	28,231	165	28,066	1,175	194
Average 1950–60	26,684	601	640	25,443	133	25,310	773	193

	Percentage of total supply							
1950	100.0	2.7	1.7	95.6	0.7	94.9	2.4	0.6
1951	100.0	2.9	2.3	94.8	.4	94.4	2.7	.7
1952	100.0	3.3	2.1	94.6	.2	94.4	2.3	.8
1953	100.0	3.1	1.7	95.2	.2	95.0	1.9	.8
1954	100.0	2.3	1.6	96.1	.1	96.0	1.7	.7
1955	100.0	2.3	1.5	96.2	.3	95.9	1.8	.7
1956	100.0	2.3	1.2	96.5	.1	96.4	1.3	.9
1957	100.0	2.0	1.9	96.1	.8	95.3	2.7	1.0
1958	100.0	1.3	4.2	94.5	1.3	93.2	5.5	.6
1959	100.0	1.4	4.5	94.1	.7	93.4	5.2	.7
1960	100.0	1.7	3.4	94.9	.6	94.3	4.0	.7
Average 1950–60	100.0	2.3	2.4	95.3	.5	94.8	2.9	.7

[1] Carcass weight equivalent.
[2] Obtained by subtraction.
[3] Meat and meat animals.
[4] Exports of live animals are negligible.

Total meat animal and meat imports declined from 634 million pounds in 1951 to 406 million in 1956, then rose to 1,500 million in 1959. They declined once more in 1960, to 1,175 million pounds.

(2) *Sizable imports of feeder stock.* A large part of meat animals imported are feeder cattle and calves received from Canada and Mexico—these supplement the U.S. supply of animals for feed-lot feeding.

(3) *Substantial quantities of lower grade cattle and beef imported.* Much of the beef that is imported is of low grade. Some is canned beef for direct consumption and some is fresh or cured beef for processing. Likewise, a sizable percentage of slaughter cattle brought in are of lower grade stock, suitable as source of processing beef. Trend in U.S. beef production toward the higher grades has created a demand for lower grade products from foreign sources. However, this demand is notably cyclical; it is strongest when many cows are being withheld from slaughter for the purpose of expanding U.S. cattle herds.

(4) *Preferred products of pork imported.* Whereas much of the beef import is a supplemental supply of lower grade product, most imported pork is of preferred products. A high percentage of all pork products brought into the U.S. consists of canned hams.

(5) *Miscellaneous products of pork and beef exported.* Exports of meat from the United States once were large but are now essentially confined to certain minor products. Among these are variety meats—liver, heart, and so on.[5] Exports of pork often are of lower quality and fatter cuts. As pork imports are products of high quality, foreign trade in pork acts as an exchange for meat U.S. consumers like least, for that they like most.

Major beef exporting countries such as Argentina and Australia raise cattle on an extensive scale and produce much middle grade, grass fattened beef. As production of better grades of beef requires intensive grain feeding, it is not well adapted to the beef exporting countries, which have only limited supplies of feed grains available. On the other hand, the major pork exporting countries, Denmark and the Netherlands, produce a lean-type, barley-fed hog which results in better quality pork than the fatter, corn-fed hogs grown in the United States. The United States produces most of the good beef its consumers want, but relies on imports to supplement its supply of the best cuts of pork.

Not much meat is stored from year to year. For 1950 to 1960, the average carryin was 2.3 percent of supply, and the largest for any of those 11 years was 3.3 percent (table 1). Moreover, although year-to-year changes in exports partially offset year-to-year changes in meat production, changes in stocks are less effective in this regard.

These features of meat supply are simplifying to price analysis.

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[5] Quantities of variety meats are not included in the export data of table 1; those are officially classed for statistical purposes as edible offal rather than as meat.

Because demand for meat to go into stocks is so small, and net foreign trade is seldom very large, annual consumption is almost equal to production. Use of production alone as a measure of annual meat supply to consumers is a convenient shortcut in price analysis.

Unlike many farm commodities, meat finds its exclusive use as a food; and except in wartime, most of its consumption is by the civilian population. Although rates of consumption per man are higher in the military than in the civilian population, total military takings in 1959 were only 2.0 percent of total consumption.

Individual household use predominates in meat consumption. According to most estimates it accounts for 75 to 80 percent of all meat consumed.[6] The remaining 20 to 25 percent consumed outside households is large enough to bear on price analysis; however, neither a theoretical structure nor empirical data are available to make allowance for it. Significant studies of institutional feeding have begun only recently (*14*), (*18*), (*34*), (*38*).

Institutional Setting for the Making of Retail Meat Prices

Prices of meat animals and meat are closely related and they are subject to the interplay of all the economic and other forces that bear on them. Actual prices at any given time and place, however, originate in the marketing system. That system is by no means neutral with respect to price-making; its makeup and efficiency can have much to do with the level of prices that is arrived at. Moreover, unless either demand or supply is highly elastic, influences of the price-making mechanism on prices can persist for quite a long time.

The meat marketing system is more than a setting for price-making—in many respects it is functional. It provides processing and transport in meat distribution, and it is a communications center. It transmits to producers the demands of consumers for meat and marketing services, and passes on to the final consumer the results of the plans and intentions of producers. Price is the magic device, the universal language of trade, often supplemented but seldom replaced.

Many of the various price-making forces find their focus at the retail level. It has become almost traditional in price analysis to search diligently for an explanation of prices at retail, and to convert them to wholesale or farm level by routine adjustment for marketing costs. The study upon which this report is based also centers on analysis of retail prices of meat, but the discussion beginning on page 12 develops at some length the relationship between price-making at successive marketing stages. That relationship is rather involved and complex.

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[6] In 1954–57, the retail value of all food going to "eating places" was 16 to 17 percent of the retail value of all food disappearing into civilian channels. In Minneapolis and Fairmont, Minnesota, in 1948, where 16 to 18 percent of all food was marketed by eating places, 21 to 22 percent of all meat, fish, and poultry was so marketed. These data make it appear that non-household consumption of meat amounts to 20 to 25 percent of total civilian consumption. *Cf.* (*18*, p. 3), (*34*).

No measuring device is at hand by which to judge the effectiveness or efficiency of the marketing system. Inasmuch as the system is designed to conform to the principles of a freely competitive enterprise economy, the best—and certainly most customary—means for evaluating it is to observe how closely those principles are in fact adhered to.

Specifications of perfect competition begin with the requirement that there be many buyers and sellers.[7] Commodities must be standardized, or essentially so, as it is impossible to compare prices of differing products with exactness. A third market characteristic often regarded as essential is ease of entry: It should be possible for any new firm to enter the market without obstruction.

Close contact and accurate market information are usually considered necessary to make a market work "perfectly."

Advertising, now so much a part of the U.S. economy, is inconsistent with the more exacting definitions of perfect competition. Chamberlin (*7*, p. 10), an authority on the subject, declares that "advertising and selling outlays" are a "complete misfit" if the theory of perfect competition is to be applied to the working of economic forces.

Economic literature is replete with elaboration of the meaning of concepts of perfect competition to the firm, the industry and the economy; for example, (*21*).

In the commodity area of meat the conditions of perfect competition are as nearly met as anywhere in the economy. This is not to suggest that they are entirely satisfied, or even very nearly so, for they are not. But a relatively good case can be made for meat compared with other commodities. Data bearing on this question, pro and con, will follow.

In 1954, there were 279,440 grocery stores in the United States, a sizable number. However, for the criterion of "many sellers" to be complied with, several stores must be available to each buyer. The facts that (1) the size of store varied so widely, and (2) most consumers prefer to shop near home, present evidence that indicates less than perfect competition. Certainly the qualities of "reputation, convenient location," and others that Chamberlin lists as differentiating are commonly associated with retail grocers (*7*, p. 8).

Evidence on wide variation in size of store is found in Census data showing that in 1954 single unit stores averaged $70,000 sales, while stores in firms having 11 or more units averaged $802,000 sales per store (*49*, p. 23).

Extensive and continuous advertising by food retailers is further proof that Chamberlin's requirements are violated.

Nearly perfect competition at the retail level, even if it existed, would have limited effect unless a high degree of competition prevailed also in meat packing. Statistics are available on extent of concentration among packers. However, these data too are inconclusive. They do not of themselves demonstrate whether

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[7] No distinction was made in the study between "perfect" and "pure" competition. The former term is used, largely as a convenient antonym for imperfect competition.

conditions meet minimum acceptable standards. In 1960, meat packing plants numbered the following: (*29*)

Federally inspected	530
Other commercial: large	902
medium	1,712
Total	3,144

There is considerable concentration within these numbers. In 1955, the percentage of all commercial slaughter accounted for by the largest firms was: (*49*, p. 23)

	4 largest	*10 largest*
Cattle	30.8	37.9
Calves	34.7	40.4
Sheep and lambs	58.5	68.5
Hogs	36.4	57.6

A weighty factor in judging the degree of competition in marketing and distribution of meat is the fact that meat is a fairly standard, uniform product. Much of it bears no brand name or other identification of the packer or retailer. Particularly is meat that is sold fresh, which includes most beef and more than a third of all pork, customarily unmarked by private brand or label.

A high percentage of beef and considerable veal and lamb sold fresh is identified by a U.S. Government grade. A great deal more is graded for wholesale sale only. Among its other effects, U.S. Government grading contributes very materially to an approximation to perfectly competitive pricing. Grading aids in standardized, perfectly competitive selling at both retail and wholesale (*3*).

Concentration seems to be on a decrease in meat packing but on an increase in retailing. A general reduction in concentration in meat packing was reported from 1947 to 1955 (*49*, p. 21). On the other hand, the 12 largest chain food companies increased their share of all sales by grocery stores from 27 percent in 1948 to 30 percent in 1954. The 3 largest had 22 percent of total sales in 1954. Moreover, as another measure, sales by supermarket retailers "increased from 43 percent to 62 percent of food stores' sales in 1952–56 and they appear to be assured of an even larger share in the years ahead." (*49*, p. 32)

Growing size and market power of food chains has become a major factor in the market structure for foods, including meat. In farming circles the searchlight has been diverted, at least in part, from meat packers to food chain retailers. Moreover, meat packers themselves have frequently protested publicly that their outlets were so dominated by a few chains as to prevent competitive price-making.

A recent study by the Federal Trade Commission of competitive methods and practices used in marketing foods confirms the earlier reports such as those quoted above. It too indicates that chains of 11 or more stores showed greater gains in sales from 1948–58 than other retailers. "Total food store sales increased 72 percent. Food chains increased their dollar sales 118 percent (census data) or 123 percent (FTC survey)." (*46*, p. 3)

If these trends toward concentration in retailing should con-

tinue, they would raise serious question whether the minimum requirements for competitive pricing are any longer fulfilled. High concentration at one or more levels of meat packing, processing and distribution would make it necessary to discard the traditional description of price behavior as an expression of the operation of perfectly competitive forces. The replacement would be the newer concepts, as yet only partially developed, that have been highlighted and popularized by Professor Galbraith's coinage, "countervailing power." Much of the developing theory centers on principles of negotiation, for example (*25*) and (*47*).

Relation Between Retail and Farm Prices

Meat is exclusively a food, and meat animals are now produced primarily for their meat. Not so many generations ago cattle were slaughtered in the U.S. West for their hides. The carcass was discarded. In 1959, 91 percent of the value of Choice grade cattle was derived from their meat, and only 9 percent from their hide and all other byproducts combined. Even the value of lard lifted the byproduct return from hogs to only 13 percent of their total value (table 2). Meat is clearly the main product of meat animals.

Table 2.—*Distribution of retail price of beef and pork, and of farm value of cattle and hogs, 1959*

Meat	Distribution of retail price of meat			Distribution of farm value of meat animals		
	Price per pound at retail	Farm-retail spread	Net farm value[1]	Gross farm value	Value of by-products	Net farm value[1]
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Beef, Choice grade	82.8	31.7	51.1	56.2	5.1	51.1
Pork, retail cuts	57.1	29.8	27.3	31.3	4.0	27.3
	Percentage of totals					
Beef, Choice grade	100	38.3	61.7	100	9.1	90.9
Pork, retail cuts	100	52.2	47.8	100	12.8	87.2

[1] Value of the quantity of live animal required to produce one pound of meat at retail. Excludes value of byproducts.

Compiled from *Marketing and Transportation Situation*, January 1961, (*28*).

This fact alone causes the pricing of meat animals to be related closely to that for meat. Even more important as a reason for the close relationship is the limited transformation given meat before it reaches the consumer. Fresh meat is distributed after only "dressing," which only changes its exterior form, with no manufacture or processing. Of meat that is processed, much receives only a rather simple and superficial treatment such as

the smoking or liquid cure given hams and picnics. Moreover, the slaughter of meat animals and distribution of meat claims a relatively small part of the consumer's dollar spent for the final product. In 1959 this farm-to-retail spread was 38 cents of the dollar spent for Choice beef, and 52 cents of the dollar spent for pork (table 2). Compared with spreads for other foods, these are narrow. In 1959, the farm-to-retail spread for all foods absorbed 62 cents of the retail dollar.

To repeat, price-making for meat animals is closely related to that for meat. In modern economic thought, price analysis for commodities related in this way is frequently centered on the retail level. Prices of the more basic commodity are regarded as derived primarily from the price as determined for the retail product (*26*, p. 42). Analytically, they are said to be the retail price less a more or less routinely estimated "marketing charge."

Even though the relatively close price relationship between prices of meat and meat animals lends much validity to this point of view, it should not be overstressed. Pricing of meat animals as sold by the farmer and of meat at retail are two separate and detached processes. Not in every respect is the farm price purely derived from and synchronized with the retail price. The sensitivity of their relationship depends in large measure on how well the marketing system conforms to the ideal of perfect competition. At the least, the marketing system needs to approach that ideal, or equally satisfactory alternative market institutions must be present.

Thus the exactness of the tie between farm price of meat animals and the retail price of meat rests on the same kind of judgment as to the characteristics of the price-making system as was discussed above in connection with the determination of retail prices.

Relationship of farm to retail prices in the very short run is especially influenced by the nature of the price-making process. Prices at retail are often "sticky," slow to be changed, especially for processed meats. Prices at the farm are more variable and can even be volatile. The urgent position of the farmer whose cattle or hogs are at peak condition and must be sold, proclaims the partial independence of farm-level pricing from that at a retail meat counter that may be thousands of miles distant.

Many studies have reported the tendency of changes in retail prices of meat to lag behind changes in farm prices of meat animals. For pork, supplies and prices of which have a marked seasonal pattern, this tendency results in wider spreads or margins, on the average, in the second half of the year, the period of maximum supplies, than the first half (*33*, p. 24).

A similar pattern appears when meat animal prices go through their characteristic cycles. "For livestock and meat . . . margins . . . have exhibited a persistent short-run tendency to widen when supplies are increased and narrow when supplies decrease . . . a direction of movement that adds to instability of prices to farmers . . . *The greater the increase in supply, the wider the margin.* Conversely, the more supply decreases, the more margins shrink. Far from being constant in either dollars-and-cents or percent, marketing margins for meat fluctuate greatly in the short run

according to the rate of change in market supplies of livestock." (*4*, pp. 691–92).

Marketing margins for meat animals in shorter time periods thus bear no close relation to either the price of meat or marketing costs. They are truly a "margin" and not a cost, as they reflect differential trends in prices of live animals and meat.

The longer run behavior of meat and meat animal prices introduces another viewpoint. When consumers buy meat they pay for not only the farmer's labor and feed, but also for all the goods and services expended in preparing the retail product and delivering it for retail sale. If consumers increase their willingness to spend money for meat, a supply-increasing signal is sent out to the marketing system. But who receives it? Marketing agents, who may be encouraged to provide more marketing services? Or livestock producers, who thereby feel a similar encouragement to produce more livestock? And what is the response of marketing firms and farmers in either case?

In technical economic language these are questions of relative elasticities of demand and supply for marketing services versus the product itself. Although conclusive analyses bearing on these questions are few, there is much evidence that demand for marketing services has increased substantially in the last several decades. The premium which high income consumers place on quality and service, as revealed in budget studies (see page 97), contributes much to that evidence. Unless the supply of marketing services were extremely elastic—it almost certainly is not—the resulting tendency would be for prices of meat at retail and of meat animals at the farm to diverge. The marketing spread would become wider.[8]

Further complicating the problem of understanding price and supply forces in marketing is the role of advertising and other promotion. This is a marketing service, and it involves a cost. The question is whether it lifts the demand curve sufficiently to offset its cost. Insofar as promotion (including advertising) is engaged in, it definitely appears as an added marketing charge, and it lowers the percentage of the consumer's dollar received by the farmer. But does it induce consumers to spend enough more dollars that the farmer's dollar return is as high or higher than it would be without promotion? Few if any satisfactory analyses of the impact of promotion are to be found (*48*).

Farm and retail prices thus can fail to follow identical courses in the longer run, as demand and supply relationships vary at successive marketing levels.

In summary, marketing spreads or margins for meat are highly affected in the shorter run by current but transitory situations of supply of livestock and meat. Over a longer time, they are determined by the quantity and cost of marketing services performed, which in turn reflect both consumer wishes and the organization and responsiveness of the production and marketing system.

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[8] Dale Hathaway summarizes the thesis, previously presented by Schultz and by Bunkers and Cochrane, that "the income elasticity for marketing services is higher than for the farm products component of food at retail . . ." (*13*, p. 488).

Over a very long period the marketing margin for meat has displayed almost the same trend as has the consumer price index. Witness the data in table 3.

For the years 1921–58 (1942–47 excluded), the rate of uptrend in the marketing margin for meat was almost identical with that for the general price level as measured by the consumer price index. This was true for Choice beef, for pork, and for all meat combined. Evidence is the coefficients of 1.01, 0.97, and 1.05, all very near 1.0.

Assuming that cost rates for the various constituent goods and services in marketing of meat have paralleled over many years the price level of the economy, which is plausible, this observation has one of two possible meanings: that marketing services offered, per pound of meat, have remained constant, and efficiency has not changed; or that any increase in quantity of services has been offset—and only just so—by equivalent gains in efficiency.

TABLE 3.—*Coefficients of flexibility of farm-to-retail price spread for meat with consumer price index, selected periods* [1]

Period	Choice beef	Pork	All meat
1921–29	0.41	1.50	0.89
1930–41	1.31	1.51	1.59
1948–58	1.87	1.58	1.85
1921–41, 1948–58	1.01	0.97	1.05

[1] Ratio of percentage change in margin to change in consumer price index.

As a matter of fact, the bundle of marketing services provided has changed greatly in composition. It would be futile to try to assess precisely what the net change in service, or the gain in efficiency, has been. Doubtless both have seen a net increase. It suffices to repeat that, when all is considered, the long-run trend in marketing margin for meat has conformed very closely to the long-run trend in the general price level.

Yet, the prewar-postwar advance in margins and price level is vital to this close association. When individual time periods are considered, the relationship for each shows a tendency for the marketing margin to outrun changes in the price level (table 3). The only exception is Choice beef in 1921–29. For beef, there is a tendency for the margin to increase ever faster relative to the price level. By 1948–58, the margin for beef was increasing 87 percent faster than the general price level.

As margins generally outran the price level in shorter periods, only the prewar-postwar adjustment holds the 38-year relationship so close. Between prewar and postwar years the price of meat animals increased much more, relatively, than did the price of meat. The marketing margin increased relatively less. The livestock producer and meat consumer seem to have benefitted relative to the economy as a whole in the immediate postwar readjustment.

For the shorter periods, a searching question must be asked.

Although there is no way to know how nearly constant marketing services may be, and whether they have included new functions that fully pay their way, the burden of defense is on the marketing industry. If the marketing margin for pork now rises 58 percent faster than the price level, and that for beef 87 percent faster, as has been true since 1948, do added services provided in marketing fully justify such increases? And is efficiency in marketing being encouraged and achieved? To what extent do the added services and costs thereof improve returns to farmers?

Analytically, there is no question at all. So long as present relationships continue, and if the general price level continues slowly upward, the benefit to the producer arising from an increase in demand for meat can be calculated only by taking the associated wider marketing margin into account. Depending on the relative rate of increase in each, the result may or may not be beneficial for him.

FACTORS IN LONG-RUN CHANGES IN DEMAND

National Income

Growth in production and consumption of meat and meat animals has been an integral part of growth in the United States economy. It is only a slight exaggeration to say that whatever has influenced or marked overall economic growth has had some bearing (1) on growth in the supply of meat provided our consumers, and (2) on the pricing of meat.

For a generation, economists have used data on national income to represent both economic growth of the United States in an aggregate physical sense and buying power of consumers as a fund of dollars for spending. In statistical price analysis, national income, in one of its many measures, has been an almost universal "demand shifter." (*12*)

As our national economy has expanded and our national income has increased, extensive changes of noneconomic nature also have taken place. Changes have occurred in the size of our population, its location by region and residence, its makeup by nationality, and other characteristics such as age distribution. In the merchandising of meat great departures from former practice have appeared; witness the replacement of independent "meat markets" by the self-service meat display section of a modern supermarket. The way people work and live and their facilities for preparing food in the home have altered a great deal. These various evolutionary developments are by no means without impact on demand for meat. As a single but impressive example, when electric refrigerators became commonplace in the 1920's, demand for every food that benefitted from refrigeration was given a boost.

Most of the economic and institutional features of economic growth that bear on meat, as well as on all foods, are so intertwined as to resist isolation and separate measurement. For this reason it has become customary simply to regard national

income as a standard-bearer for all economic and noneconomic factors in economic growth. National income has become virtually an emblem of the multiplicity of associated factors that affect demand for food, and a universal component of price analysis for foods.

To so regard national income for purposes of analysis is satisfactory provided its limitations for prediction are borne in mind. Coefficients of regression upon national income as so conceived are reliable for prediction only insofar as the interassociation for which national income is the parameter remains essentially unchanged.

This interpretation of the significance of national income helps to explain why coefficients of regression upon it obtained in time-series price analysis are substantially different from the results of family purchase (budget) studies in which expenditures for food are compared as of a particular time for successive income groups of the population. One is a study of concomitant economic growth in all its manifold aspects. The other relates only to an instantaneous, cross-sectional pattern of food purchases—it is really an apportionment study, showing how a given supply of food is divided (through the economic process) among the various income groups of the population.

Recognition of this fundamental difference between historical and cross-sectional studies will set the stage for the two sets of analyses to be presented in this report.

National income as a concept lends itself to various interpretations. In one sense it is a measure of aggregate national product—of the economy's total output of goods and services. The "measure" is in terms of dollars. It also is thought of as so-and-so-many dollars being passed from employer to employee, or earned by the self-employed. National income may be expressed in current dollars, or in constant dollars. If in current dollars, the income figure for any year is composed of a price level element and of a "real" element. If in constant dollars, it reflects real output only.

It is sometimes assumed in price studies that price level is passive and analyses should be made in terms of deflated price and income data. For some commodities the procedure may be justified. Commodities of farm origin, however, are so notably sensitive to changes in the price level that separate consideration of the general price level as a factor is warranted. This is particularly true for shorter-run studies. In the analyses presented in this study (beginning page 55), the price level and real components of national income are taken as separate independent variables. The procedure allows price level and real-purchasing-power forces to be appraised independently of each other.

Use of real-product or real-purchasing-power as a separate and independent variable in analysis essentially means that the economic system may be viewed, in one of its aspects, as consisting basically of production and exchange of goods and services. This price-less concept not only has certain analytical usefulness but also reminds that economic values are inherently real and not dollar ones. Employment of this technique allows these ques-

tions to be asked: As our economy has grown in outturn of goods and services per person, how has beef (for example) fared in its output and its exchange ratio with other commodities? How has the exchange ratio varied as the supply of beef has fluctuated?

For convenience, the measure of national income used here is the conventional disposable personal income series. It is expressed on a per-person basis.

Figure 1 presents trends since 1921 in disposable income per person, in the consumers' price index, and in deflated or "real" disposable income per person. All three show uptrends during the overall period.

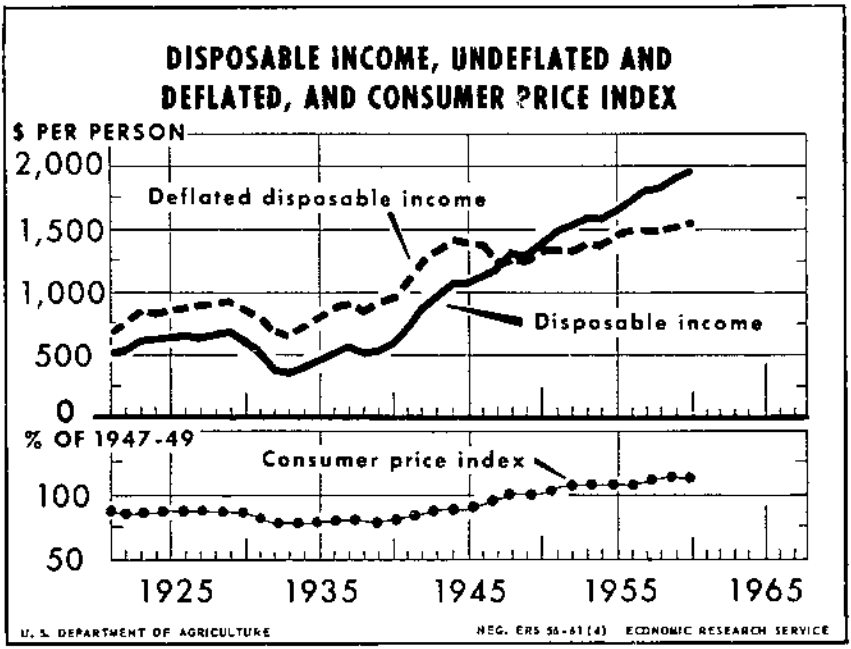

FIGURE 1

As an aid in analysis the entire span of years may be broken into shorter periods having the following characteristics:

(1) *1921–29. A time of rising disposable income per person that consisted entirely of increasing output of real goods and services.* The consumer price index was stable.

(2) *1930–41. A period of business cycle fluctuation.* A nose-dive in disposable income until 1933 consisted almost equally of lower real production and a falling price level. The uptrend in income from 1933 to 1941 was primarily a gain in real output of the economy, as the price level increased relatively more slowly.

(3) *1942–47. These were wartime years of price control, followed by postwar inflation.* By 1947, disposable income

per person was substantially above 1941, but while the price level was up 52 percent real income per person had gained only 12 percent.

(4) *1948–60. Another period of prosperity, somewhat similar to the 1920's.* However, a major difference was the rising price level in this later decade. A 20 percent rise in the price level during this period was a faster uptrend than the 15 percent increase in real disposable personal income per person.

These are the three periods (1942–47 is excluded) for which price analysis will be reported in the section beginning on page 55.

Trends in Population Distribution

Differential trends in population have deep meaning to historical evolution of demand for meat because meat eating habits differ by region and residence. Moreover, the pattern of meat consumption by region and residence has changed over time.

During the growth of our economy the residential (that is, urban vs. rural) and regional distribution of the population has altered so much as to amount to a massive relocation. Highlights of the change are relative movement from East to West, and from farm to city. Between 1920 and 1960 the population of the Pacific Coast more than tripled, and that region's share of the U.S. total jumped from 5 to 11 percent. New England

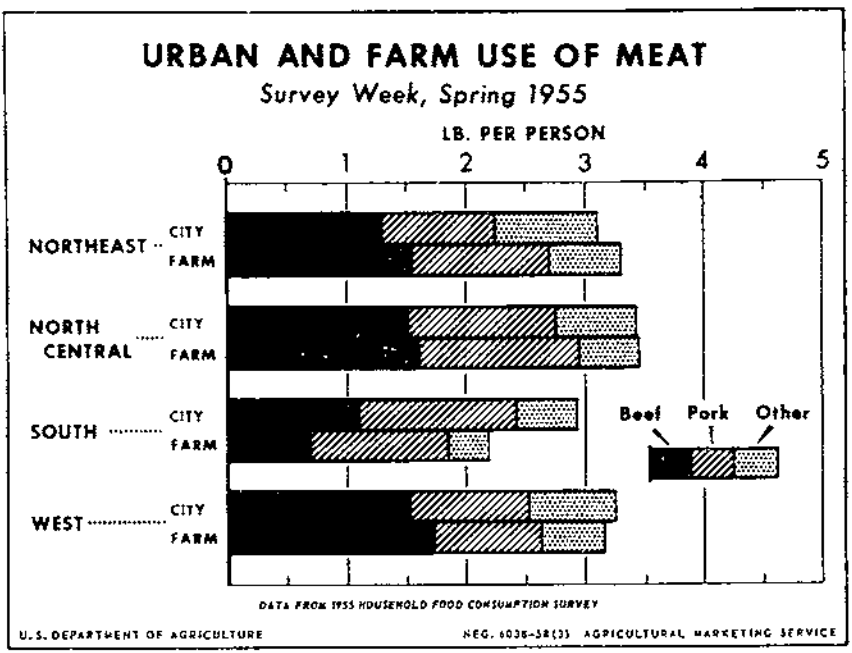

Figure 2

TABLE 4.—*Meat consumed per person, farm and nonfarm households, by regions, one week in Spring of 1955*

Region and household group	All meat[1]	Beef	Veal	Lamb and mutton	Pork	Variety meats[1]	Luncheon meats
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
United States:							
All	3.02	1.25	0.08	0.09	1.14	0.10	0.36
Urban	3.17	1.34	.10	.12	1.13	.11	.36
Rural nonfarm	2.80	1.10	.05	.03	1.15	.08	.39
Farm	2.82	1.18	.02	.02	1.21	.07	.32
Northeast:							
All	3.07	1.29	.12	.19	.98	.13	.37
Urban	3.10	1.29	.15	.23	.95	.14	.35
Rural nonfarm	2.92	1.23	.06	.09	1.01	.10	.43
Farm	3.30	1.54	.05	.07	1.15	.09	.39
North Central:							
All	3.37	1.51	.07	.05	1.23	.09	.42
Urban	3.42	1.52	.10	.08	1.22	.09	.42
Rural nonfarm	3.17	1.43	.05	.01	1.17	.08	.43
Farm	3.45	1.61	.02	.01	1.34	.06	.40
South:							
All	2.57	.85	.04	.02	1.26	.09	.30
Urban	2.93	1.09	.06	.03	1.33	.12	.30
Rural nonfarm	2.32	.64	.03	.02	1.22	.06	.34
Farm	2.18	.68	.01	.01	1.18	.06	.23
West:							
All	3.31	1.62	.07	.13	1.00	.11	.37
Urban	3.25	1.52	.07	.17	1.00	.12	.38
Rural nonfarm	3.58	1.89	.12	.04	1.05	.09	.38
Farm	3.15	1.73	.03	.10	.89	.08	.31

[1] Data as published have been recomputed to exclude game.

Derived from Reports of Household Food Consumption Survey, 1955 (*40*).

and West North Central saw their inhabitants increase in number by no more than a third, and they lagged behind the country as a whole.

Even more marked has been the movement from farm to city. The twilight zone, rural nonfarm, has expanded most of all. The rural farm population was a third smaller in 1959 than 1920. The urban population had increased by three-fourths, and the rural nonfarm had more than doubled. Farm population was 30 percent of the total in 1920 and only 12 percent in 1959.

In the spring of 1955, when a household food consumption survey was taken, differences in meat use per person were as shown in figure 2, data for which are in table 4. Chief observations are the following:

(1) *In the Northeast, North Central and West,* total meat eating is about equally large. Also, farm and urban averages there are similar.

(2) *Farm consumption differs from urban in those three regions* chiefly in its smaller use of "other" meats, which include veal, lamb, variety meats, and luncheon meats. In the Northeast and North Central, farm people eat both more beef and more pork per person than do city people, but in the West they eat more beef and less pork than city dwellers.

(3) *The West as a whole* eats relatively more beef and less pork than other regions.

(4) *The South* is in every respect a special case. Meat consumption is less in the South than in other regions, and it is especially low on farms there. A low use of beef on Southern farms accounts for the small farm total, as farm pork consumption is about the U.S. average.

(5) *Meat consumption rates for the rural nonfarm population* tend to be rather low except in the West. That region's nonfarm rate is the highest of any rate in the United States. (See table 4.)

Much of the difference in meat eating is traceable to differences in income. Certainly the lower average incomes of the South, and of southern farmers in particular, contribute to below-average meat eating in that region.

Yet closer examination of 1955 data reveals some differences not explained by income, notably in pork consumption. These often relate to farm versus city use. As indicated in figure 3, use of beef tends to be somewhat higher, income dollar for income dollar, on farms than in cities. Yet as there is some question as to whether farm and urban incomes are reported in identical manner, the farm-versus-city difference in beef consumption relative to income probably cannot be held as significant.

Not so for pork. For each income group except the lowest, pork consumption, according to the 1955 data, is as high on farms as in cities, or higher. More importantly, the consumption-income relationship on farms is positive, while in cities it has a slightly negative slope. That is, farm families of higher income eat more pork per person than do those of lower incomes, but among city families the higher income groups eat less. Rela-

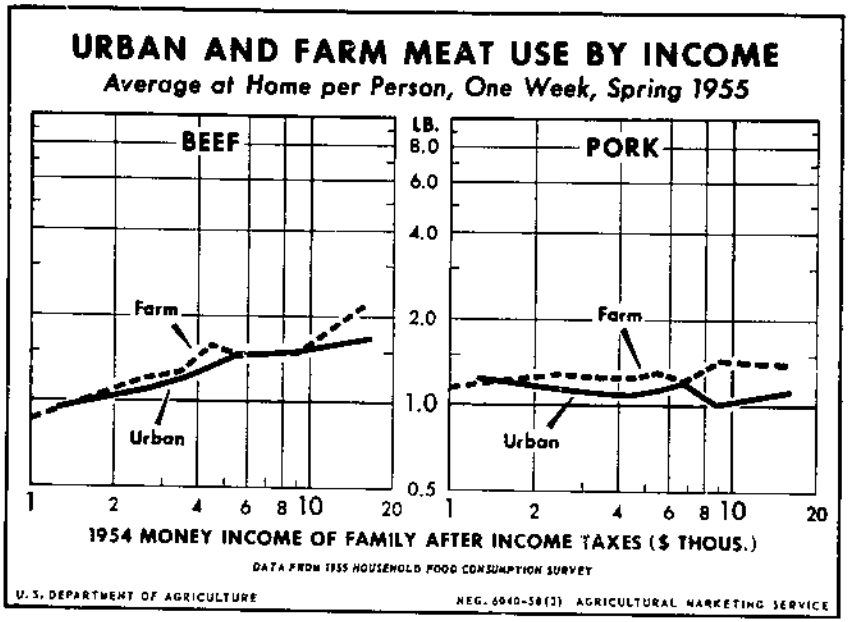

FIGURE 3

tive to income, farmers remain more clearly pork eaters than do city people.

The small differences in meat eating patterns found in 1955 would have an appreciable effect when magnified by the large scale redistribution of population which has taken place. Viewing the South as more pork than beef eating and the West as the opposite, and farmers more pork eating than are city people, we find substantial evidence explaining a part of the historical increase in demand for beef relative to that for pork. Most of the migration of population has been away from regions or residence that are identified as more pork-eating, and toward those that are beef-eating. Population trends and migration have worked against demand for pork and to the benefit of demand for beef.

This influence of changing population distribution on make-up of demand for meat is clear enough even when viewed only in terms of the pattern of differences in meat eating habits as reported for 1955. But the pattern has not been constant, and it has changed in such a way as to widen the disparity between trends in demand for beef and pork.

Years ago, farm-city differences in meat-eating practices were wide indeed, but by 1955 they had been significantly compromised. One cause for change has been the closer social and economic contact brought about by modern means of transportation and communication. Even more a factor is the revolution in facilities for storing meat on farms—first the cold storage locker available in villages, and later the home freezer as it came into use in newly electrified farm homes. Refrigerated storage

simplified the storing of all meat on farms, but it was of greater aid for storing beef than pork. Storage of pork had long been possible through curing, but similar processes for beef were unsatisfactory. It became traditional for farm families to eat beef only during the few weeks after winter "butchering." Pork was the staple meat the rest of the year.

Reliable data indicating the magnitude of this transformation in meat eating on farms are sparse. A study taken in the spring of 1942 affords certain comparisons with 1955. Between the two surveys, farmers' meat consumption increased materially. The makeup of their consumption changed even more. The proportion of beef rose from 30 to 42 percent, while that of pork fell from 60 to 43 percent (table 5). Rough estimates suggest that farmers ate a little more pork per person in the spring of 1955 than in the same season of 1942. Their consumption of beef more than doubled between the two years.[9]

TABLE 5.—*Farm household meat consumption: Percentage distribution by kinds and by source, one week in Spring of 1942 and 1955*

Year	Kind of meat[1]					
	All meat	Beef	Veal	Lamb and mutton	Pork	Variety and luncheon meats
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1942	100.0	29.6	1.1	2.1	59.6	7.6
1955	100.0	41.7	.7	.8	43.1	13.7
	Obtained from home production					
1942	59.8	39.9	50.0	20.0	76.7	16.4
1955	49.2	59.9	37.6	49.8	51.6	10.0

[1] Includes estimates for home canned meat.

Derived from data furnished by Food Consumption and Utilization Section, Economic and Statistical Analysis Division, Economic Research Service, U.S. Department of Agriculture.

The increase in beef consumption on farms in 1955 over 1942 occurred partly through greater home slaughter—made practicable, in turn, by the new freezers in which home-produced meat could be stored. Home-produced beef rose from 40 to 60 percent of farmers' consumption, while the home-produced portion of pork fell from 77 to 52 percent (table 5). It appears that the quantity of home-produced beef eaten increased between two and three times.

In the 1955 survey, consumption of meat per person averaged 89 percent as great for the farm population as for urban (table 4). It seems likely that this is a higher relationship than pre-

[9] Estimates prepared by the Food Consumption and Utilization Section, Economic and Statistical Analysis Division, Economic Research Service, U.S. Department of Agriculture, from data in (*41*).

vailed for earlier years. In 1942, for example, the farm rate was reported as only 64 percent as great as the urban. (*41*) In 1935–36 a comprehensive budget survey yielded data of questionable reliability for aggregation. Relief distribution of food, including meat produced from "drought-emergency" purchases of livestock, interfered with comparisons. The best summary data to be had show total meat consumption per person in farm families to have been 87 percent that of city families. The difference by meats was startling: only 48 percent as much beef was eaten per person on farms as in cities, but 168 percent as much pork.[10]

The only other historical source is a set of estimates compiled for 1920 by the Crop Reporting Board of the U.S. Department of Agriculture (*42*, p. 828). These were based on a questionnaire sent local crop correspondents rather than on home interviews. It is extremely doubtful that the data from this survey are very accurate in their absolute values. Most unexpected of its results is the 5 percent higher rate of meat consumption for farm than for city families. While no conclusive evidence is available to refute this statistic, it is so much in conflict with data for later years as to be highly questionable.

Farm-city relationships by kinds of meat appear more reasonable. Beef consumption on farms was reported as only 61 percent as great as that in cities. Pork consumption per person, on the other hand, was said to be 65 percent higher. This wide difference in farm-city consumption rates for beef and pork, which is consistent with the 1935–36 data, typifies the situation prior to adoption of refrigeration in rural areas. Much of the farm-city gap in meat eating pattern has since been closed.

In the 1920 data, farm use of veal and lamb was less than urban, as has been reported on every occasion.

There is yet one other source of data that provides a clue to trends in meat consumption by farm families. This is farm slaughter of livestock for home use. In the data of table 6, the quantity sold has been subtracted from the estimated quantity of meat produced from slaughter of livestock on farms. As a part of farmers' sale of meat is to other farmers, this correction causes total farm consumption of home-produced meat to be understated. On the other hand, failure to correct would credit as farm consumption the quantity sold to nonfarmers.

Data so computed show that farm families' use of home-produced beef was only about 4 pounds per person in the 1920's and 1930's, but is now more than 13 pounds. Use of home-produced pork increased from just under 50 pounds in those early years to well over 50 in the 1940's, then slid off rapidly to its recent average of less than 40 pounds.

Farmers' use of home-produced pork in 1925–29 was 13 times that of beef; in 1958, was 3 times.

The above data are too meager to permit reliable appraisals to be made as to how much population redistribution has affected consumption of meat. However, a hypothetical calculation will

[10] Taken from unpublished data prepared by Dr. Hildegarde Kneeland on file in the Commodity Analysis Branch, Economic Research Service, U.S. Department of Agriculture.

TABLE 6.—*Consumption of meat per person by farm families from their own slaughter, 5 year averages, 1925–29 to date*[1]

Period	Beef	Veal	Lamb and mutton	Pork	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Average:					
1925–29	8.7	1.3	0.5	48.5	54.0
1930–34	4.0	1.4	.7	50.8	56.9
1935–39	3.9	1.4	.7	46.3	52.3
1940–44	4.8	1.6	.7	52.4	59.5
1945–49	6.8	2.1	.6	54.6	64.1
1950–54	8.7	2.4	.5	42.2	53.8
1955–59	13.8	3.4	.6	38.3	56.1

[1] Computed as the number of head slaughtered by or for farmers multiplied by average yield per head, less estimated sales. These estimates do not include all meat from farm slaughter consumed by farm families, as some sales of home-produced meat doubtless are to other farmers.

illustrate how great might be the effect of farm-nonfarm population change together with new farm dietary habits. If the farm population in 1955 had been the same percentage of total population as in 1920, namely 30 percent, it would have been 48½ million. This is 27 million more than the actual number in 1955. Assuming that the meat eating rate on farms in 1920 was 80 percent the nonfarm rate but the rate for beef was only 40 percent that for pork, and that in 1955 the farmers' meat use was 89 percent of nonfarm and beef was 98 percent that of pork, we can calculate how many pounds of beef and pork consumption were represented in the movement of farm population to towns and cities and in changed farmer eating habits relative to nonfarm.

If as high a percentage of all the population had been on farms in 1955 as in 1920, and the nonfarm meat consumption in 1955 were the same as actually existed but the farm rate bore the same relationship to it as the farm rate bore to the nonfarm rate in 1920, total U.S. consumption of pork would have been greater by 1 billion pounds or 9 percent than it actually was, but beef consumption would have been smaller by 2 billion pounds or 15 percent. Combined beef and pork consumption would have been less, had 1920 relationships prevailed in 1955, by 1 billion pounds or 4 percent.

In the increase in meat-eating due to population redistribution and changed meat diets on farms, beef-eating gained at the expense of pork. This took place in part because nonfarm consumers tend to be more "beef-eating" than are farmers, and also because farm people today eat a lot more beef than did those of yesteryear.

Migration to cities may be said to have enlarged total meat consumption—if capacity to fill the larger demand is assumed—because city families eat more meat per person than do farm families. But apart from migration, if the ratio of farmers' to city folks' meat eating has actually improved as indicated in the ex-

ample, that too, of itself, has helped to increase total meat consumption in the United States.

These illustrative data are not accurate enough to be incorporated in statistical price analysis. It seems clear, however, that the farm-to-city population shift and changed eating habits of farm people have been very substantial factors in the historical growth in demand for all meat, and even more influential in the disproportionate growth in demand for beef relative to pork.[11]

Technological and Institutional Factors in Demand for Meat

Hand in hand with economic growth of the U.S. economy have appeared institutional and technological developments of much importance to demand for meat. They influence demand in total, but they have a differential advantage among kinds of meat.

They have been part and parcel of the overall growth in our economy. Even more than population redistribution, they have escaped separate inclusion in statistical analysis. So long as further progress of similar or equivalent nature accompanies economic growth in the future, their common identification presents no problem. Demand for meat would continue to bear about the same trend relationship with national income as it has in the past. It seems likely that concurrent progress may be expected, and that such an assumption may safely be made. Nevertheless it will be helpful, and will put us on guard in interpreting projected future trends, if some of the historical developments are separately identified. Certainly if the past interassociation should be lost in years to come it would be necessary to deal with various influential developments separately, not as a composite package.

Several of the principal items in technological advance as it affects demand for meat have already been described. Foremost is that in refrigeration. Electric refrigerators became commonplace in urban homes during the 1920's. By 1950, only 14 percent of urban homes lacked them. (*43*) On farms their appearance came later. In 1940 a mere 15 percent of farm families had a mechanical refrigerator. By 1956, however, 90 percent were so equipped. (*1*) Farm families were not quite so underprivileged in earlier years as these data suggest, as they, together with village people, were the primary users of frozen food lockers. These numbered a million by 1940 and about 4¾ million by 1958.[12]

Farmers also have shared in the convenience afforded by home freezers. Total freezers in use in the U.S. were estimated at 10⅓ million for December 1958. (*9*, p. 59) In 1956, 39 percent of farm families had a freezer. (*1*)

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[11] This demographic influence on meat consumption is not confined to the United States. A West German study concludes that "the population shift from the farm to the nonfarm category . . . means a lower consumption . . . of pork . . . With beef the situation is (the opposite) . . . ; additional beef supply becomes necessary as the per capita consumption of the urban population is considerably higher than that of farm population." (*50*)

[12] Estimated from data published by the Farmer Cooperative Service (*19*).

Technological and institutional factors combine in changed methods of meat production and merchandising. Most dramatic among these, in their effect on demand, are those at the retail level. The following major ones may be listed:

1. *Increased size of stores and retailing firms.* "During the 1920's most food retailing was done by relatively small independent stores. In contrast, less than 20 percent of the food product sales in 1957 were made by independent, unaffiliated retailers." (*49*, p. 29)

Recently the greatest growth in food retailing has been that of supermarkets, both chain and independent. "Supermarket sales increased from 43 percent to 62 percent of food store sales in 1952–56 . . ." (*49*, p. 30)

Prime feature of supermarkets is their mass handling of food, presumably at a gain in efficiency and reduction in cost. "Supermarkets first attracted customers by selling at lower prices. To do this they adopted self-services, eliminated credit and delivery, and sought to reduce operating costs wherever possible. Furthermore, they probably obtained economies of scale which helped them cut prices." (*49*, p. 30)

2. *Self-service display of meat.* In years after World War II, retailing of meat by display, pre-packaged, in self-service selection trays was rapidly adopted. By 1958 approximately 50 percent of all meat was sold in self-service meat departments.[13]

Self-service can have an effect on demand for one kind of meat versus another, or certain cuts versus others, or certain grades relative to others. It would be assumed, of course, that retailers adopted self-service because it would increase profits through either reduction of cost or increase of sales. Demand for meat would be increased, in the classical definition, only if more meat were bought at the same price, or if an increase in purchases in response to lower price were greater than normal.

Such scattered data as can be found point to the influence of self-service as positive, and as largely confined to beef rather than pork. Kramer (*17*) reports from a study made in Flint and Grand Rapids in which one-half of paired stores converted to self-service and the other half did not. He concluded that ". . . the stores which converted to prepackaged meat merchandising sold more meat than before they converted and, also, increased their meat sales relative to the butcher-service meat stores."

Moreover, ". . . self-service beef did increase the sale of beef." But ". . . self-serving pork did not increase the sale of pork."

The Michigan study appears to confirm the impression received so often in talk with members of the retail trade, that beef displays more effectively in self-service than does pork.

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[13] Only 11 percent of all grocery stores were estimated as selling meat by self-service in 1958. The number was made up of 60 percent of all chain stores and 6 percent of independents. The larger size of chain stores accounts for the estimate of 50 percent for volume of meat. (*20*, p. 44)

"It was believed that the 'eye appeal' of a nice cut of beef wrapped in film caused beef sales to increase in the self-service store." (*17*, p. 16)

Self-service retailing probably has been of differential benefit to beef over pork, but it has been of most aid to the higher grades of beef. Higher grade beef displays well. Lower grade does not. Said the Vice-President of Safeway Stores, "Self-service . . . has accentuated the demand for the higher quality meats . . . soft, watery meat will not hold up well in self-service.

"Commercial (the new Standard) grade beef will only hold its bloom about 24 hours . . . grass or short-fed beef with higher moisture content will lose more tissue fluids which affects the appearance of the packages." (*23*, p. 13)

3. *Advertising and promotion.* A hallmark of all modern merchandising, advertising and promotion have been brought to bear on trade in meat also. Advertising of meat now runs into about 100 millions of dollars annually.[14]

Here too, accurate estimation of impact is difficult.[15] There is evidence that beef has profited more than other meats. Beef has come to be regarded as ". . . the backbone of the retail meat business." Food chains reporting in a survey said that ". . . 29 percent of their advertising dollars was spent on meat," and beef was a little more than half of the meat total. (*49*, p. 30)

When the U.S. Department of Agriculture attempted to assess the effects of a lamb promotion campaign carried on by the American Sheep Producers Council, it found "the degree of success observed" to be related to the merchandising efforts conducted by the stores themselves. In particular, chains merchandised lamb more aggressively than independents during the promotional period. This was indicated by: (1) an increase in the variety of cuts offered consumers; (2) a larger increase in the proportion of meat display space given the product; and (3) more extensive use of in-store advertising of lamb." (*15*, p. 2)

4. *Federal grading of meat.* A fourth institutional change, already touched on, is increased Federal grading of meat. In 1958, half of all beef produced, a third of lamb and a seventh of veal was federally graded (figure 9, page 40). Of meat sold fresh, to which grading is largely confined, the proportion sold graded is higher.

Grading as a factor in market demand is closely allied with growth of supermarkets and of self-service. Federal grades have also been a convenient basis for much advertising and promotion. Grades and standards of beef have been an agent of both increasing differentiation, and improving quality of product.

"A uniform Nation-wide grading service for meat is help-

[14] Estimate made by Max Cullen, Assistant Executive Secretary, National Live Stock and Meat Board. It is composed of about $50 million each by packers and by retailers.

[15] Frederick V. Waugh has reviewed the problem and the limited success to date (*48*).

ful to both consumers and producers. Consumers can learn to recognize the several Federal grades for fresh meat much more easily than they could a variety of private brands. Federal grades are an effective basis for transmitting consumers' desires to producers. The Federal grading system has been an educational tool for programs to improve quality in meat animal production.

"Widespread use of Federal grades has been a factor accounting in part for the steady growth in U.S. demand for beef." (*3*, p. 20)

FACTORS IN LONG-RUN CHANGES IN PRODUCTION

It is axiomatic that the long-run growth record for any commodity is determined not only by secular trends in its demand, but also by the capacity of production to fulfill whatever challenge demand sets for it. Emerging strength or weakness of demand is both a controlling force over production and a standard by which its adequacy is measured.

Productivity becomes a part of a study in long-run growth for yet another reason. Identification—that is, the separation of the forces of supply and demand—is often cited as complicating short-term price analysis. It does so; but it also has a bearing on interpretation of long-run trends. How readily and widely a product is made available can influence how insistently it is demanded. Over time, demand can be cultivated or discouraged by the very fact of the efficiency with which supply is provided

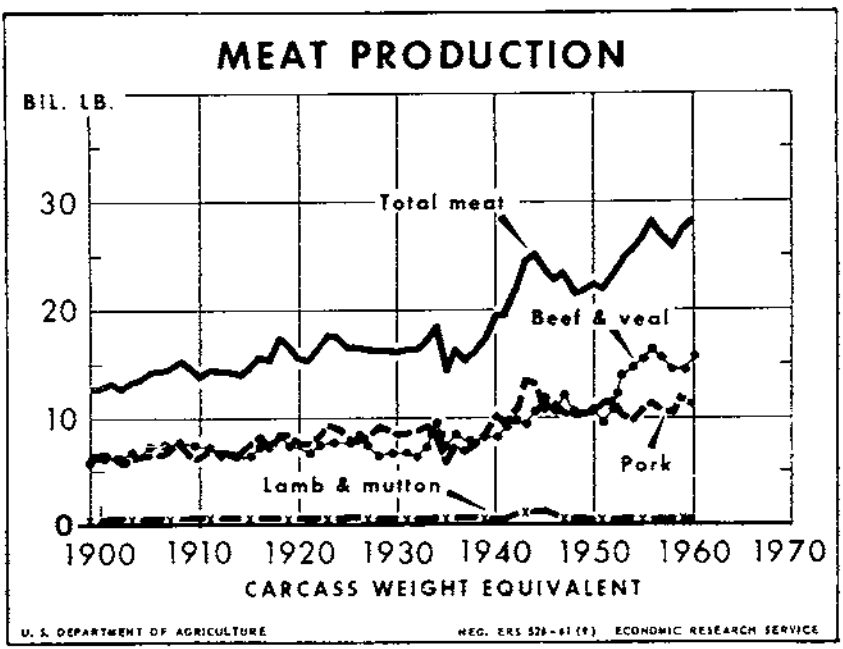

FIGURE 4

to satisfy it. Analytically, this takes the form of different elasticities of demand in the short and long term, to which attention will be called in a later section.

The record of meat production in the United States is one of prolonged expansion, at a slow rate until the 1930's and swiftly since (fig. 4). Between the decades of 1901–09 and 1930–39, meat production increased at an average rate of slightly over one-half percent per year. From 1930–39 to 1950–59 the average annual rate of increase was 2 percent.

From the early 1900's to the 1930's, the increase in production failed to keep pace with population. Meat consumption per person, reflecting the lag in supply, declined from 153.9 pounds in the first decade to 130.6 pounds in the fourth (1930–39). Even though population growth itself speeded up beginning in the early 1940's production advanced even faster. The average consumption of 1950–59, at 153.8 pounds, was well above 1930–39 and approximately equal to the level of the first years of the century. Peak years of the 1950's set new record highs.

Figure 5 graphs these changes in consumption per person.

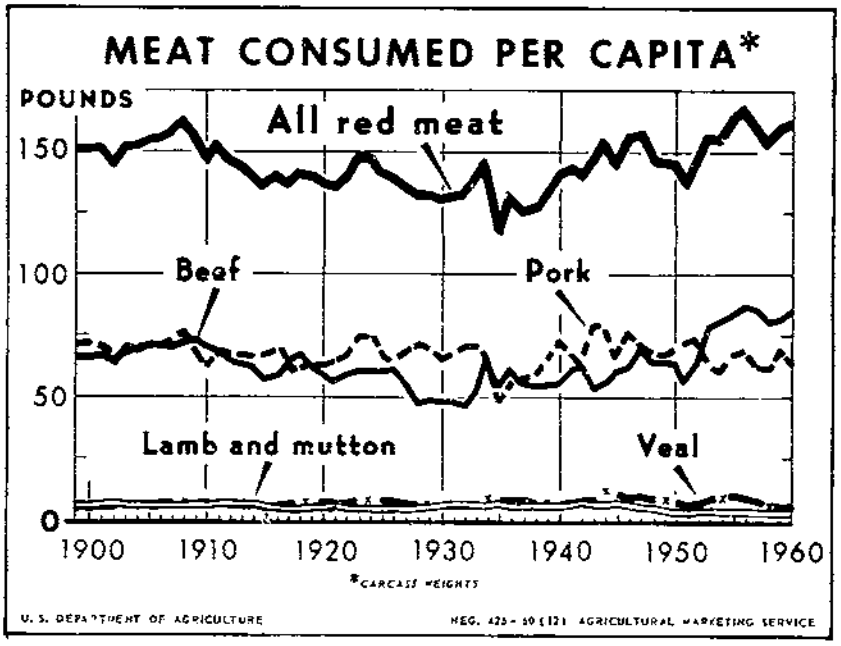

FIGURE 5

More descriptive of trends for individual meats is the sectional chart of figure 6. This is a semi-log chart, on which equal vertical distances represent equal relative rates of change.

The trend in consumption of all meat per person since 1910 has been one of symmetrical downtrend and uptrend, tracing a concave curve. Most of the reversal of trend is ascribable to suc-

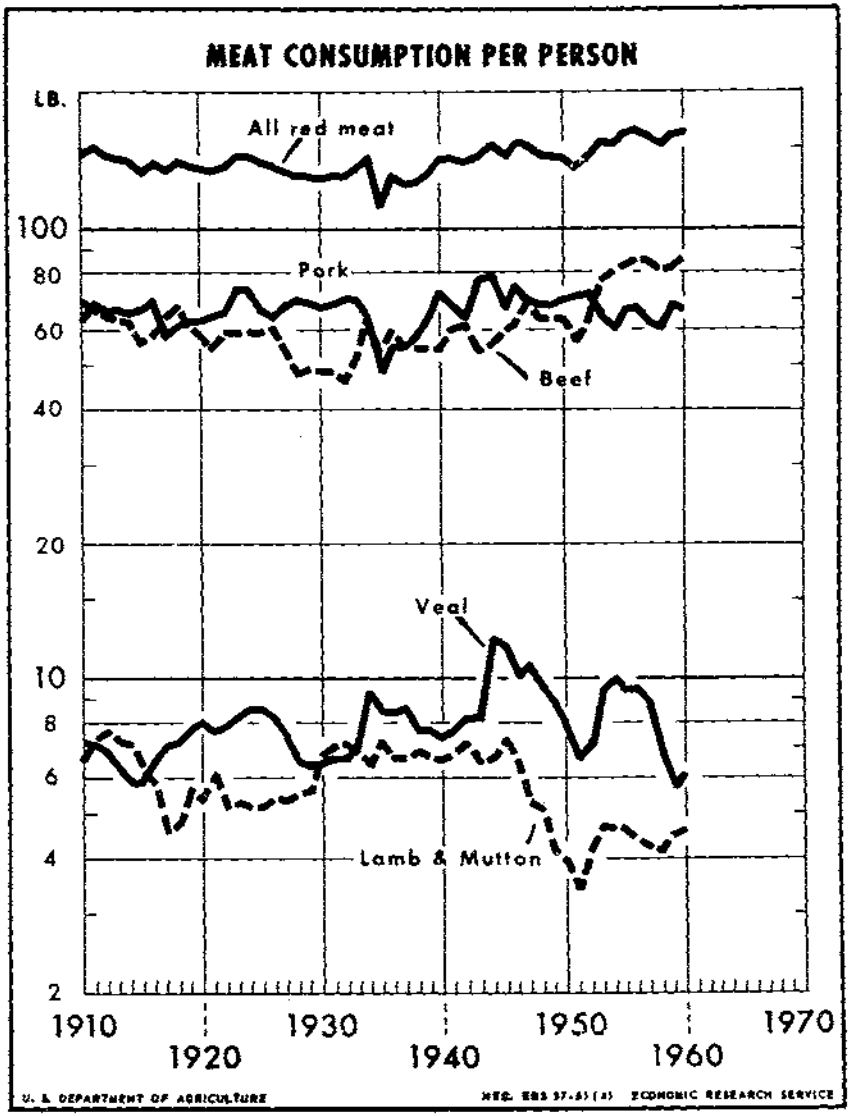

FIGURE 6

cessive decline and increase in consumption of beef. However, beef consumption made more net gain at the end of the period than did total meat. The gain for beef at that time partly counterbalanced a decline for pork. Pork consumption per person has slowly edged lower in recent years.

Sharpest variations, in percentage terms, have been in consumption of veal and lamb. Supplies of veal have been primarily molded by swings in the cattle cycle, as slaughter or withholding of calves has been a controlling factor in the cycle. Sheep production has been so volatile in size, character and location that

no generalized explanation is possible for the fluctuations shown in lamb and mutton consumption.

The overall trend in veal consumption was upward until the 1930's, but has been variable since. The trend in lamb consumption was level until the 1930's, but has been downward since.

Technology in Production

As meat animals are not a primary enterprise but a converter of raw product, the output capacity of the industry is determined in great measure by the supply of raw product at its disposal. Certainly this is true for all livestock as a whole. Reasons are three:

(1) Livestock are almost the exclusive outlet for feed production. Except for net addition to storage in some years, about 85 percent of all feed grains produced, and virtually 100 percent of all forage, is fed to livestock.

(2) Supplies of feed limited the volume of livestock production in most years until government storage was begun. Only recently, when stocks of feed grains began to accumulate in government hands, has livestock production failed to keep pace with production of feed.

(3) The efficiency of conversion of feed to livestock products has been improved only very slowly. Technological gains in the livestock industry have been quicker to appear in use of labor and capital than in use of feed (see below).

The striking expansion in production of meat in the U.S. since the 1930's was made possible by an almost equally striking uptrend in production of feed. The feed grains particularly have displayed a fast increase in output. Data are in table 7, which presents indexes of feed crop and of meat animal production. From the 1930's to 1955–59, meat animal production increased 60 percent. This gain was greater than that for forage feeds, which increased 41 percent, but exactly equaled the 60 percent

Table 7.—*Production of feed crops and meat animals, five-year averages, 1920–59*

(Index numbers 1947–49=100)

Year	Feed grains	Hay and forage	Commercial high protein feeds[1]	Meat animals
1920–24	89.0	91.0	----	75.4
1925–29	86.4	85.8	----	76.2
1930–34	74.6	77.2	41.7	80.4
1935–39	77.4	89.6	52.6	75.0
1940–44	95.2	109.2	82.6	103.6
1945–49	100.4	103.4	97.6	100.8
1950–54	102.0	108.6	127.8	116.0
1955–59	124.6	116.6	151.5	125.4

[1] Consumption data. Production and consumption indexes are similar.

Compiled from reports of Changes in Farm Production and Efficiency, (*35*); Consumption of Feed by Livestock, 1909–57, (*37*).

rise in feed grain production. Still greater, however, was the increase over this period of time in production of protein supplement feeds.

Supplies of feed available to productive livestock (meat and dairy animals, and poultry) have increased somewhat more the last 40 years than has total feed production. This is true because the number of horses and mules on farms has decreased.[16] Relative to other productive stock, meat animals have neither gained nor lost much ground as a claimant on feed supply. Recently, a fast increase in poultry production has created a strong competitive demand for feed. On the other hand, a declining consumption rate for butter over many years has tended to release feed from production of butter to that of meat.

TABLE 8.—*Index numbers of meat animal production per man-hour and livestock production per unit of feed fed, five-year averages, 1920–59*

Year	Meat animal production per man-hour (1947–49=100)	Production per 1,000 feed units fed [1]		
		Cattle and calves [2]	Hogs [2]	All livestock [3]
		Pounds	*Pounds*	*Units*
1920–24	87	91	173	163
1925–29	90	93	184	188
1930–34	90	109	190	202
1935–39	89	109	193	199
1940–44	98	100	190	189
1945–49	99	102	186	183
1950–54	105	107	193	192
1955–59	111	106	186	189

[1] Year beginning October 1 of previous calendar year.
[2] Liveweight production.
[3] Milk production per cow or its equivalent computed by weighting production by all feed consumed, including pasture.

Compiled from reports of Changes in Farm Production and Efficiency, (*35*); Livestock-Production Units, Annual 1910–57, (*36*); Consumption of Feed by Livestock 1909–56, (*37*).

Ratios between total feed consumption and livestock production have not changed much since the middle 1920's (table 8). They show only a small improvement in feeding efficiency as measured by this aggregate comparison. For hogs and beef cattle individually, the conversion ratios have increased somewhat more. The limited gain in the overall ratio is due to several factors, among which are (1) the relatively smaller increase in forage than in feed grain supplies; (2) a shift among classes of livestock from more efficient users of grain such as hogs to less efficient ones such as cattle in feedlot feeding; (3) more intensive feeding for high production, notably of dairy cows.

Moreover, there has been no great economic pressure to improve feed conversion ratios. Feed, the most basic factor in pro-

[16] For a comprehensive analysis of factors underlying the increase in total food supply of the U.S., see (*5*).

duction of meat animals, has been produced in such generous supply that there has been little urge to economize on its use. Instead, as feed has become cheaper relative to costs of labor and other factors of production, it has tended to be substituted for those factors.

Technological progress has found its chief expression not in improved feed input-livestock output ratios but in rising efficiency in use of labor and capital.

In the economy of the United States, efficient employment of labor has long been a fundamental objective. That objective has been achieved to significant degree in production of meat animals. Even so, meat animals have lagged far behind field crops in this respect. Production of meat animals as practiced has continued to require "husbandry." Mechanization, impersonal and efficient, has not proved a ready replacement. Indexes of labor efficiency in meat animals in 1955–59 show a 28 percent improvement since 1920–24 (table 8). By contrast, production of crops per man-hour has more than trebled since those years.

More dramatic than feed efficiency among productivity gains in meat animals has been that relative to capital investment. This is demonstrated by statistics of output per year in relationship to the size of breeding stock inventory. A rising output per cow, sow, and ewe is clearly in evidence (table 9). This demonstrates not only an increased output relative to breeding animals, but also in terms of housing and other capital investment that is provided in a direct ratio to size of the breeding herd.

Higher productivity per breeding animal has also helped to make possible the higher productivity of labor in meat animals.

In the 5 years of 1955–59, an average of 585 pounds of cattle and calves was produced per cow in the inventory January 1. In 1925–29, production per cow was 390 pounds (table 9). The 30-year gain in productivity was 50 percent.

TABLE 9.—*Productivity of breeding herds: Annual liveweight production per cow, sow, and ewe, 5-year averages, 1925–59*

Year	Liveweight production of—		
	Cattle and calves per cow on farms January 1[1]	Hogs per sow farrowing during year	Sheep and lambs per ewe on farms January 1
	Pounds	*Pounds*	*Pounds*
1925–29	390.2	1,154.7	58.3
1930–34	398.6	1,205.1	52.8
1935–39	399.8	1,213.7	55.4
1940–44	460.5	1,329.0	59.2
1945–49	454.7	1,391.4	61.8
1950–54	556.9	1,419.0	69.9
1955–59	584.6	1,478.3	75.8

[1] Beef and dairy combined.

Derived from data furnished by Economic and Statistical Analysis Division, Economic Research Service, U.S. Department of Agriculture.

For hogs, the number of sows farrowing per year is a better base for comparisons than the number on farms January 1. Liveweight production per sow is high. In 1955–59 it averaged 1,478 pounds, 28 percent more than the 1,155 pound average for 1925–29.

Production of sheep and lambs per ewe likewise has risen appreciably. At 58 pounds in 1925–29, it was up 31 percent to 76 pounds in 1955–59.

These gains in productivity are attributed to the whole complex of advancements in meat animal production, usually referred to under the caption of "scientific agriculture" or "new technology." They embrace genetic improvement in breeding; higher percentage crops of calves and lambs and larger litters of pigs; and better feeds and rations that shorten the time required for young slaughter animals to reach market weight (*cf. 27*, Aug. 1956, pp. 15–20).

Differentiation of Meat

As more and more producing firms cater to the whims and preferences of consumers, products are modified in great or small measure. They are differentiated, and the economic system becomes more complex and institutionalized; it may become one not of "perfect" competition but of monopolistic competition.

This is particularly true for traditional items of consumption. It is true because affluent consumers need not be satisfied with commonplace forms of a good, but can, and do, select for distinctive features or qualities. They are ready targets for differentiation, either genuine or proclaimed. They in fact provide the economic base for differentiation.

Until perhaps the present century, the various meats were regarded as essentially standardized products. Beef was beef, and pork was pork. The chief differences recognized in fresh meat were in the cuts that might be chosen from a carcass.

For pork, this assumption of uniformity continued unchallenged until recent years. Only in the last decade has a growing sensitivity to fatness in pork led to a proclamation of grade standards for hog carcasses, and to a clamor for producing a "meat type" hog.

For beef, on the other hand, quality differences were recognized early in this century. These were incorporated into grade standards, and since 1927 the United States Department of Agriculture has made available a service of grading carcasses of beef according to Federal standards.

Not surprisingly, the recognition of quality differences in beef that gave occasion to setting up grade standards for beef also resulted in a change in kind of beef produced. The quality make-up of the annual beef output was substantially different in the 1950's than it was in, say, the 1920's.

Consequently, it is not possible to trace the economic development of beef, and beef cattle, in this century as of that of a single invariable commodity. Instead, the recent history of beef is that of a material transformation of the beef producing industry and

of the kind of beef produced. The one-time preponderance of grass fat beef, much of it from cows including cull dairy cows, has been replaced by a very sizable out-turn each year of beef from animals of "beef" breeding. Many beef animals are now finished on grain or other concentrate feeds in a farm or commercial feedlot. In 1960, more than half of all beef produced was fed beef.

Beef thus joins many other commodities in the complexity brought to analysis by alteration in its form. In effect, differentiation itself has been a variable to be considered in historical analysis alongside production and price.

Although measurement of differentiation in a single index is impossible, the trends in commodity make-up can be shown. From 1923 to the middle 1940's, the percentage of steers, of cows and heifers, and of bulls in federally inspected cattle slaughter did not change greatly. Cyclical fluctuation was marked but there was no secular trend (fig. 7). Since the middle 1940's, however, the proportion of steers and heifers in slaughter has risen a great deal, replacing cows and bulls.

Although it may be explained as a response to growing consumer demand for higher quality beef, the change in composition of slaughter has the following production base: (1) Numbers of beef type cattle have increased a great deal more than numbers of dairy cattle. Slaughter of dairy stock consists largely of cows and calves, marketing of which is incidental to milk production; but beef cattle slaughter includes many steers and heifers raised for the purpose. (2) More calves are born per 100 cows

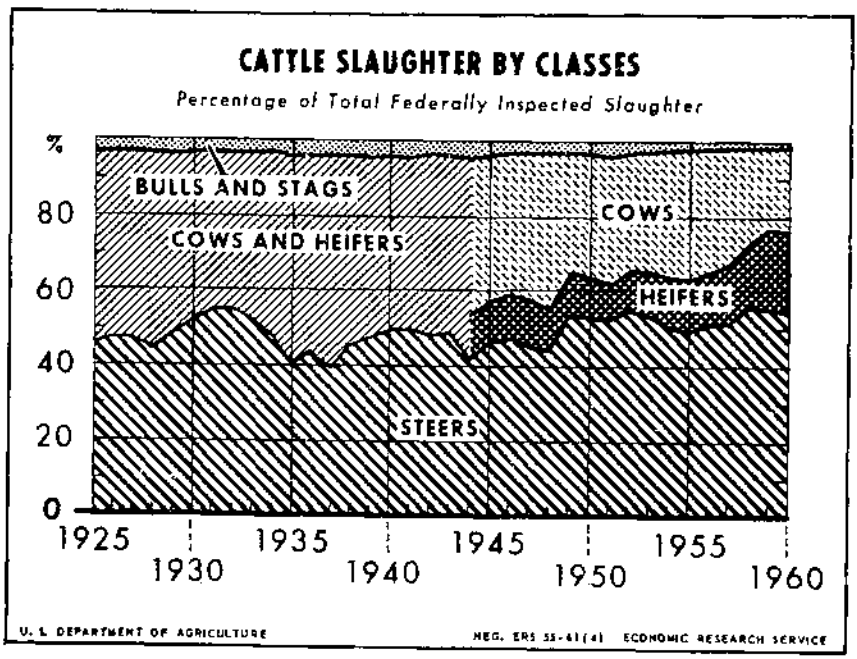

FIGURE 7

now than formerly as management practices have improved. This increases the number of steers and heifers that can be produced relative to number of cows. (3) Artificial insemination has reduced the number of bulls in herds and the number slaughtered. (4) Strong demand for fed beef, declining costs of feed, and better breeding have resulted in raising more beef calves to maturity as steers and heifers.

Feeding of cattle for a period before slaughter was already extensive in the Corn Belt during the 1920's. It has since multiplied several times and has moved to other areas also, the West most of all.

TABLE 10.—*Beef cattle: Number on feed and fed cattle marketed, 1922–60* [1]

Year	Number cattle on feed January 1	Number fed cattle marketed during year	Fed cattle as percentage all cattle slaughtered	Fed beef as percentage all beef produced
	1,000 head	*1,000 head*	*Percent*	*Percent*
1922		3,400	24.8	
1923		4,000	28.0	
1924		3,850	26.1	
1925		3,600	24.5	
1926		3,800	25.7	
1927		3,600	26.8	
1928		3,400	28.3	
1929		3,600	29.9	
1930	3,113	3,675	30.5	
1931	3,025	3,625	30.0	
1932	2,878	3,500	29.2	
1933	3,080	3,825	29.2	Less than 30.
1934	2,890	3,650	18.7	
1935	2,215	2,875	19.4	
1936	3,202	4,225	26.6	
1937	2,759	3,600	23.6	
1938	3,336	4,600	31.0	
1939	3,303	4,625	31.6	
1940	3,633	5,225	34.9	
1941	4,065	5,925	36.1	
1942	4,185	6,190	34.3	
1943	4,445	6,670	37.4	
1944	4,015	6,125	30.9	
1945	4,411	6,936	32.0	38.7
1946	4,211	5,997	30.3	36.5
1947	4,322	6,341	28.3	34.1
1948	3,821	5,805	30.3	37.3
1949	4,540	7,800	41.6	48.8
1950	4,390	7,411	39.8	46.6
1951	4,534	7,198	42.1	49.0
1952	4,961	8,013	43.0	50.5
1953	5,762	8,648	35.3	42.3
1954	5,370	8,893	34.4	41.0
1955	5,795	10,071	37.9	44.7
1956	5,929	10,642	38.3	45.2
1957	6,122	10,623	39.2	45.8
1958	5,898	10,844	44.5	50.7
1959	6,601	12,125	51.1	57.6
1960	7,173	13,200	50.7	57.0

[1] 1922–41 from table 28, page 105.

Estimates of the number of fed cattle slaughtered and quantity of fed beef produced are derived from published data on cattle feeding. Estimates of the number of cattle on feed January 1 have been issued each year since 1930. Shipments of feeder cattle and calves from public stockyards have been recorded since 1915. Beginning in 1948, quarterly data on fed cattle marketings have been published for selected States. Data on receipts of fed steers at Chicago [17] have been collected since 1922, and similar data for several other markets, as well as data on receipts of fed heifers, are available for recent years. These various series make it possible to estimate fed cattle slaughter and fed beef production with reasonable accuracy. Summary data are presented in table 10.

Fed cattle made up just over 25 percent of all cattle slaughtered in the 1920's. In the last few years they have averaged nearly 40 percent of all slaughter, and recently exceeded 50 percent.

Grades as Differentiation

Beef that has been fed usually falls in one of the higher grades, Good, Choice, or Prime. It is estimated that in 1956 about 48 percent of all beef was of those grades. 1956 was a year when many lower-grade cattle were slaughtered, as severe drouth and low prices caused many herds to be reduced in size. In 1952,

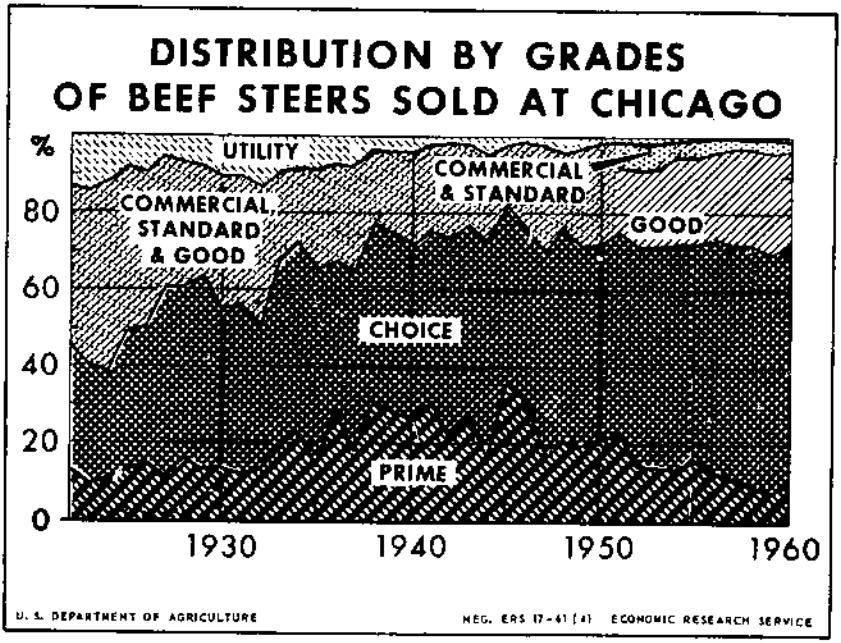

Figure 8

[17] More exactly, these are beef steers from feeding areas sold out of first hands.

when cattle herds were being expanded and high-quality animals predominated in slaughter, 61 percent of all beef was estimated as of the same three grades. Doubtless in 1958 and 1959, years similar to 1952, the percentage in those grades was again around, or above, 60. It may have decreased slightly in 1960.

Table 11 presents a grade distribution for beef output for the only three years for which estimates have been made.

Although data for earlier years are not available, it is virtually certain that less of total output was of the three top grades years ago than recently. The estimates of proportion of fed beef (table 10) suggest as much. Additional evidence is provided by data on the grade distribution of fed steers received at the Chicago market (fig. 8.) It may be noted that in the 1920's the percentage of Choice steers was about 38 percent but it has increased to about 60 percent recently. The percentage of Prime generally increased until World War II years but has declined since. The Choice grade has gained at the expense of the highly finished Prime, as well as having displaced much of the lower grades.

TABLE 11.—*Estimated distribution of beef production, by grade, 1947, 1952, 1956*

Grade [1]	1947 [2]	1952 [3]	1956 [2]
	Percent	*Percent*	*Percent*
Prime	4.3	6.0	4.2
Choice	26.7	36.2	32.8
Good	19.8	18.7	21.1
Top 3 grades	50.8	60.9	58.1
Commercial and Standard	18.0	14.0	15.9
Utility	16.6	12.7	12.9
Canner and Cutter	14.6	12.4	13.1
All grades	100.0	100.0	100.0

[1] Grades as in use since June 1, 1956. Data for all years refer to those grade definitions.
[2] Year of reduction in cattle numbers on farms.
[3] Year of expansion in cattle numbers on farms.

Compiled from *Livestock and Meat Situation*, March 1958, (*27*).

Although the Chicago market is not truly representative of other markets, trends in steer receipts at Chicago almost certainly conform in general direction to those on other markets.

Most of the increased differentiation in beef, veal, and lamb has been expressed in terms of Federal grades. Use of the Federal grading service has increased steadily. In 1960 approximately 49 percent of all beef produced commercially, 17 percent of veal, and 37 percent of lamb and mutton was Federally graded.

Grading was compulsory during the two price control periods of World War II and the Korean conflict. After each period the volume of grading fell off sharply, yet held a net gain (table 12 and fig. 9).

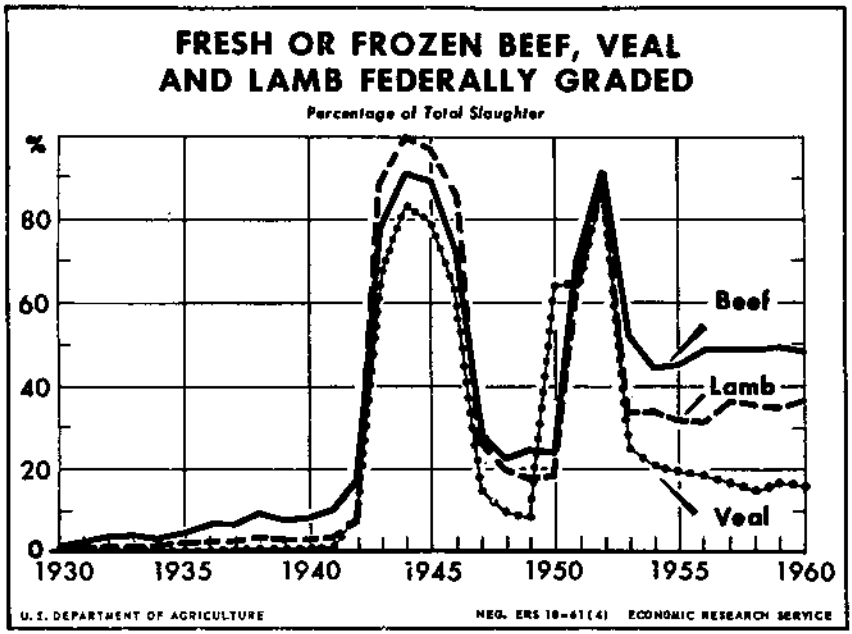

FIGURE 9

TABLE 12.—*Quantity of meat graded by the U.S. Department of Agriculture, and its proportion of all commercially produced meat, 1937–60*

Period	Quantity graded			Percentage of commercial production		
	Beef	Veal and calf	Lamb and mutton	Beef	Veal and calf	Lamb and mutton
	Million pounds	*Million pounds*	*Million pounds*	*Percent*	*Percent*	*Percent*
Average:						
1937–42	729	23.2	35.2	9.7	2.2	3.9
1943–46 [1]	7,774	1,116.6	978.8	86.0	78.9	96.4
1947	2,931	236.5	208.9	29.0	15.8	26.8
1948	2,022	133.6	146.6	23.1	10.1	20.1
1949	2,280	104.2	107.6	24.9	8.4	18.3
1950	2,262	78.0	110.4	24.5	6.9	19.0
1951 [1]	6,250	680.0	365.4	73.1	70.0	71.9
1952 [1]	8,784	1,029.7	567.4	94.1	95.3	89.4
1953	6,529	380.1	245.1	54.2	26.2	34.3
1954	5,708	337.2	250.1	45.3	21.7	34.7
1955	6,050	305.6	242.7	45.8	20.6	32.6
1956	7,027	306.9	233.3	49.9	19.9	32.0
1957	6,947	263.3	258.8	50.2	18.3	37.3
1958	6,456	179.0	242.1	49.7	16.2	35.9
1959	6,757	171.1	257.4	50.9	18.4	35.6
1960	7,067	176.9	282.1	49.2	17.3	37.4

[1] Grading compulsory under price control regulations during most or all of period.

Compiled from *Livestock and Meat Situation*, July 1959, (27).

A very high proportion of all beef sold fresh is now federally graded. Not much beef for processing receives Federal grading.

While increased utilization of grade distinctions constitutes differentiation, the grading system itself is fixed over rather long periods of time. The system, once adopted and if allowed to remain too long unchanged, can retard further differentiation. However, both the two modifications in beef grades in recent years were in the direction of added differentiation. In 1950, a grade that had been largely unused was dropped and the old Medium grade was divided into Good and Commercial. In 1956 the Commercial grade was further divided as a Standard grade was split off.

Another possible road to differentiation is that of private brands. Soon after Federal grading was begun several national packers introduced their own private brands for fresh meat. (Brands for processed products had been in use for many years.) They first did so in August 1927 after Federal grading was begun in May (*49*). Packers were relatively successful in promoting their private brands of beef up to World War II. During the war, Federal grading was compulsory under the Office of Price Administration (OPA). Since then, Federal grades have provided the dominant system of marking beef. In recent years some retail chains have adopted their own labels for fresh beef. If the Federal grading service were to be discontinued, differentiation by private branding would mushroom.

Most beef sold fresh at retail is sold by cut. Cutting systems have doubtless become more elaborate over the years. Nevertheless, the anatomy of the bovine does not lend itself to a great increase in differentiation through introducing new cuts.

By processing, on the other hand, a great variety of products can be developed. For fresh beef, brand names reflect little unique contribution by the branding firm; they relate only to selection. That is, a brand on a fresh cut indicates chiefly the criteria and exactness of selection made from the raw product available, plus any differences in trim and aging applied. No other distinguishing treatment is possible. For processed beef, on the other hand, brand naming is well adapted as a differentiating device. In processing there is choice as to formula or recipe, and the product can be standardized according to individualized specifications.

In beef, the mortality rate for attempts at brand-name processing has been fairly high. A new form of merchandising, selling of prepackaged frozen beef cuts, offers a wide field for shift to branded product, but its acceptance has been slow.

If perishability of beef and other meat should be eliminated, so that retailing of prefabricated, branded product should replace the present selling of fresh cuts, differentiation would become the rule in meat distribution.

TRENDS IN PRICES AND EXPENDITURES

Price Data for Beef

The standard price series for beef at retail are those of prices of retail cuts collected by the U.S. Bureau of Labor Statistics. Prices for each cut (not hamburger) are held to apply approximately to U.S. Choice grade. How nearly this is true is open to question. However, no test data are to be had, and the prices are usually accepted at face value as essentially those of Choice beef.

Prices are collected for only a few cuts. Either a price analysis must be confined to those cuts, or averages for all cuts must be computed. The Economic Research Service regularly calculates an all-cut average in connection with its work on farm-to-retail price margins. It does so by ". . . grouping the estimated average yields of retail cuts from 100 pounds of carcass. In grouping . . . consideration was given to similarity of price trends and to the wholesale cut from which the retail cut comes." (*30*, p. 78)

The BLS price data are taken for days at the first of the reporting week, avoiding the prices of weekend specials. Professor Working has called attention to the possibility of sizable error in price series so computed. Also, he found an arbitrariness in splicing at several points of discontinuity in BLS price series, and he called attention to differences in all-cut prices that could result from various methods of weighting (*51*). Riley found actual prices paid by Lansing, Michigan, consumers to vary more from week to week than did BLS price quotations for Detroit. "Presumably this variation in Lansing prices reflected more of the effects of 'specials' and to some extent changes in commodity composition from one period to another." (*22*, p. 90)

After enumerating possible flaws in statistics, little choice remains than to accept, as Working did, "in spite of . . . difficulties, the United States average retail price of the various cuts of meat as reported by the Bureau of Labor Statistics . . ." (*51*, p. 32) Weighted all-cut averages used here are those of the Economic Research Service, as modified to an all-grade average by the procedure that follows.

Composite average retail prices for Choice grade beef are published regularly (*28*). In the past these prices have been used for analysis of the retail price of beef. Justification was dual: (1) Choice grade is the grade of largest volume. It is by far the largest for beef sold fresh. (2) No other retail price data are available.

Choice beef is not terribly unrepresentative of all beef sold at retail because much of lower grade beef goes into processed products, for which the expense of processing is a cost that is absent in selling of fresh beef. Hence, the price of lower grade beef in processed form at retail is not greatly below the price of Choice beef sold fresh.

Nevertheless, use of Choice prices in price analysis is not entirely satisfactory. Certainly the value of all beef as computed from Choice prices overstates true value by an appreciable extent.

For this reason a series of estimated retail prices for all grades of beef, recently developed (*27*, July 1959) and explained in appendix I, is used for the time series price analyses of this study.

Trends in Beef Prices by Grades

Rising demand for beef has taken the form of demand not only for more beef but also for a better and more distinguishable quality of beef. The resultant improvement in quality produced, brought about partly through more feeding of cattle, has already been explained. The growing demand for the higher grade has not been frustrated but has been effectively met. It has been met by the increased quantity of the higher grades produced—much more in that way than in a wider price margin between grades.

Data in table 13 illustrate the relative stability that has prevailed in relative prices between grades. In the table prices for all grades of beef at retail are compared with prices for the Choice grade alone. As a second comparison, two price series for lower grade carcass beef at wholesale at Chicago are compared with prices for Choice grade.

These ratios, while not entirely conclusive, present no clear evidence of a widening price spread for the Choice grade. The ratio between all grades and Choice grade at retail is without a long-run uptrend or downtrend. For wholesale carcasses the trend is mixed. Commercial cow carcasses have declined in value relative to Choice steer beef, but Utility steer carcasses have risen relative to Choice. On balance, no trend in relationships of lower to higher grades at retail is to be inferred.

It is established economic theory that when potential demand exists for a higher quality product—or when demand calls for a range of qualities—much is to be gained by catering to those desires. When products are differentiated in response to demand, the total effective demand is increased. If, as seems likely, consumers prefer that beef be made available in various forms and qualities, acceding to that preference increases the total demand for beef and the amount of money consumers are willing to spend for it.

Whatever the range of consumer preferences may be for various meat products, demand for individual products has been whetted in many cases by promotion and market development. For example, the lower grades of beef, not usually regarded as the most celebrated products, have lately found active sponsors. By diligent efforts in developing processed products, and by plugging the merits of hamburger, meat packers and processors have developed demand for lower grade beef very effectively.

When income, institutional factors, and taste combine to create a favorable potential for product differentiation, a great deal is to be gained by taking advantage of it.

TABLE 13.—*Beef prices: Retail and wholesale, with comparisons by grades, 1921–60*

Year	Retail price per retail-equivalent pound			Wholesale price per 100 pounds, Chicago[1]				
							Ratio to Choice steer	
	All grades	Choice	Ratio	Utility steer[2]	Commercial cow[3]	Choice steer[4]	Utility steer	Commercial cow
	Cents	*Cents*		*Dollars*	*Dollars*	*Dollars*		
1921	27.7	29.3	105.8	11.48	12.81	16.26	70.6	78.8
1922	25.6	27.7	108.2	10.96	11.40	15.08	72.7	75.6
1923	25.6	28.8	112.5	11.96	12.14	16.30	73.4	74.5
1924	25.4	29.5	116.1	11.75	12.70	16.76	70.1	75.8
1925	26.0	30.7	118.1	10.97	12.79	17.00	64.5	73.5
1926	28.8	31.4	109.0	12.07	13.21	15.32	78.8	86.2
1927	29.5	32.8	111.2	13.44	14.66	18.21	73.8	80.5
1928	33.2	37.4	112.7	16.51	17.07	21.20	77.9	80.5
1929	35.7	39.2	109.2		17.28	20.71		83.4
1930	32.4	36.2	111.7	13.50	13.68	17.16	78.7	79.7
1931	26.8	30.0	111.9	9.59	9.96	13.01	73.7	76.6
1932	22.1	24.9	112.7	8.47	8.24	11.53	73.5	71.5
1933	19.7	21.5	109.1	6.45	6.88	8.17	78.9	84.2
1934	20.4	23.3	114.2	6.97	7.60	10.81	64.5	70.3
1935	25.0	30.5	122.0	11.04	11.85	16.20	68.1	73.1
1936	25.6	28.6	111.7	10.01	10.38	13.12	76.3	79.1
1937	27.0	32.5	120.4	12.15	12.98	17.98	67.6	72.2
1938	26.8	28.7	107.1	12.05	11.88	14.52	83.0	81.8
1939	27.3	29.5	108.1	13.04	12.34	15.12	86.2	81.6
1940	26.8	29.5	110.1	12.86	12.97	16.03	80.2	80.9
1941	29.5	31.5	106.8	14.53	14.19	16.92	85.9	83.9
1942	32.5	35.0	107.7	16.96	17.09	19.87	85.4	86.0
1943	33.8	36.2	107.1	16.62	18.65	20.62	80.6	90.4
1944	29.1	34.2	117.5	15.88	17.88	19.88	79.9	89.9
1945	30.3	33.5	110.6	15.88	17.88	19.88	79.9	89.9

1946	38.3	42.5	111.0	19.75	21.35	27.91	70.8	76.5
1947	54.8	61.8	112.8	29.88	28.55	42.42	70.4	67.3
1948	67.7	75.3	111.2	39.19	38.80	50.05	78.3	77.5
1949	62.0	68.4	110.3	34.87	32.88	41.86	83.3	78.5
1950	69.3	75.4	108.8	41.98	37.83	46.20	90.9	81.9
1951	81.8	88.2	107.8	48.42	45.44	56.18	86.2	80.9
1952	76.5	86.6	113.2	41.59	38.71	53.20	78.2	72.8
1953	60.5	69.1	114.2	28.31	28.64	39.98	70.8	71.6
1954	58.5	68.5	117.1			40.10		
1955	58.9	67.5	114.6			38.48		
1956	57.8	66.0	114.2		23.10	36.26		63.7
1957	63.5	70.6	111.2		27.84	38.52		72.3
1958	75.1	81.0	107.9		35.65	43.83		81.3
1959	76.8	82.8	107.8		33.92	43.88		77.3
1960	74.2	80.7	108.8			42.39		

[1] Per 100 pounds, carcass weight.
[2] Common grade, 1921–38.
[3] Good grade, 1921–July 1939.
[4] Good grade, 1921–50.

Retail Value of Beef Consumed

From estimates of average retail prices of all grades of beef, together with published data on quantity of beef consumed per person, data on value at retail of all beef consumed can be derived. A series is presented in table 14. The data relate to consumption by civilians only.

Data on retail value of meat are an approximation to dollar expenditures for meat. Certainly short-run changes in retail value of beef accurately reflect similar changes in amount of money spent for beef. In the longer run, the two statistics may be less closely associated. One reason lies in the fact that much beef short-cuts retail distribution. Since frozen food lockers, and later home freezers, became popular, a number of consuming families have bought their beef at wholesale. A more important use of meat outside retail distribution is institutional use in group feeding. This growing market ranges from inexpensive factory lunches to serving steaks at $7 in the plushest hotels or nightclubs. Also, farm families obtain part of their meat from their own production rather than from retail purchase.

Hence the retail value data are an imputed value, reflecting what consumers would have spent had all meat been sold at retail prices. As such, the data parallel actual expenditures but they are not identical with them.

The retail value of beef consumed per person has increased over the years, reflecting in part the uptrend in the general price level. Relative to the disposable income of consumers, a series which also incorporates price level, the retail value has climbed slowly. The value averaged 2.1 percent of disposable income in the 1920's, and 2.4 percent in the 1950's.

Insofar as the exchange economy affords a meaningful measurement, this increase means that a steady to rising percentage of the resources of the economy has been devoted to production of beef.

This is highly significant. It may be expected from the tenets of Engel's law that the percentage of resources devoted to a staple good such as food will decrease as an economy grows. For beef this has not happened. Instead, the percentage so devoted has increased.

Trends in Pork Prices by Cuts

Hogs may be fellow denizens with cattle of the barnyard, and pork may be companion piece with beef in the American diet, but the economic records of the two species and meats are distinctly different.

Contrasts in the economic history of pork and beef are many. For economic analysis one individual feature of pork is simplifying: its homogeneity as a product over time has contributed to its unspectacular record, but it facilitates economic analysis.

Unlike beef, pork has been produced and sold with little differentiation. There is no Federal grading of pork. "Pork is pork" has been the unexpressed axiom.

TABLE 14.—*Beef: Retail price, value consumed per person, and ratio to disposable personal income per person, 1921–60*

Year	Retail price per retail-equivalent pound	Beef consumed per person [1]	Retail value of beef consumed per person [2]	Disposable personal income per person	Retail value of beef consumed as percentage of disposable income
	Cents	*Pounds*	*Dollars*	*Dollars*	*Percent*
1921	27.7	55.5	12.10	508	2.4
1922	25.6	59.1	12.00	541	2.2
1923	25.6	59.6	12.10	616	2.0
1924	25.4	59.5	11.90	610	2.0
1925	26.0	59.5	12.20	636	1.9
1926	28.8	60.3	13.70	651	2.1
1927	29.5	54.5	12.70	645	2.0
1928	33.2	48.7	12.80	653	2.0
1929	35.7	49.7	14.00	682	2.1
1930	32.4	48.9	12.50	604	2.1
1931	26.8	48.6	10.30	515	2.0
1932	22.1	46.7	8.20	390	2.1
1933	19.7	51.5	8.00	364	2.2
1934	20.4	[3] 55.9	9.00	411	2.2
1935	25.0	[3] 52.9	10.40	459	2.3
1936	25.6	[3] 58.1	11.80	517	2.3
1937	27.0	55.2	11.80	551	2.1
1938	26.8	54.4	11.50	506	2.3
1939	27.3	54.7	11.80	538	2.2
1940	26.8	54.9	11.60	576	2.0
1941	29.5	60.9	14.20	697	2.0
1942	32.5	61.2	15.70	871	1.8
1943	33.8	53.3	14.20	977	1.5
1944	29.1	55.6	12.80	1,060	1.2
1945	30.3	59.4	14.20	1,075	1.3
1946	38.3	61.6	18.60	1,136	1.6
1947	54.8	69.6	30.10	1,181	2.6
1948	67.7	63.1	33.70	1,291	2.6
1949	62.0	63.9	31.30	1,271	2.5
1950	69.3	63.4	34.70	1,369	2.5
1951	81.8	56.1	36.20	1,473	2.5
1952	76.5	62.2	37.60	1,520	2.5
1953	60.5	77.6	37.10	1,582	2.3
1954	58.5	80.1	37.00	1,582	2.3
1955	58.9	82.0	38.20	1,660	2.3
1956	57.8	85.4	39.00	1,742	2.2
1957	63.5	84.6	42.40	1,804	2.4
1958	75.1	80.5	47.80	1,826	2.6
1959	76.8	81.4	49.40	1,905	2.6
1960	74.2	85.2	49.90	1,969	2.5

[1] Carcass-equivalent weight.
[2] Value of retail weight equivalent.
[3] Excludes consumption from Government emergency programs.

Compiled from *Livestock and Meat Situation*, July 1959, (*27*).

Only recently has a clamor begun for recognizing differences in quality of pork. This has acquired the by-line of demand for "lean pork" and a "meat-type hog." The economic impact is doubtless by now considerable. It has arisen so recently, however, as scarcely to be a factor in historical price analysis.

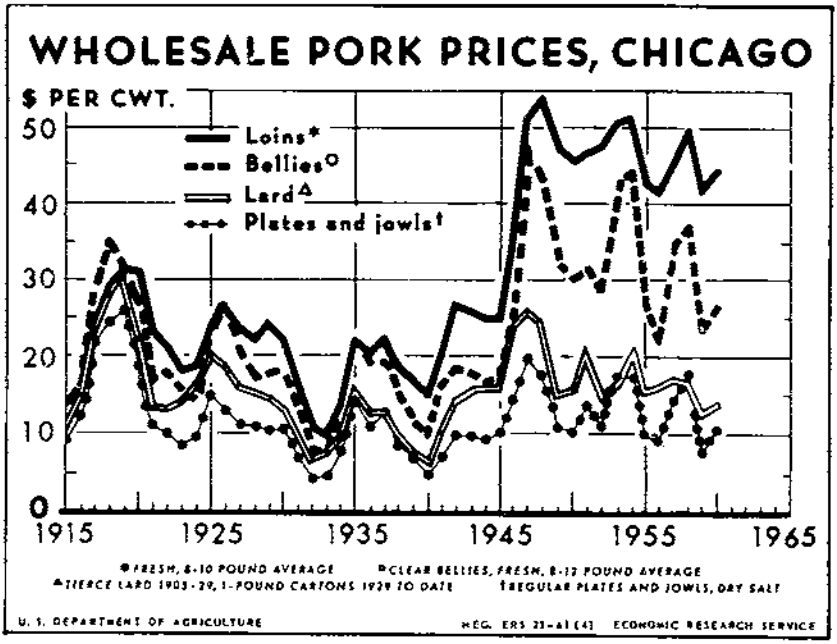

FIGURE 10

Emerging appreciation of quality differences in pork, while not yet meaningful historically, could bear on projections into the future. It could render invalid the extrapolation of price analysis regressions. In practical application, it could mean that the outlook for pork and hogs may not be as uninviting as recent trends would suggest. Certainly many hog producers who are trying hard to improve the quality of pork produced are hopeful that economic benefits will result.

Historical observations bearing on quality in pork are afforded by comparing price trends for various cuts of pork. Data are for the wholesale trade. Figure 10 presents price trends at wholesale for 4 hog products: loins, bellies, plates and jowls, and lard. The percentage increases since early years in this century are in the order named; prices of loins are up most, those of lard least.

Comparative changes in price reliably indicate comparative changes in demand because the supply of one product relative to another is almost exactly determined by the anatomy of the animal. There is a degree of choice as to yield of lard, as some fat cuts can either be sold as such or rendered into lard. Otherwise, the various products of pork are produced in a nearly fixed ratio to each other.

Data in table 15 show the comparative changes in price for the entire period and for three subperiods. Clearly, prices of loins and bellies—the leaner products—had outrun the other products by the prosperous years of the 1920's. Differences narrowed in the decline to depression. They widened again in the rise to postwar prosperity. From these data it may be concluded that rela-

tive demand for lean versus fat products of pork is associated with changes in incomes of consumers. Rising incomes hold much more benefit for lean than fat products. Insofar as demand for hog products as a whole has failed to show marked response to improving incomes of the last 25 years, the fat products must be held partly to blame.

This explanation in terms of demand cannot be attributed entirely to consumer preference, however. Demand for lard, and for fat cuts from which it can be obtained, has been affected measurably by increasing competition from other sources of edible fats and oils. The soybean has become the chief competitor. Rising

TABLE 15.—*Pork products: Percentage changes in Chicago wholesale price, selected periods*

Product	1905–10 to 1950–58	1905–10 to 1923–29 [1]	1923–29 to 1931–34 [2]	1931–34 to 1950–58 [3]
	Percent	*Percent*	*Percent*	*Percent*
Loins	+314.9	+100.0	−43.8	+269.0
Bellies	+175.4	+58.5	−44.7	+214.4
Plates and jowls	+56.0	+27.7	−47.5	+132.9
Lard	+41.3	+36.6	−50.9	+110.6

[1] Ends in a period of prosperity.
[2] Prosperity to depression.
[3] Depression to prosperity.

Compiled from *Prices of Hogs and Hog Products, 1905–56, (31).*

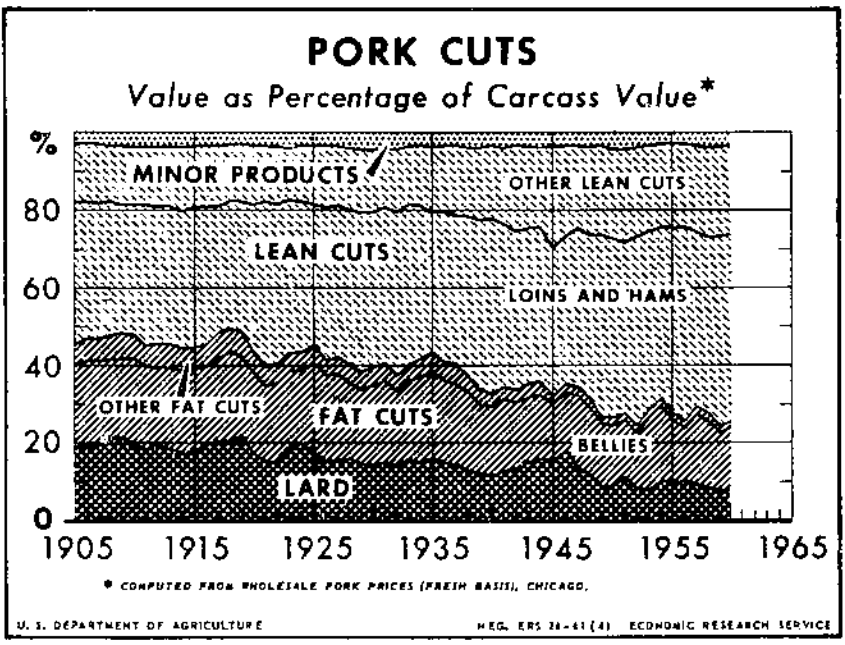

FIGURE 11

production of soybeans, principally a Corn Belt crop, has limited to some extent the demand for the major Corn Belt product, hogs.

Figure 11 demonstrates the impact of changing price relationships among hog products. In 1905–10, the lean cuts and minor products contributed 53 percent of the total carcass value of hogs. Fat cuts and lard accounted for the other 47 percent. By the 1950's, lean and minor cuts had to carry 73 percent of the total, as fat cuts and lard contributed only 27 percent.

Although fresh pork has not been subject to quality distinction, differentiation has been achieved to some extent in processed pork. Unlike beef, a high percentage of pork is distributed in processed form. According to the 1955 survey, only 36 percent of all pork used by household consumers was in the form of fresh cuts (table 16). All the rest was processed. Even these data understate the importance of processed pork, as a great deal of pork is used in processed meat products of mixed composition.

TABLE 16.—*Pork: Quantity used by household consumers, by cuts, one week in Spring of 1955* [1]

Product	Quantity	
	Pounds per person [2]	Percentage of total
	Pounds	*Percent*
Fresh or frozen cuts:		
Chops	0.19	16.7
Ham	.04	3.5
Loin	.08	7.0
Other	.10	8.8
Total	.41	36.0
Processed:		
Sausage	.09	7.9
Ham	.26	22.8
Bacon	.25	21.9
Salt pork	.05	4.4
Canned	.02	1.8
Other	.06	5.2
Total	.73	64.0
Total pork	1.14	100.0

[1] In addition, pork was consumed in processed products of mixed composition.

[2] This distribution by cuts does not conform to relative weights in carcass cut-out tests, indicating consumers' reporting errors. The distribution between fresh and processed is probably reliable.

Compiled from *Food Consumption of Households in the United States*, (*40*).

Meat packers have tried ceaselessly to develop a wide variety of processed pork items. Some firms have built their reputation on sausage. Yet it seems that the brand-naming carried on for processed pork has been only moderately effective as an expression of, or stimulant to, expanded demand. Brand-naming for

any food is effective differentiation only insofar as consumers clearly associate different qualities with the brands, and it is questionable how much they do so with pork products. Most consumers probably do not have extreme loyalty to a particular brand.

Retail Value of Pork Consumed

Data on retail prices paid for pork cuts by consumers in larger cities have been collected by the Bureau of Labor Statistics for many years. The series parallels that for beef cuts. Developing a composite average price for all cuts from the price data for selected cuts is less difficult for pork than for beef. Wholesale price data are available for very nearly all products of pork, even the minor ones. The selected retail price data can be applied to an average price for all products at wholesale, lifting it to the retail level (*30*, p. 79).

The average retail price for all pork computed in this way and regularly published by the Economic Research Service is tabulated in the first column of table 17. The price does not, however, include all the minor products. In computing the retail value an allowance was made for prices of those products. The retail weight of pork is generally considered to be 93 percent of the wholesale weight.

The retail value series for pork consumed has the same limitations as that for beef. The primary limitation is that it is an imputed value and only an approximation to expenditures.

The retail value of pork has increased over the entire span since 1921. But this rise must be ascribed entirely to the uptrend in the general price level. Relative to the disposable income of consumers, the retail value of pork per person has lost ground steadily. It averaged 3.4 percent of income in the early 1920's, 3.0 percent in the 1930's, jumped above 3.0 percent briefly in 1947–48, then fell to around 2.0 percent in the latter 1950's.

Regression coefficients of retail value on disposable income allow comparisons to be made between the history for pork and beef:

1. Flexibility coefficient, retail value on disposable income [18]

Pork	0.69
Beef	1.12

2. Flexibility coefficient,[19] retail value on

	Disposable income, deflated	Consumer price index
Pork	0.18	1.19
Beef	0.97	1.28

[18] Flexibility coefficients are a direct measure of proportionate relationship. Thus a change of 1.12 percent in the retail value of beef has accompanied each 1 percent change in disposable income. These flexibility coefficients were derived by the following formula:

$$b_{12}\frac{\overline{X_2}}{\overline{X_1}}$$

where $\overline{X}_1$ is the mean of the dependent variable in a regression, $\overline{X}_2$ is the mean of the independent variable, and b_{12} is the simple regression coefficient of X_1 on X_2.

[19] These flexibility coefficients were derived using the net regression coefficients from multiple regressions of retail value on deflated disposable income and the consumer price index.

TABLE 17.—*Pork: Retail price, value consumed per person, and ratio to disposable income per person, 1921–60*

Year	Retail price per pound [1]	Pork consumed per person [2]	Retail value of pork consumed per person [3]	Disposable personal income per person	Retail value of pork consumed as percentage of disposable income
	Cents	*Pounds*	*Dollars*	*Dollars*	*Percent*
1921	31.6	64.8	18.40	508	3.6
1922	30.0	65.7	17.50	541	3.2
1923	28.3	74.2	19.00	616	3.1
1924	28.4	74.0	19.00	610	3.1
1925	34.8	66.8	20.70	636	3.3
1926	37.3	64.1	21.20	651	3.3
1927	34.9	67.7	21.20	645	3.3
1928	32.9	70.9	20.90	653	3.2
1929	33.7	69.6	20.90	682	3.1
1930	32.4	67.0	19.40	604	3.2
1931	26.6	68.4	16.50	515	3.2
1932	17.6	70.7	11.30	390	2.9
1933	15.6	[4] 69.6	9.80	364	2.7
1934	21.0	[4] 63.1	12.10	411	2.9
1935	30.2	48.4	13.00	459	2.8
1936	29.8	55.1	14.60	517	2.8
1937	30.6	55.8	15.20	551	2.7
1938	27.3	58.2	14.10	506	2.8
1939	24.7	64.7	14.30	538	2.7
1940	21.6	73.5	14.20	576	2.5
1941	27.2	68.4	16.40	697	2.3
1942	32.9	63.7	18.30	871	2.1
1943	33.9	78.9	23.30	977	2.4
1944	31.9	79.5	22.00	1,060	2.1
1945	32.1	66.6	18.80	1,075	1.7
1946	41.3	75.8	27.60	1,136	2.4
1947	60.7	69.6	36.70	1,181	3.1
1948	61.7	67.8	36.50	1,291	2.8
1949	55.8	67.7	32.90	1,271	2.6
1950	55.1	69.2	33.20	1,369	2.4
1951	59.2	71.9	37.20	1,473	2.5
1952	57.5	72.4	36.30	1,520	2.4
1953	63.5	63.5	35.50	1,582	2.2
1954	64.8	60.0	34.20	1,582	2.2
1955	54.8	66.8	32.50	1,660	2.0
1956	52.1	67.3	31.30	1,742	1.8
1957	60.2	61.1	32.90	1,804	1.8
1958	64.8	60.2	34.80	1,826	1.9
1959	57.1	67.6	34.50	1,905	1.8
1960	56.6	65.3	32.90	1,969	1.7

[1] Average price of retail cuts, exclusive of certain minor products.
[2] Carcass-equivalent weight.
[3] Value of retail-equivalent weight of pork consumed, priced at retail price as shown with allowance for value of all minor products.
[4] Excludes consumption from Government emergency programs.

Compiled from Livestock and Meat Situation, July 1959, (*27*).

From 1921 to 1958, each 10 percent rise in the disposable income of consumers was accompanied by an 11 percent increase in the retail value of beef consumed, but only a 7 percent increase in retail value of pork.

When each series is related to deflated disposable income (i.e., real income) and to the price level index separately, it becomes clear that the increase in retail value for pork results almost entirely from the rise in the general price level. Pork's responsiveness to the price level is almost fully as great as that for beef. But in relation to rising real income of consumers, the retail value of pork demonstrated only small gain (coefficient of 0.18) while beef is highly responsive.

It is possible that the limited uptrend in retail value for pork reflects to some degree a downward shift (relative to deflated prices) in the supply curve for pork. Whenever the demand curve for a commodity is relatively inelastic in slope, as is true for pork (see page 76), the price is highly influenced by any shifts in the supply curve. As a working hypothesis, it seems likely that gains in efficiency in production of hogs have become translated into relatively lower prices and values for pork because demand for pork is relatively inelastic. On the other hand, a net regression coefficient of 1.19 for pork value on consumer price index, almost as high as that for beef, argues against pursuing this hypothesis very far.

The contrast between pork and beef, wherein retail value for beef has been a steady to rising percentage of national income but that for pork has declined, is not nearly so much a discredit to pork as it is a tribute to the phenomenal record of beef.

All Meat

Retail price data for veal and lamb are limited and not entirely satisfactory. The two meats do not bulk large in the all-meat total. Estimated retail values for them nevertheless must be added to those for beef and pork in order to arrive at a total for all meat. Data are in table 18.

As would be expected, trends in retail value for all meat are essentially a blend of those for beef and pork. The all-meat value has risen faster than that for pork but not as fast as the value for beef. It has been a declining portion of the consumer's income dollar, although its decline is less than for pork.

Here again, interpretation is difficult. It might be said that retail value data have meaning only insofar as the elasticity of demand is close to unity. In a sense this objection is justified. Yet if the pricing mechanism is at all efficient, trends in the proportion of disposable income devoted to meat are an indication of trends in the proportion of the Nation's resources devoted to its production of meat. Furthermore, elasticity of demand is not invariable, but is itself subject to change over time.

As an average for 1921 to date (excluding war years), the interrelationship between factors of supply and demand for meat relative to the total economy has been such that retail value of all meat consumed has increased 86 percent as fast as

TABLE 18.—*All meat: Retail price, value consumed per person, and ratio to disposable personal income per person, 1921–60*

Year	Retail price [1]	Meat consumed per person [2]	Retail value of consumption per person [3]	Disposable personal income per person	Retail value of meat consumed as percentage of disposable income
	Cents	*Pounds*	*Dollars*	*Dollars*	*Percent*
1921	29.4	134.0	34.20	508	6.7
1922	27.6	137.7	32.90	541	6.1
1923	27.0	147.3	34.70	616	5.6
1924	27.1	147.3	34.70	610	5.7
1925	30.3	140.1	36.80	636	5.8
1926	32.5	138.0	38.80	651	6.0
1927	32.1	134.9	37.70	645	5.8
1928	32.6	131.6	37.60	653	5.8
1929	34.0	131.2	39.00	682	5.7
1930	31.9	129.0	35.90	604	5.9
1931	26.4	130.7	30.20	515	5.9
1932	19.3	131.1	22.20	390	5.7
1933 [4]	17.2	135.0	20.30	364	5.6
1934 [4]	20.7	133.7	24.10	411	5.9
1935 [4]	27.0	116.2	27.00	459	5.9
1936 [4]	27.2	128.2	30.10	517	5.8
1937	28.3	126.2	30.90	551	5.6
1938	26.5	127.1	29.20	506	5.8
1939	25.5	133.6	29.70	538	5.5
1940	23.6	142.4	29.40	576	5.1
1941	27.6	143.7	34.40	697	4.9
1942	31.9	140.3	38.70	871	4.4
1943	32.8	146.8	42.20	977	4.3
1944	30.1	154.2	40.60	1,060	3.8
1945	30.8	145.2	38.80	1,075	3.6
1946	39.1	154.1	52.50	1,136	4.6
1947	55.6	155.3	74.60	1,181	6.3
1948	62.5	145.5	78.70	1,291	6.1
1949	57.3	144.6	71.80	1,271	5.6
1950	60.1	144.6	75.40	1,369	5.5
1951	67.0	138.0	80.50	1,473	5.5
1952	64.7	146.0	82.00	1,520	5.4
1953	60.7	155.3	80.80	1,582	5.1
1954	60.2	154.7	79.60	1,582	5.0
1955	56.3	162.8	78.60	1,660	4.7
1956	54.7	166.7	78.10	1,742	4.5
1957	61.3	158.7	83.00	1,804	4.6
1958	69.6	151.5	89.90	1,826	4.9
1959	66.6	159.2	90.90	1,905	4.8
1960	65.5	161.3	90.20	1,969	4.6

[1] Price weighted by consumption of each meat in each year.
[2] Carcass-equivalent weight.
[3] Computed from retail weights of consumption and retail prices of all beef, veal, lamb and mutton, and all pork (including minor pork products).
[4] Excludes consumption from Government emergency programs.

Compiled from *Livestock and Meat Situation*, July 1959, (*27*).

disposable income in current dollars. When income is separated into its two components, real income and general price level, the retail value of all meat is found to rise 34 percent as fast as deflated disposable income (real income); but, as for beef and pork, it is highly responsive to trend in the general price level. Its movement, as a net regression, is a fifth faster than the changes in the general price level.

Data are as follows:

1. Flexibility coefficient, retail value on disposable income [20]	0.86
2. Flexibility coefficient, retail value on:	
Disposable income deflated	.34
Consumer price index	1.20

These coefficients suggest that the efficiency of production and marketing of meat animals and meat has not fully kept pace with the rest of the economy. Resources applied to them have perhaps increased in value relative to the general average of all commodity prices, as witnessed by the 1.20 coefficient. Similar coefficients were found for beef and pork.

As an observation on the history of demand, the increase in retail value of meat, a third as fast as the growth in real income despite rising prices, is a distinguished record indeed for a staple food.

PRICE MAKING FORCES: TIME SERIES ANALYSIS

The economics of meat and meat animals in its broad outline is relatively simple. The economic system of which they are so important a part is complex. The simplicity of the economics of meat and meat animals alone should not mislead the analyst or lure him into rash judgment. Values of commodities are not self-determined within their own economic setting but are derived out of resolution of all forces in the system as a whole. It is not hard to arrive at simple relationships within the meat-meat animal economy as such; it is harder to establish the relationship between that economy and the total economy.

A prime feature of the economic system is its interconnections and interdependence. There are no truly independent or "exogenous" values. This is a handicap to economic analysis directed to any one part of the economy. Moreover, the economy is functionally an exchange economy. One workable viewpoint—the choice made here—from which to study the economic status of a good such as meat is to look at it as part of the creation of economic wealth, and also as deriving its valuation from its exchange position relative to all other goods. This is the "real income" or "real product" approach, and may be distinguished from the consumer-oriented or psychological approach in which translation of economic values is sought solely and directly in terms of consumer behavior. Real income has been used in several preceding analyses, and will be resorted to frequently in this chapter.

The price analyst who undertakes a study of a particular seg-

[20] See footnotes 18 and 19, page 51, for an explanation of flexibility coefficients.

ment has a practical concern with how the economy works. Moreover, he is at the mercy of observable regularity in the economy. Only insofar as an economic process operates in an orderly and repetitive manner can systematic study be made of it. It would be futile to try to describe regularity where there is none.

More exactly stated, in this as in so many other considerations in historical analysis, constancy—consistency of behavior—is the major requirement. If a certain regularity of performance is observable a satisfactory price analysis should be possible. This is true even though the precise nature of all the economic forces at work may not be understood.

How do we know when we have chosen the right variables and the right relationship to describe an economic process? A high coefficient of correlation may not mean that the truly influential economic forces have been isolated and correctly measured, but only that adequately representative ones have been chosen and that they have operated in a reliable manner. All that is known for sure is that the analysis has worked. An analysis which proves successful for historical data will be successful in forecasting the future if the setting remains virtually unchanged —and only if it remains unchanged.

To choose the correct economic relationships, the price analyst must deal with the perplexing problems of identification and specification. To recognize the interdependence that marks the economic system is to lead directly to the knotty problem of *identification*. Identification is the term given to the principle that few observed values are of either pure supply or pure demand. Price changes in the market place do not carry any labels accommodating to analysts which explain whether they were due to demand forces or supply forces. Elmer Working's Journal article (*52*) of more than 30 years ago remains the basic reference. Working concerned himself with how to identify supply and demand forces as represented in statistical data, and with how to separate slopes of demand and supply curves from shifts in their positions.

A certain number of requirements must be met if any statistical technique in price analysis is to yield valid results. A *specification* problem arises when some of those conditions are not fulfilled. The particular conditions relate, of course, to the kind of economic problem dealt with and to the kind of technique employed.[21] In this context a specification error is not the same as incorrect economic theory and is to be distinguished from it.

Errors of observation in the data and the use of nonrepresentative series to reflect certain price or quantity changes also add to the problem of price analysis. Despite their completeness and

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[21] The method of estimation requires that certain conditions be met in the model to obtain estimates with desirable properties. The model in turn specifies the form of the structural equations and the restrictions imposed upon the unknown parameters.

As an example, least squares regression analysis stipulates that the covariance or the correlation between the residual and the explanatory variables be zero. If the results do not indicate this, it is an indication that the estimating method does not meet the specification of the problem.

the care given their collection, all statistics for meat and meat animals and related series embrace some error, and for some series it may be sizable. All data are estimates. It would be unwise to conduct analyses, or to evaluate their results, without taking note of this fact.

For many years statistical analysis of prices of commodities of agricultural origin has been conducted by the single-equation least-squares technique. Making the technique appropriate has been the assumption that the supply of a product available for utilization in a given year is essentially predetermined at the beginning of the year. The supply curve for each year thus is considered to be perfectly vertical. Consequently the average prices for successive marketing seasons are considered to trace a demand curve. A number of demand shifters have been employed to isolate the demand curve. Recognizing that the supply curve is not in fact perfectly vertical, and armed with new techniques, some analysts have recently challenged the adequacy of the single-equation least-squares approach and have introduced the simultaneous equation approach as an alternative. They use it in certain cases when there is interaction between price and either supply or demand within the time period to which each datum applies. Foote (*10*) gives several examples where the simultaneous equations approach has been applied to agricultural commodities.

Fox (*12*), however, after considering the various aspects of the single-vs.-simultaneous argument and conducting several simultaneous analyses, concluded that the least-squares method was reasonably satisfactory for many analyses of prices of commodities of farm origin.

The annual supply curve for meat is not perfectly vertical. It is not so exactly so as is the supply curve for a perishable crop that has a single harvest season, such as cottonseed or soybeans. For those crops, the supply cannot be increased between one harvest and the next. Output of meat can be affected during a year by new economic forces, as when a rising price for hogs causes farmers to feed their hogs to heavier weight before marketing. Yet to a large extent output of meat in a given year is shaped by forces in existence prior to that year. Its magnitude is in large measure predetermined by the volume of meat animal production that is under way at the beginning of the year.

Other criteria set forth by Fox as governing the acceptability of a least-squares technique for price analysis are met fairly well by the meat and meat animal commodities. The first is that the supply of a competing commodity is not affected by the current price of the commodity under question. For example, the current price of beef does not materially affect the current supply of pork. Secondly, changes in the price or consumption of the commodity do not materially affect consumer income or other demand shifters which are assumed to be determined outside the meat economy.

Moreover, as Working (*52*) pointed out in his article on identification, it is not necessary that true demand and true supply curves be constructed if the analyst only wants a method that will help him to forecast future trends in prices. Working explained

that even though the supply curve is not perfectly vertical, "it does not follow that an attempt to construct a demand curve will give a result that will be useless . . . A (fitted) curve . . . will be useful for purposes of price forecasting, provided no new factors are introduced which did not affect the price during the period of study."

Working thus accepts the concept of constancy as a consideration in analysis. Price analysis "works" not through extraction of data on pure economic forces, but through the repetitive character of the highly mixed forces that can be measured.

With such a background concept, what are the relevant economic relationships for determining factors affecting prices of meat? Our concern is not primarily with measurement of demand elasticities. Rather the emphasis is on price-estimating or forecasting equations.[22] Specifically, relationships are needed which will permit the study of the effect of income and meat supplies on price. To accomplish this objective, the following price-estimating relationship is basic in this study:

$$X_1 = f(X_2, X_3, X_4, X_5, X_6)$$

where annual data for these variables are defined as follows:

X_1—The price, at retail, of the particular meat.

X_2—Production of that meat, per person.

X_3—Production of major competing meat or meats, per person.

X_4—Real disposable income per person (disposable income deflated by consumer price index).

X_5—Consumer price index.

X_6—Time.

As discussed earlier, production of meat can be assumed as given at the beginning of each year. Likewise, since the consumer price index and disposable income are not significantly affected by the meat economy, they also are assumed as given in the analyses. As the retail price is the only dependent variable, least squares regression analyses may be used to fit statistically the price-estimating relationship.

Deflated disposable income is made to serve a double purpose in this study. It is taken as a measure of gross output of the economy, and of dollar income available to be spent by consumers. Ideally, two different measures would be desirable, but it is a convenience to use a single one.[23]

Analysis was conducted in logarithms of absolute values, except that time, where included, was taken as a natural number. The regression coefficients obtained, except for time, can be interpreted directly as coefficients of flexibility.

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[22] However, the parameters in these equations imply certain demand elasticities. The relationship between the parameters in the price-estimating equations and demand elasticities are shown in appendix II, page 104.

[23] If Federal defense expenditures are regarded as nonproductive in the traditional sense, the double use is justified by the near-equality of those expenditures and of personal income tax deductions. In fiscal 1960, Federal personal income tax deductions were 40.7 billion dollars. In the Federal budget, major national defense appropriations were 44.7 billion and the Department of Defense budget alone was 42.9 billion.

Period of Analysis

For a choice to be made as to period used in analysis, answers must be provided to the question as to the appropriate length of run. What is the periodicity in the economic relationships with which the analysis is concerned?

There is much confusion in literature on this subject. Some of the difficulty stems from the fact that the real world is a composite of instantaneous decisions and actions, all of which have impacts that are both long and short run. For the most part, interest in economic analysis disregards merely brief and passing phenomena. It centers instead on forces that shape the course of economic events during a considerable period. Aside from this general posture it is hard to arrive at clear consensus on length of run.

Economic data for analysis are totals or averages of observations made over a period of a week, month, quarter, year, or even longer. Which of these is to be preferred? If any of these lengths of run bears peculiarly on the objective sought in analysis, there would be reason for choosing it. For instance, quarterly data would likely reflect seasonal influences on consumption or price of meat; therefore if seasonal analyses were desired, use of quarterly data would be appropriate.

In many instances, it is impossible to correlate the period of actual adjustment with some time period. This is true because adjustments are continuously taking place, with no natural time distinctions or cutoff points. Prices of meat may change a hundred times during a year. To elect to build a statistical analysis on annual average data in such a case is largely an arbitrary decision. Where economic adjustments are continuous, there is little *a priori* reason for choosing a particular length of run, annual or any other period.

The length of run problem can be viewed in opposite manner. If annual data are used in analysis, do the results measure only those economic forces having an approximately 12-month period? Are all forces of either briefer or longer duration screened out? Many authors have called attention to lagged or delayed economic response, and to the extra force exerted by persistence of a particular economic value. Working (*51*), convinced that long-run elasticities are different from those of short-run (that is, annual), felt he had to work with 5-year or 10-year averages to obtain long-run elasticity coefficients.

Furthermore, if annual data are employed, are the results affected by the length of the time series for which the analysis is conducted? That is, do coefficients from an analysis of 10 years of annual observations differ from those for longer periods such as 20 or 30 years?

No definitive answer to all these questions can be given here. Nevertheless, it is profitable to take recourse in the proposition that all results of statistical analysis have meaning in terms of the economic model from which they originate and the analytical techniques employed. Single-equation least-squares correlation used here is nothing more than a mathematical device to match

up, or associate, departures from a mean. A 10-year analysis deals with departures from the mean for those 10 years. Similarly, a 30-year analysis is concerned with departures of values from a 30-year mean. Therefore, the number of months which each datum averages (12 months, in annual data) is of less significance than is the actual production span or cycle from which the empirical data arise.

Supply values for pork originate in a hog cycle that commonly combines two years of increase and two of decrease. The supply of beef fluctuates through cycles two to three times as long. Price responses to changing supplies should be thought of in terms of a 2-year evolution in the case of pork, and 5 or 6 years for beef. Such is the process by which those prices originate. Certainly it dare not be assumed that if the aggregate 5-year rise in beef supply were telescoped into a single year, the price response would be identical with that which takes place in 5 years of evolution!

In the analysis reported in this study no attempt was made to isolate short- and long-run influences as such. Because the supply of beef trended upward so sharply, that trend influence had much to do with the regression coefficients for price on supply that were obtained. That is to say, the departures of price from their means, insofar as they are determined by supply, reflect largely the marked uptrend in supply (as it evolved in its cyclical course). Yet the result is in no sense a pure long-run elasticity; that could be obtained only if a static supply situation were in fact perpetuated for a number of years. The result is instead a supply-price relationship that can be described only in terms of the long-run trend situation from which the data were derived.

The conclusion, then, is that the results of a statistical analysis can be interpreted in terms of length of run only by examining closely the particular time series incorporated in the analysis. That is, it is necessary to look into the reasons which explain why the series of annual data depart from their mean as they do. If long-run trends are the dominant factor, the results relate principally to long-run trends. If production cycles are instrumental, results relate thereto. If only erratic annual fluctuations are to be found, results apply to them.

It follows that if any continuous trend exists, the longer the time span included in the statistical study the more does the long trend influence the results. The shorter the number of years that are included, the more do cyclically-evolving or even briefer phenomena govern the outcome of the study.

Analyses are presented here for the three separate periods outlined in the section beginning on page 18, and for all three combined. Identifying characteristics of each period have been described. In brief, 1921–29 and 1948–60 are periods of high and rising national incomes. They are times of "prosperity" and of economic growth. Main difference between the two lies in the relatively stable price level for the earlier period, as contrasted with the rising level (inflation) in the later one. The years 1930–41 are of a severe business cycle—recession, depression, recovery.

Analyses for the three subperiods are not replication of a single

model but sources of observations on the effect of the several kinds of economic situations existing in those periods. Business cycles and livestock cycles are the reigning forces.

The period as a whole from 1921 to 1960 embraces all the characteristics of the subperiods, and analysis for it chiefly reflects long-term relationships. The technological and institutional factors described in the section beginning on page 26, vital to the economic values emerging during those years, have much to do with the results of this analysis for the entire period.

The results for the 34-year period describe the price reaction actually experienced during a 34-year uptrend in the U.S. meat supply. If meat production should continue upward under conditions similar to those of the past—including a cyclical production pattern—the results would have value for prediction. Since the price flexibilities yielded in the 34-year analysis are not truly long-run values, they will be referred to as long-term coefficients.

Beef

The economic record of beef from 1921 to 1960 is essentially that of a steady uptrend in production and consumption, both in total and per person, accompanied by an increase in price to a much higher level at the end of the period than at the beginning. Most of the price increase occurred during wartime and immediate postwar years. When the peacetime economy was resumed in 1947 and 1948, the price of beef per pound was more than twice what it had been in 1941 (fig. 12). Although no separate

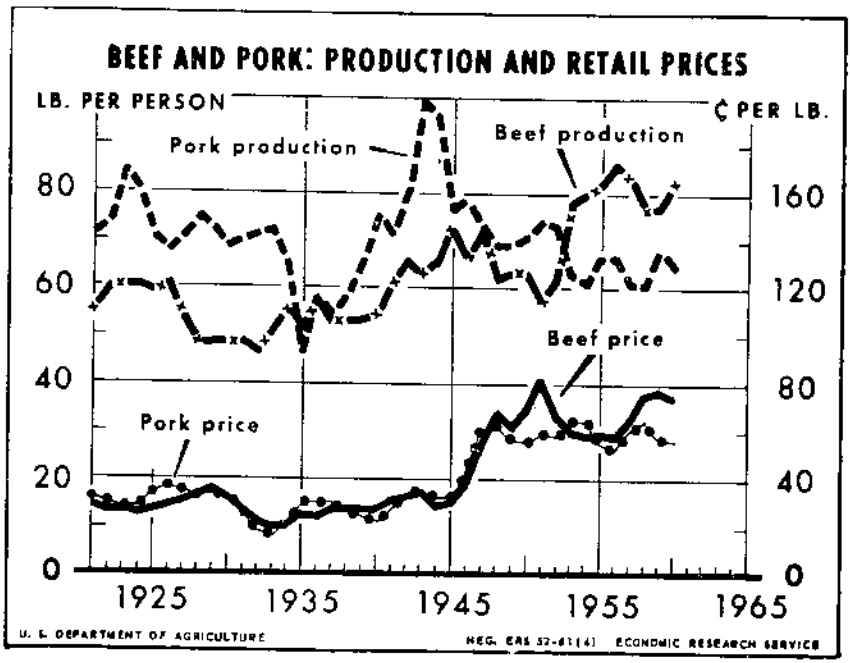

Figure 12

short-term analysis was made for 1942–47, the big price advance during that period is a major element in price analysis for the entire span of years studied.

The importance of the 1942–47 revaluation of beef is even more prominent when it is contrasted with the absence of a positive trend in the price of beef from 1921 to 1941, and again from 1948–60.

Data of figure 12 compare supply and price for beef and pork. The data are in absolute values. In figure 13 relationships with real income and price level are shown in ratio form. From figure 13 it is seen that the uptrend in beef output, im-

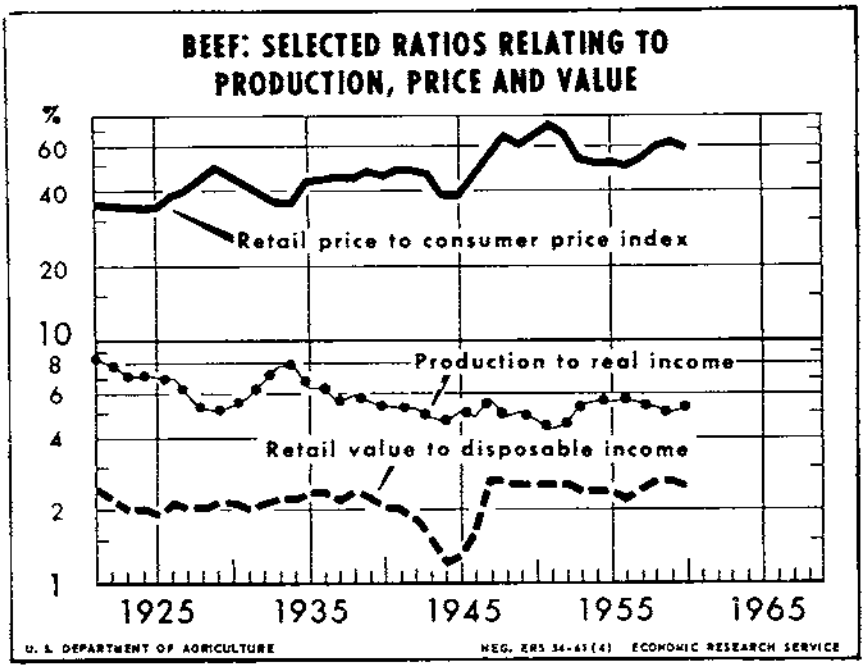

FIGURE 13

pressive though it is, has not equalled the rise in real income. But the price of beef has risen relative to the general price level; and, a more striking record, the retail value of beef, as a long-run trend, has risen relative to disposable income. This latter observation testifies to the high position beef holds in the minds of consumers. The larger part of economic growth in an economy is normally realized in industrial products and the services. It is dramatic indeed when the value of a food increases relative to the value of all the output of the economy.

Superficially, it would be impossible to determine how much of this uptrend in relative value is due to expanded demand, and how much to a lagging supply.[21]

[21] The latter contributes more to the result if demand is inelastic.

"Beef," however, has not been a commodity of uniform characteristics. Its quality has been improved measurably, and beef of today is a better product than the beef of 1921. The uptrend in quality accounts to considerable extent for the rise in relative prices as an overall trend, and for the higher relationship of retail value to disposable income.

For the beef price analyses the following are the variables chosen:

X_1—Retail price of beef, per pound.
X_2—Production of beef per person.
X_3—Production of pork per person.
X_4—Deflated disposable personal income per person.
X_5—Consumer price index.
X_6—Time.

1. 1921–29

This was a period when production of beef per person was first stable, then declined cyclically (fig. 12). Pork production, on the other hand, was more variable. The real output of the economy marched steadily upward. The price level was almost stable.

The amount of intercorrelation between independent variables affects the results of an analysis. High intercorrelation tends to result in a lowered reliability for the individual regression coefficients because it often increases their standard errors. Coefficients of simple correlation (r_{ij} matrix) for this analysis are the following:

	X_1	X_2	X_3	X_4	X_5	X_6
X_1	1.000	−0.925	−0.330	0.511	0.055	0.819
X_2		1.000	.165	−.377	.049	−.697
X_3			1.000	.083	−.615	−.256
X_4				1.000	−.301	.877
X_5					1.000	−.059
X_6						1.000

Greatest intercorrelation was of real income with time—an inevitable result since the period was one of consecutive economic growth. Whenever national product trends upward so that it is correlated with time, estimation of the influence of real income versus that of the grabbag of other trend influences becomes indeterminate. For this reason two regressions were computed, one including time and one excluding it.

Equations are as follows. Standard errors are in parentheses.[25]

(1)

$$\log X_1 = 2.972 \underset{(0.766)}{-0.881 \log X_2} \underset{(0.707)}{-0.190 \log X_3} \underset{(1.472)}{-0.023 \log X_4} + \underset{(1.303)}{0.219 \log X_5} + \underset{(0.030)}{0.006 X_6}$$

$$R^2 = 0.933$$

[25] Some of the effects of intercorrelation can be seen by comparing the standard errors in these two equations. All the standard errors in equation (1.1) are much smaller than those of equation (1). Yet the only difference in equation (1.1) is the omission of the intercorrelated variable, time.

$$\text{Log } X_1 = 2.422 \underset{(0.187)}{-1.040 \log X_2} \underset{(0.301)}{-0.324 \log X_3} \underset{(0.182)}{+0.293 \log X_4} \underset{(1.061)}{+0.320 \log X_5} \qquad (1.1)$$

$$R^2 = 0.932$$

For this period the most influential factor by far was the production of beef. The coefficients of flexibility were −0.88 and −1.04, meaning that an increase of 1 percent in beef output per person reduced the retail price of beef 0.88 percent in the one estimate, and 1.04 percent in the other. The percentage relationship so estimated between price and production does not translate precisely into a coefficient of elasticity of demand; that is, that relationship is not an exact reciprocal of the ratio between changes in consumption and changes in price. (See appendix II, p. 104.) But in this case, the reciprocals of price flexibility coefficients give fairly good approximations of demand elasticities. Essentially, these amount to roughly unitary elasticity.

Neither the general price level nor real income had great effect (*b*'s of 0.22 and −0.02 in equation (1)). The price level did not change much during the 1920's. Real income rose most in early years of the decade when the beef situation was unvarying, and least later when beef production and prices fluctuated. Removal of time as a factor in equation (1.1) forced some of the uptrend in demand to be carried by the real income variable. The particular time pattern for real income prevented it from showing a large effect. Its flexibility coefficient of 0.29 is not unacceptable were it a variable truly confined to real income; but as a carrier for other associated trend values, it would be expected to show a coefficient higher than that figure.

On a judgment basis, the only coefficients that appear to have meaning for 1921–29 are those for the production of beef and pork. The coefficient for beef production could be low; the particular configuration of data for the 1920's may have resulted in an unrealistically low coefficient, thereby making demand seem more elastic than it actually was.

It is hard to judge on *a priori* grounds the reliability of the coefficient for production of pork per person. The least that can be said is that it is not entirely unreasonable.

2. 1930–41

In this period beef production per person trended steadily upward (fig. 12). Great cyclical fluctuations in the price level and real income dominated the influence of those 12 years. The retail price of beef was not as high at the end of the period as at the beginning, but it gained relative to the general price level.

Intercorrelation between independent variables was not extremely high. It was greatest for beef production and disposable income against time. A comparison of the results including and excluding time as a variable therefore is worth attention. Coefficients of simple correlation were:

	X_1	X_2	X_3	X_4	X_5	X_6
X_1	1.000	0.084	−0.043	0.779	0.841	0.248
X_2		1.000	−.096	.628	−.244	.771
X_3			1.000	.010	.135	−.070
X_4				1.000	.423	.740
X_5					1.000	−.257
X_6						1.000

Equations obtained were the following:

(2)

$$\text{Log } X_1 = -1.442 \underset{(0.240)}{-0.507 \log X_2} \underset{(0.064)}{-0.145 \log X_3} \underset{(0.350)}{+0.436 \log X_4} \underset{(0.549)}{+1.479 \log X_5} \underset{(0.005)}{+0.005 X_6}$$

$$R^2 = 0.976$$

(2.1)

$$\text{Log } X_1 = -1.276 \underset{(0.221)}{-0.597 \log X_2} \underset{(0.063)}{-0.142 \log X_3} \underset{(0.120)}{+0.758 \log X_4} \underset{(0.219)}{+0.984 \log X_5}$$

$$R^2 = 0.973$$

The low coefficient of price flexibility for beef production indicates a highly elastic demand for this period. Incomes of consumers were low during those depression years. At lower incomes, the demand for a commodity such as beef is expected to be more elastic. Nevertheless, doubt may be raised as to whether the flexibility coefficient of −0.507 is entirely reliable. Its standard error is fairly large and it might overstate somewhat the elasticity of demand for beef during those years. Beef supply was not the dominating price influence during the 1930's; the business cycle was.

The big fluctuations during the 1930's associated with the business cycle were those in the general price level and national income. The results of the analysis reported here place modest weight on real income—coefficient of 0.44—(when time is a separate variable), but show sharper responsiveness to the price level. Even though the coefficient of 1.48 on price level may be overlarge, it does substantiate an axiom in the behavior of prices of commodities of farm origin: That in a sharp business cycle, their prices swing even more violently than do prices in general.

A single depression experience is not adequate for broad generalization. Insofar as it is at all reliable, the depression of the 1930's tells us that the retail price of beef is responsive to cyclical fluctuations in national income, and is more so to the price level than to the real component of it. It appears to be less sensitive to variations in its own supply than in more prosperous times.

The coefficient for the effect of pork production bears about the same relation to the coefficient for beef production in this period as in 1921–29, equalling about a fourth of the coefficient for beef.

3. 1948–60

The experience of this decade is exactly opposite that of the 1930's. The general price level and real income surged steadily

upward. Beef production traced a highly arched cyclical pattern, yet it also showed a sizable net gain over the period. Prices of beef outlined a sharply cyclical course. However, they closed the period higher than at the beginning despite a much larger beef output, testifying to a substantial rise in demand for beef.

But in trying to ascertain the causal influences affecting prices in this period, we are handicapped by the pronounced intercorrelation between beef production, real income, consumer price index, and time:

	X_1	X_2	X_3	X_4	X_5	X_6
X_1	1.000	−0.499	0.458	0.044	0.222	0.116
X_2		1.000	−.775	.825	.707	.795
X_3			1.000	−.499	−.508	−.544
X_4				1.000	.920	.975
X_5					1.000	.965
X_6						1.000

Results of the analysis are:

$$\text{Log } X_1 = 0.626 - \underset{(0.152)}{1.541} \log X_2 - \underset{(0.209)}{0.316} \log X_3 + \underset{(0.589)}{1.089} \log X_4 + \underset{(0.414)}{0.471} \log X_5 + \underset{(0.006)}{0.007} X_6 \qquad (3)$$

$$R^2 = 0.977$$

$$\text{Log } X_1 = -1.435 - \underset{(0.156)}{1.565} \log X_2 - \underset{(0.208)}{0.389} \log X_3 + \underset{(0.401)}{1.641} \log X_4 + \underset{(0.302)}{0.836} \log X_5 \qquad (3.1)$$

$$R^2 = 0.972$$

The apportionment of effects on price among the three intercorrelated independent variables (real income, price level, and time) is almost indeterminate. The regressions ascribe sharpest response of price to deflated income, with coefficients of 1.1 and 1.6. Perhaps all that can be said with certainty is that prices have been considerably higher for beef in the postwar years. There is no clear proof as to which economic (or noneconomic) factor has been most influential.

The coefficient of flexibility on beef output, −1.5, is large. It signifies less than unitary demand elasticity. This is not surprising to observers of meat price trends in recent years. The analysis substantiates the marked sensitivity of beef prices to beef production which has often been witnessed and reported in years since World War II. The coefficient for the effect of beef production is larger in 1948–60 than 1921–29, and far larger than in the depression period of 1930–41. Similarly, the coefficient for the effect of pork production on beef prices is larger for 1948–60 than for either of the two earlier periods. The ratio between the two coefficients is not out of line with other periods—the coefficient for pork is about a third that for beef.

It seems to be a characteristic of modern economic society at times of high employment and income that consumer demands are exceptionally firm and inflexible. Evidence on this is even

more convincing for pork than for beef, as will be seen in the analyses that follow. Certainly in the postwar decade when the demand for beef increased rapidly it also became more inelastic. The price response to an increase or decrease in supply has become exceedingly sharp.

4. Entire period, 1921–41, 1948–60

An analysis for the 34-year period has a much different significance than do the analyses for individual decades. Whenever a variable registers a material overall change during a long period, that long-term evolution overshadows short-term fluctuations as a price-making factor.

In the period being considered pronounced trends are observed (fig. 12). Much of the change was between the prewar level ending in 1941 and the postwar level beginning in 1948. The results of an analysis spanning war years (even though omitting data for them) are highly shaped by the nature of the prewar-postwar jump.

Intercorrelation is often a greater problem over a long period than a short one. Coefficients for the 1921–41, 1948–60 period are:

	X_1	X_2	X_3	X_4	X_5	X_6
X_1	1.000	0.712	−0.058	0.939	0.952	0.860
X_2		1.000	−.166	.825	.827	.758
X_3			1.000	−.125	.002	−.312
X_4				1.000	.904	.916
X_5					1.000	.781
X_6						1.000

Pork production is the only variable not highly associated with other ones. Otherwise, the interlinkage is so great as to make it necessary to use careful judgment in interpreting the results.

Regression equations obtained are:

$$\text{Log } X_1 = -0.761 \underset{(0.097)}{-1.064 \log X_2} \underset{(0.097)}{-0.067 \log X_3} \underset{(0.127)}{+0.574 \log X_4} \underset{(0.085)}{+1.341 \log X_5} \underset{(0.001)}{+0.004 X_6} \qquad (4)$$

$$R^2 = 0.990$$

$$\text{Log } X_1 = -1.430 \underset{(0.119)}{-1.059 \log X_2} \underset{(0.106)}{-0.237 \log X_3} \underset{(0.102)}{+0.955 \log X_4} \underset{(0.103)}{+1.288 \log X_5} \qquad (4.1)$$

$$R^2 = 0.984$$

Long-run trends dominate this analysis so completely that pork production, which is almost trendless, finds little room for expression, particularly when time is included as a variable. The effects of pork supplies on beef prices, which are primarily short-term, can be observed better from the short-term analyses. The coefficient for pork in equation (4) is negligible. That in (4.1) is consistent with those for individual periods, but at their lower limit.

As real income and the price level are so closely intercorrelated, no clear validity can be attached to the coefficient of flexibility of 0.57 on the former (equation (4)). And yet the coefficient is not unreasonable. As an economy grows and matures the proportion of income and resources devoted to a staple food tends to become ever smaller.

The coefficient of 1.34 on the price level shows once more that the price of beef has responded relatively more to changes in the general price level than to other factors. In a short-run study this is a not unexpected result. As a longer-run phenomenon it is more surprising, and largely attributable to the new height of prices established after the immediate postwar inflation. That inflation lifted beef prices to a higher level than can be explained by the supply of beef and pork and by real income.

One method of accounting for the prewar-postwar jump in beef prices is to introduce a dummy variable (X_7) which has the value 0 for prewar years and 1 for postwar years. This variable will have the effect of raising or lowering the constant term for the postwar years in a regression equation covering the entire period.

The regression equations including the dummy variable X_7 are:

(4.01)

$$\begin{aligned}\text{Log } X_1 = {} & -0.507 - \underset{(0.089)}{1.008} \log X_2 - \underset{(0.087)}{0.109} \log X_3 + \underset{(0.121)}{0.703} \log X_4 \\ & + \underset{(0.140)}{0.999} \log X_5 + \underset{(0.001)}{0.001} X_6 + \underset{(0.039)}{0.113} X_7 \\ & R^2 = 0.992\end{aligned}$$

(4.11)

$$\begin{aligned}\text{Log } X_1 = {} & -0.526 - \underset{(0.086)}{0.998} \log X_2 - \underset{(0.079)}{0.131} \log X_3 + \underset{(0.082)}{0.759} \log X_4 \\ & + \underset{(0.099)}{0.937} \log X_5 + \underset{(0.025)}{0.132} X_7 \\ & R^2 = 0.992\end{aligned}$$

The coefficient for time is not significant when the dummy variable is included. This indicates that when the jump between the prewar and postwar years is taken into consideration, there is no residual trend which is unaccounted for by the other variables. Although the other coefficients are largely unchanged, that for the consumer price index has dropped from 1.3 to about 1.0. This is significant; it demonstrates conclusively the exceptionally great influence the change in price level just after the war had on the retail price of beef.

A resumé of these analyses is aided by the recapitulation of regression coefficients in table 19.

Figure 14 compares beef prices estimated by equation (4.11) with actual prices. The estimates correspond quite closely to the actual prices.

In summary, although beef production per person has not increased in full proportion with growth in real income, as a basic food it could not be expected to do so. The record of demand for beef is outstanding. The coefficient of flexibility of beef price on real disposable income for the entire period is 0.57, a relatively

TABLE 19.—*Net regression coefficients, retail price of beef on five independent variables, selected periods* [1]

Period	X_2 Beef production per person	X_3 Pork production per person	X_4 Deflated disposable income per person	X_5 Consumer price index	X_6 Time [2]
1921–29	−0.88 (0.08)	−0.19 (0.71)	−0.02 (1.47)	0.22 (1.30)	0.006 (0.030)
1930–41	−.51 (.24)	−.15 (.06)	.44 (.35)	1.48 (.55)	.005 (.005)
1948–60	−1.54 (.15)	−.32 (.21)	1.09 (.59)	.47 (.41)	.007 (.006)
1921–41; 1948–60	−1.06 (.10)	−.07 (.10)	.57 (.13)	1.34 (.09)	.004 (.001)

[1] All coefficients except X_6 are coefficients of flexibility. The coefficient for X_6 cannot be interpreted directly. However, the values shown are the equivalent of an increase of about 1 percent per year, on the average. Standard errors are in parentheses.

[2] Regression on natural numbers.

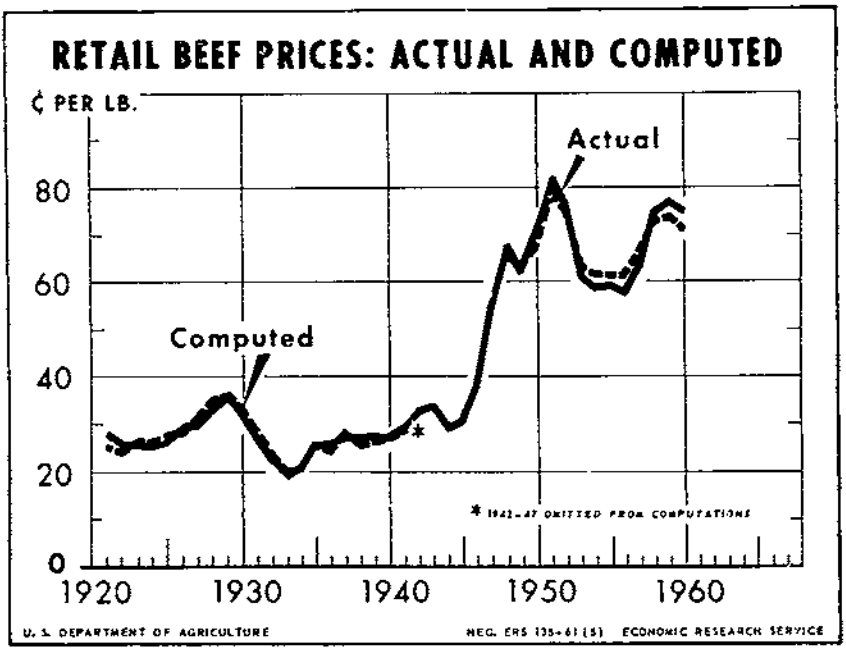

FIGURE 14

high figure demonstrating a marked positive relationship between overall economic growth and the demand for beef.

Over the entire period, the relative trends in supply and price for beef—an approximation to the concept of elasticity of demand—indicate about a unitary relationship. A similar result was obtained for 1921–29. In 1930–41 the business cycle overshadowed supply forces, but in 1948–60 demand was clearly inelastic. There appears to be evidence that short-run demand has been growing more inelastic, and that demand for beef is more elastic in the long term than the short.

PORK

The record of production and consumption of pork per person is the opposite of that for beef: it is one of a slow downtrend during the last four decades (fig. 12). The retail price of pork was much higher after the war than before, both in cents per pound and relative to the general price level. But the pork price barely held a stable relationship with the general price level before the war, and since 1948 it has slipped downward relative to the general price level (fig. 15).

Because neither the relative price nor the consumption record of pork has been favorable, the calculated relationship of retail value of pork to disposable income has traced a steady decline. This too is in contrast with the record for beef.

As noted previously, however,[26] the rising relative value of

[26] See page 35.

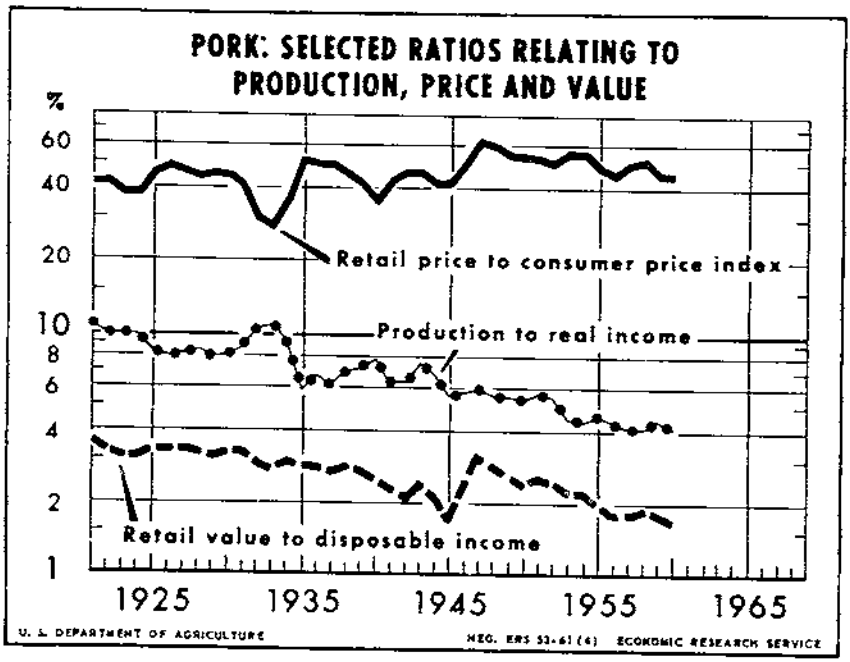

FIGURE 15

beef was partly attributable to an improving quality of product. It is improbable that the quality of pork has risen similarly. Whether demand for pork has been of a nature to favor improvement of quality is an issue on which there is much disagreement and few supporting data.

For the pork price analyses the variables were:

X_1—Retail price of pork, per pound.
X_2—Production of pork per person.
X_3—Production of beef per person.
X_4—Deflated disposable personal income per person.
X_5—Consumer price index.
X_6—Time.

1. 1921–29

In the 1920's, when real product of the economy increased, first fast then more slowly, and the general price level was stable, pork production and price fluctuated considerably but without major underlying trend (fig. 12).

Intercorrelation is a less serious problem in price analyses for pork than for beef, inasmuch as the supply of pork per person is less correlated with other variables than is the supply of beef. In other respects the intercorrelation problem is similar for the two meat price analyses.

The matrix of simple correlation coefficients is of course the same as that shown for beef except that X_2 and X_3 variables are interchanged. They will not be repeated here, as they may be referred to in pages 63 to 67. The coefficients for 1921–29 on

page 63 show that pork production was fairly highly correlated with the consumer price index in those years. Two variables were closely associated with time. Otherwise, intercorrelation was not serious.

Equations of results are:

$$\text{Log } X_1 = -0.903 \underset{(0.346)}{-1.293 \log X_2} \underset{(0.375)}{-0.252 \log X_3} \underset{(0.721)}{+0.984 \log X_4} \underset{(0.638)}{+1.312 \log X_5} \underset{(0.015)}{-0.011 X_6} \qquad (5)$$

$$R^2 = 0.974$$

$$\text{Log } X_1 = 0.027 \underset{(0.159)}{-1.067 \log X_2} \underset{(0.099)}{+0.017 \log X_3} \underset{(0.096)}{+0.450 \log X_4} \underset{(0.562)}{+1.140 \log X_5} \qquad (5.1)$$

$$R^2 = 0.969$$

According to these results, demand for pork was somewhat inelastic during the 1920's—a flexibility coefficient for supply on price of −1.29 in the analysis which includes time.

Validity of the high coefficient for disposable income in equation (5), 0.98, must be questioned. It is only slightly larger than its standard error. Pork is usually regarded as lower in the scale of consumer appreciations than is beef. The benefit accruing to pork from a rising real income of the economy is usually considered to be rather small. The 0.98 coefficient is largely due to the record of 1921–23, when the price of pork fell only moderately despite a sharply rising supply. A rising real income was the only variable that could explain this pattern. But the coefficient for real income is to be distrusted for a more urgent reason, that of high intercorrelation for that factor with time. The rather strange result of a large positive coefficient of one of two intercorrelated variables and negative for the other is not too rare an occurrence. It of course casts doubt on the reliability of each —as do the high standard errors of each (*cf.* (*11*)).

When time is omitted, the coefficient for the effect of real income is a much more reasonable 0.45.

The high coefficient for the effect of general price level in equation (5) (and only a little less in (5.1)) is consistent with *a priori* judgment that prices of foods of farm origin are highly responsive to fluctuations in the general price level. But as the price level varied little during the 1920's, the results are not especially reliable or useful.

2. 1930–41

In this period of recession and recovery, much fluctuation appeared in all variables. Production of pork was highly affected by drouth in the middle of the 1930's, turning first downward and then up. Real income and the consumer price index mirrored the business cycle.

Equations obtained from analyses for that period are:

$$\text{Log } X_1 = -2.767 \underset{(0.106)}{-1.028 \log X_2} \underset{(0.399)}{+0.466 \log X_3} \underset{(0.581)}{+0.622 \log X_4} \underset{(0.913)}{+1.954 \log X_5} \underset{(0.008)}{-0.005 X_6} \qquad (6)$$

$$R^2 = 0.974$$

$$\text{Log } X_1 = -2.938 \underset{(0.101)}{-1.031 \log X_2} \underset{(0.352)}{+0.559 \log X_3} \underset{(0.191)}{+0.288 \log X_4} \underset{(0.348)}{+2.466 \log X_5} \qquad (6.1)$$

$$R^2 = 0.973$$

The response to the general price level was very great during the 1930's, almost 2 to 1 in equation (6) and even more in equation (6.1).

The severe cutback in pork supplies midway of the decade brought pork prices back to where they had been in 1930–31, but no higher. Consequently, the flexibility coefficient for influence of supply, at –1.03 (equation (6)) indicates a demand of about unitary elasticity instead of the inelasticity found for 1921–29.

The coefficient for the bearing of beef output on pork price has the wrong sign. Beef supply did not prove an adequate explanation of the price of beef during those explosive years; it could hardly be expected to do so for the price of pork.

Once again real income appeared to have a strong positive influence on the price of pork (coefficient of 0.62) when time was included as a variable. When the negative effect of time was removed (equation (6.1)) the coefficient for real income became smaller (0.29).

3. 1948–60

Pork did not fare well during this postwar decade. Its price, while fluctuating, showed little overall trend despite an uptrend in both general price level and real income and a declining pork production per person. Estimation of regression values is complicated by higher intercorrelation than for the two earlier periods, as was noted in the beef analysis.

Nevertheless, the coefficients obtained are reasonable ones. Equations are:

$$\text{Log } X_1 = 1.666 \underset{(0.198)}{-1.219 \log X_2} \underset{(0.144)}{-0.405 \log X_3} \underset{(0.557)}{-0.008 \log X_4} \underset{(0.392)}{+1.734 \log X_5} \underset{(0.006)}{-0.014 X_6} \qquad (7)$$

$$R^2 = 0.935$$

$$\text{Log } X_1 = 5.462 \underset{(0.242)}{-1.084 \log X_2} \underset{(0.181)}{-0.361 \log X_3} \underset{(0.466)}{-1.026 \log X_4} \underset{(0.351)}{+1.061 \log X_5} \qquad (7.1)$$

$$R^2 = 0.881$$

Demand for pork is shown to be more inelastic in 1948–60 than in the 1930–41 period. This result is comparable with that for beef during the same period. The evidence is that price response to supply both of a given meat and of a competing meat has been much greater since the war than before it.

A negative coefficient is found in equation (7) for real income, but its small size and large standard error eliminates any significance. The general price level has a large (1.73) positive coefficient. But the price elevating force of this is offset by a relatively big negative influence shown for time. The price of pork is indicated as dropping 3 percent per year in these postwar years, when all other relevant factors are held constant.

Since such a large influence is found for time, its removal as a factor in equation (7.1) changes the coefficients. As both the real income and general price level trended upward during 1948–60, they share in compensating for dropping time as a separate variable. The coefficient for price level in (7.1) is down by two-fifths; that for real income is about 1.0 with a negative sign. The inference is strong that demand for pork has suffered a decline since the war. The equation which includes time (7) is probably the more applicable one, although the coefficients are not fully reliable.

4. Entire period, 1921–41, 1948–60

In an analysis for the entire 34 years, as was indicated in the section on beef, the character of overall trends takes on more importance, and year-to-year fluctuations have less part in determining the results. However, in both price and production, pork shows a less marked long-term trend and more violent short fluctuations than does beef. Hence, coefficients for the complete period have a less exclusively long-term meaning in pork price analysis than in beef.

Regression equations are:

$$\text{Log } X_1 = -1.136 \underset{(0.133)}{-1.027 \log X_2} \underset{(0.134)}{-0.511 \log X_3} \underset{(0.175)}{+1.056 \log X_4} \underset{(0.118)}{+1.294 \log X_5} \underset{(0.001)}{-0.008 X_6} \qquad (8)$$

$$R^2 = 0.973$$

$$\text{Log } X_1 = 0.287 \underset{(0.179)}{-0.665 \log X_2} \underset{(0.201)}{-0.522 \log X_3} \underset{(0.171)}{+0.246 \log X_4} \underset{(0.174)}{+1.407 \log X_5} \qquad (8.1)$$

$$R^2 = 0.938$$

These results can be interpreted best if compared with those for the separate subperiods, given in table 20.

The coefficients for the entire period (equation (8)) bear, on the whole, a logical relation to those for individual periods.

Outstanding is the greater price elasticity of demand for the total period. The factor of −1.03 shown indicates an approximately unitary elasticity of demand. This is the same result as was obtained in the long-term analysis for beef. It is more elastic

TABLE 20.—*Net regression coefficients, retail price of pork on five independent variables, selected periods* [1]

Period	X_2 Pork production per person	X_3 Beef production per person	X_4 Deflated disposable income per person	X_5 Consumer price index	X_6 Time [2]
1921–29	−1.29 (0.35)	−0.25 (0.38)	+0.98 (0.72)	1.31 (0.64)	−0.011 (0.015)
1930–41	−1.03 (.11)	+.47 (.40)	+.62 (.58)	1.95 (.91)	−.005 (.008)
1948–60	−1.22 (.20)	−.41 (.14)	−.01 (.56)	1.73 (.39)	−.014 (.006)
1921–41; 1948–60	−1.03 (.13)	−.51 (.13)	+1.06 (.17)	1.29 (.12)	−.008 (.001)

[1] All coefficients except for X_6 are coefficients of flexibility. The coefficient for X_6 cannot be interpreted directly. However, the values shown are the equivalent of 2½ percent per year in 1921–29, 1 percent in 1930–41, 3 percent in 1948–60, and 2 percent for the period as a whole. Standard errors are in parentheses.

[2] Regression on natural numbers.

(that is, less inelastic) than the values for individual periods. The beef and pork analyses affirm the frequently expressed theory that demand is less inelastic in the long term than the short. Also, for pork as for beef, demand is reported to be clearly inelastic in 1948–60.

These observations as to long- versus short-term elasticity of demand are subject to the same qualifications as were noted in connection with beef.

The coefficient for deflated personal income for the entire period, 1.06, is unrealistically large. Here too the intercorrelation of deflated income with time prevents reliable factors from being obtained for either. There seems almost to be a statistical contest between deflated income in giving a boost to the price of pork, and of time in reducing it.[27]

If time is omitted as a variable, the coefficient for deflated income is reduced by three-fourths (equation (8.1)). The other variable to feel the effect of eliminating time as a variable is that for pork production. However, equations omitting time are not of great value in pork price analysis. It is perhaps best, in conducting demand analysis for pork, to recognize the opposing and indeterminate influences of national income and of forces associated with passage of time, and to be reconciled to inexact results.

Even though their particular values may be unreliable, the fact that all coefficients for time are negative is of significance. The average decline of 2 percent per year reported doubtless overstates the actual rate of decline. Yet passage of time has not brought any salutary effect to demand for pork.

The coefficient of 1.29 for the long-term effect of general price level on the pork price is almost identical with that obtained in the beef price analysis. Significantly, the coefficient is lower for the entire period than for each period by itself. The price level is more controlling, so far as pork prices are concerned, in short-term abberations than long-term trend. The total period coefficient of 1.29 is so high chiefly because it incorporates the prewar-postwar adjustment of prices.

When a dummy variable (X_7), 0 prewar and 1 postwar, is included to account for the prewar-postwar adjustment, the coefficient for the consumer price index is less than 1.0 when time is also included in the analysis (equation (8.01)).

Regression equations including the dummy variable X_7 are:

$$\text{Log } X_1 = \underset{}{-0.631} \underset{(0.097)}{-1.110 \log X_2} \underset{(0.099)}{-0.397 \log X_3} \underset{(0.136)}{+1.314 \log X_4} \underset{(0.157)}{+0.611 \log X_5} \underset{(0.001)}{-0.013 X_6} \underset{(0.044)}{+0.226 X_7} \qquad (8.01)$$

$$R^2 = 0.987$$

[27] A recent West German study reported a higher income elasticity of demand for beef than pork, which is the more plausible outcome. The study gave a consumption-on-income relationship of 0.97 for beef and 0.65 to 0.75 for pork (2).

$$\text{Log } X_1 = -0.322 \underset{(0.181)}{-0.736 \log X_2} \underset{(0.198)}{-0.564 \log X_3} \underset{(0.187)}{+0.378 \log X_4} \underset{(0.227)}{+1.643 \log X_5} \underset{(0.057)}{-0.089 X_7} \quad (8.11)$$

$$R^2 = 0.943$$

The addition of this variable in the beef analysis produced a coefficient close to 1.0 for the general price level. But unlike beef, time remains an important variable in the pork analysis along with the dummy variable. This substantiates the assumption that the long-term decline in demand for pork is genuinely that and not solely a phenomenon of the prewar-postwar adjustment.

A comparison of actual pork prices with those estimated by equation (8.01) is shown in figure 16. The estimates correspond quite well with actual prices.

In summary, an analysis for 34 of the 40 years between 1921 and 1960 shows that the price of pork was highly variable and failed to register any uptrend either in cents per pound or relative to the general price level except in the single instance of the postwar readjustment. A high short-term sensitivity was found to both the general price level and the supply of pork; and the sensitivity was greater for later periods than for earlier. In the long term, as production of pork was declining, the supply factor could not become an explanation of the inauspicious price performance. Demand for pork has doubtless been on a decline. Time as a factor, with a consistently negative sign and a 2-per-cent-per-year velocity, is reported as the statistical vehicle of this drop. However, there is indeterminateness in coefficients

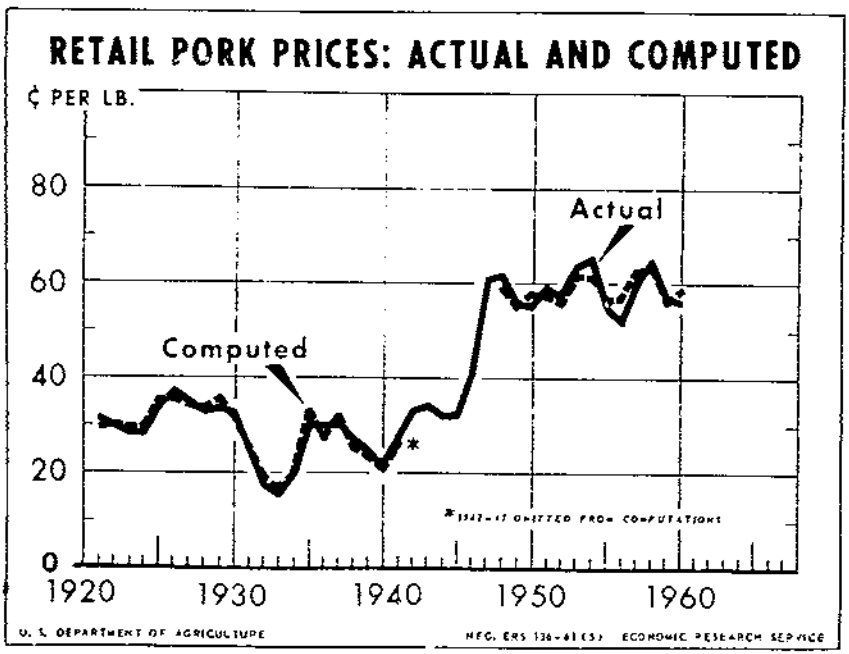

FIGURE 16

for the highly intercorrelated factors of time and deflated income, the former of which yields negative values, the latter positive. It is therefore hard to know just how much demand for pork increases with rising real income of the economy, and how much it drops due to the effect of many factors associated (statistically) with time alone. At the least, it may be said that each of these opposing trends is of substantial magnitude.

Also, as in such an analysis even the deflated income variable is proxyholder for many other influences, the results are illustrative of the fact that several factors have tended to strengthen demand for pork, others to weaken it.

Lamb

Lamb is a meat for which production, both in total and per person, has declined in recent years. It is also a minor meat in the total meat picture.

The only retail price series collected for lamb is that for the leg of lamb. A multiple correlation analysis similar to those reported for beef and pork was carried out for the retail price of leg of lamb.

In order to consider the results of analysis for a single cut as indicative of the price structure for all carcass cuts of lamb, it would be necessary to prove that price trends for all cuts have essentially paralleled those for the leg alone. No statistical data are available on this. It is known that price trends for fat and lean cuts of pork have diverged. However, there is no reason to think that a similar disparity between lamb cuts has developed over the years.

While the results of this analysis can be applied with full confidence only to the price of leg of lamb, they probably can be applied with considerable confidence to the price of all lamb.

Variables were the following:

X_1—Retail price of leg of lamb.
X_2—Production of lamb and mutton per person.
X_3—Production of beef, veal and pork per person.
X_4—Deflated disposable personal income per person.
X_5—Consumer price index.
X_6—Time.

Correlation coefficients for X_2 and X_3, as a measure of intercorrelation with the other independent variables, were as follows:

Dependent	*Independent*			
	X_3	X_4	X_5	X_6
1921–29:				
X_2	−0.606	−0.241	0.653	0.141
X_3		−.205	−.320	−.637
1930–41:				
X_2	−.163	−.109	.164	−.209
X_3		.292	−.009	.296
1948–60:				
X_2	.398	.003	−.050	−.025
X_3		.746	.561	.659
1921–41, 48–60:				
X_2	−.724	−.791	−.912	−.630
X_3		.676	.751	.505

For the period as a whole production of lamb and mutton per person has declined, and therefore shows a negative correlation with most other independent variables. In the same period, production per person of all other meats combined has increased, and shows a positive correlation with other variables.

Regression analysis results are as listed below:

(9)

1921–29

$$\text{Log } X_1 = 0.842 \underset{(0.095)}{-0.351} \log X_2 \underset{(0.183)}{-0.324} \log X_3 \underset{(0.210)}{+0.415} \log X_4 \underset{(0.165)}{+0.252} \log X_5 \underset{(0.004)}{+0.001} X_6$$

$$R^2 = 0.994$$

(10)

1930–41

$$\text{Log } X_1 = -0.383 \underset{(0.230)}{-0.562} \log X_2 \underset{(0.106)}{-0.524} \log X_3 \underset{(0.227)}{+0.562} \log X_4 \underset{(0.358)}{+1.016} \log X_5 \underset{(0.004)}{-0.004} X_6$$

$$R^2 = 0.978$$

(11)

1948–60

$$\text{Log } X_1 = 0.100 \underset{(0.081)}{-0.262} \log X_2 \underset{(0.273)}{-0.763} \log X_3 \underset{(0.518)}{+0.389} \log X_4 \underset{(0.361)}{+1.339} \log X_5 \underset{(0.005)}{-0.012} X_6$$

$$R^2 = 0.924$$

(12)

1921–41, 48–60

$$\text{Log } X_1 = 0.016 \underset{(0.117)}{-0.564} \log X_2 \underset{(0.162)}{-0.698} \log X_3 \underset{(0.135)}{+0.568} \log X_4 \underset{(0.124)}{+0.977} \log X_5 \underset{(0.001)}{-0.002} X_6$$

$$R^2 = 0.986$$

Recapitulated, the net regression coefficients are as shown in table 21.

The results for the lamb analysis conform extremely well to what might be expected *a priori*. This is a bit surprising, as the marketing and pricing structure for lamb is less "efficient" in the classical sense than is that for beef or pork.

When a meat is substitutable with other meats and is produced in small quantity relative to those meats, its prices may be supposed to be heavily influenced by those other meats. This is the case for lamb. In its price-making, lamb is overshadowed by other meats.

The demand for lamb therefore is naturally elastic with respect to its own supply. And it is becoming more so. A price flexibility of −0.35 for the 1920's and −0.56 for the 1930's had dropped to −0.26 for 1948–60. This trend is the opposite of that found for beef and pork, for which demand has become more inelastic.

Despite high intercorrelation between deflated income and time, the least-squares technique sorted influences in a way that

TABLE 21.—*Net regression coefficients, retail price of leg of lamb on five independent variables, selected periods* [1]

Period	X_2 Production of lamb and mutton per person	X_3 Production of beef, veal, and pork per person	X_4 Deflated disposable income per person	X_5 Consumer price index	X_6 Time [2]
1921–29	−0.35 (0.10)	−0.32 (0.18)	0.42 (0.21)	0.25 (0.17)	+0.001 (0.004)
1930–41	−.56 (.23)	−.52 (.11)	.56 (.23)	1.02 (.36)	−.004 (.004)
1948–60	−.26 (.08)	−.76 (.27)	.39 (.52)	1.34 (.36)	−.012 (.005)
1921–41; 1948–60	−.56 (.12)	−.70 (.13)	.57 (.13)	.98 (.12)	−.002 (.001)

[1] All coefficients except X_6 are coefficients of flexibility. The coefficient for X_6 cannot be interpreted directly. However, the values shown are the equivalent of declines of 1 percent per year in 1930–41, 3 percent per year in 1948–60, and one-half of 1 percent per year for the entire period. Numbers in parentheses are standard errors.

[2] Regression on natural numbers.

gave reasonable results. Certainly the factor for deflated disposable income is consistent from period to period. Averaging at a flexibility coefficient of about 0.5, it conforms to the theory that meat shares, but less than proportionately, in economic growth of a society.

The coefficient for price level for the entire period is so close to 1.0 that a regression using deflated price yielded almost identical values.

Insofar as trend in demand can be isolated accurately, the results are interesting. They show very slight uptrend in the 1920's, and subsequently a decline at increasing steepness. Data in the equations indicate a rate of decline of 1 percent per year during the 1930's and of 3 percent per year from 1948 to 1960. For the entire period the average rate of decline is one-half of 1 percent per year.

The price of leg of lamb has revealed a notable response to changes in real income of the economy. Except in 1921–29, however, it was more responsive to the price level than to real income; and the advantage of rising real income has been offset increasingly by a secular decline in demand for lamb.

This last factor, a downtrend in demand statistically associated only with time as a variable, is a puzzle to observers and analysts. Obviously, demand has decreased; the price of lamb has gained little advantage over other meats despite a large 15-year reduction in its supply.

But has demand really decreased, in the true classical sense? To be sure, demand originating in dietary preferences of certain national groups (Greeks, for example) disappears as the groups assimilate. Yet, the drop in production of lamb had its origin not nearly so much in a reduction in demand as in changed conditions affecting its supply. The big shift was in the supply curve, not the demand curve.

This suggests once more that there is more interrelationship, in a dynamic sense, between demand and supply than is usually assumed. Or, to state it from an opposite point of view, the obligation to obtain a measurement of the separate values for demand and supply to the extent they exist can lead to an assumption of a greater degree of independence than does exist.

If the sheep producing industry of the United States had continued to provide each consumer with as much lamb in the late 1940's and the 1950's as it had previously, "demand" for lamb as a meat would be revealed in a higher curve on a chart—or one farther to the right—than it now is.

PRICE MAKING FORCES: CROSS-SECTIONAL ANALYSIS

A second way to observe and assess price-making forces in the economy is to make use of data on consumption and expenditure patterns by various consumer groups, as obtained from budget studies. Such studies are comprehensive interview surveys taken on, or near, a single date. They are therefore cross-sectional

studies, revealing differences in consumption at a point in time. They do not measure trend over time.[28]

Still another source of data is a compromise of time series and cross-sectional approaches. It is the "diary," in which a number of families record their food purchases weekly for an extended period of time. Only occasional references will be made here to the results of recent diary studies for meat.

Primary value of a cross-sectional budget study is realized from its grouping of population by personal (family) income. By classifying consumers according to their income and recording the meat purchases (or use) for each group, it is possible to attain a measure of relationships between personal income and demand for meat.

Since the general price level would be constant, or nearly so, from the standpoint of all consumers, such an analysis would yield an income-consumption relationship that is conceptually similar to the coefficient obtained for deflated income in time series analysis.[29]

But while the two categories are similar, it would be a serious mistake to assume that results of the two kinds of analysis can be compared directly. An income elasticity coefficient obtained from time series analysis is an economic value of different nature than is an income elasticity coefficient obtained from a cross-sectional budget analysis.

It may be granted, as Marguerite Burk explains, that ". . . comparative study of the two sets of relationships can yield useful insights." (*6*, p. 919) But there are several causes for noncomparability—or, it may perhaps be said, for a superficial comparability that is deceptive and untrustworthy.

First cause for difference lies in the structure of the two series. As Marguerite Burk states the case, "Time series reflect dynamic changes in the economy and in our society whereas individual cross-sectional surveys provide static pictures." (*6*, p. 919) The "dynamic changes" are a medley of many. Statistical data on growth of real income of the economy are a composite of a manifold variety of trends and changes not only economic but institutional, demographic, sociological, even ethnic. Budget data on meat consumption by income classes, by sharp contrast, essentially describe only the allocative effect of price at a given time. They show how a limited supply of meat becomes distributed, at a particular time, among income groups.

This is not to say that budget studies deal with income as a "pure" economic factor. Income groups of the population differ in several respects in addition to income level. Some of these may have a bearing on meat consumption. Cross-sectional studies may be designed so as to make it possible to isolate some of the associated factors, such as those of location, but a detailed separation of factors would be so complex as to be impracticable.

It is usually assumed that income elasticities derived from

[28] However, an understanding of the economic setting at the particular time when the data are collected is essential to their accurate interpretation.

[29] Whether the two results were directly comparable would depend on whether the time series analysis used consumption or price as the dependent variable.

cross-sectional studies have validity because any person or family whose income rises takes on the customs and practices, including diets, associated with the income level into which they ascend. The dietary pattern of persons in any group is thus assumed to be akin to the pattern of others in their group, irrespective of their past income history. This thesis, though generally true, is subject to question as to its exactness. The Duesenberry hypothesis, for example, regards *change* in income since a prior period as an important factor, separate from and in addition to the income level itself (*8*). An empirical application is a Syracuse, New York, study in which a 1942 survey was repeated in 1948. Analysis based on data from the study shows that for any given income received per person in 1948, meat consumption was higher for families whose incomes had been especially low in 1942 and had improved markedly, than for families whose income had been more nearly stationary. At a $500 deflated income per person in 1948, the difference was about 7 percent (*24*).

As another illustration of danger in considering time series and cross-sectional studies to be analogous, the cross-sectional data reported below show lamb to have a much higher income elasticity than any other meat. Yet not only do the time series results quoted in the previous section fail to reveal such an advantage for lamb, but common observation certifies to lamb's failure to achieve the standing that cross-sectional data would seem to promise.

Lawrence Klein cites the value of pooling time series and cross-sectional data, then summarizes their irregularities for statistical analysis in this brief statement: "The pooling principle is admirable, of course, going in the direction of enlarging our sources of basic information. But it does not, in practice, proceed on the basis of a systematic model showing which variations are endogenous, exogenous, or otherwise predetermined. Most applications are not properly formulated in terms of structural estimation . . ." (*16*, p. 237)

The 1955 Household Food Consumption Survey

The most recent nationwide household food consumption study is one taken by the U.S. Department of Agriculture in the spring of 1955. Approximately 6,000 families, both rural and urban, living in all areas, were interviewed. Their use of each of many foods in the week prior to the interview was recorded. Also noted was how much was from purchase, and how much from other sources. The expenditure for purchased food was taken down in addition. The family's income per year was a basic datum.

Data were summarized according to a three-way classification —income, urbanization (urban, rural nonfarm, rural farm), and region (Northeast, North Central, South, and West). The two breakdowns of data by location are necessary if relationships with income are to be trustworthy, as urbanization and region are themselves each associated with income.[30]

[30] All data reported here originate in the extensive compilations contained in the first five reports of the 1955 Household Food Consumption Survey (*40*).

TABLE 22.—*Urban households: Quantity of meat used at home per person, by income group and by region, one week in Spring of 1955* [1]

Region and income	All meat	Beef	Veal	Lamb and mutton	Pork	Variety meats	Luncheon meats
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
United States:							
Under $2,000	2.76	0.95	0.06	0.06	1.23	0.15	0.31
$2,000–2,999	2.92	1.08	.08	.10	1.14	.13	.39
$3,000–3,999	2.96	1.19	.09	.10	1.10	.12	.36
$4,000–4,999	3.12	1.34	.12	.09	1.08	.09	.39
$5,000–5,999	3.33	1.47	.11	.14	1.13	.10	.39
$6,000–7,999	3.39	1.48	.11	.12	1.19	.10	.37
$8,000–9,999	3.20	1.50	.11	.14	1.00	.10	.36
$10,000 and over	3.59	1.67	.14	.27	1.12	.12	.28
Northeast:							
Under $2,000	2.03	.71	.05	.11	.80	.12	.25
$2,000–2,999	2.86	1.23	.14	.21	.82	.10	.35
$3,000–3,999	2.95	1.18	.15	.18	.97	.11	.37
$4,000–4,999	3.09	1.29	.16	.21	.90	.14	.38
$5,000–5,999	3.26	1.26	.16	.26	1.05	.14	.39
$6,000–7,999	3.43	1.43	.23	.27	1.01	.12	.36
$8,000–9,999	2.68	1.07	.17	.15	.87	.10	.32
$10,000 and over	3.02	1.33	.15	.26	.84	.17	.27
North Central:							
Under $2,000	3.32	1.30	.10	.03	1.38	.12	.39
$2,000–2,999	3.36	1.37	.08	.06	1.29	.07	.50
$3,000–3,999	3.22	1.44	.07	.07	1.16	.10	.39
$4,000–4,999	3.25	1.41	.10	.02	1.18	.09	.44
$5,000–5,999	3.56	1.67	.10	.05	1.23	.07	.44
$6,000–7,999	3.51	1.53	.07	.03	1.36	.10	.42
$8,000–9,999	3.44	1.70	.08	.15	1.08	.07	.36
$10,000 and over	3.58	1.67	.14	.28	1.08	.11	.30

South:							
Under $2,000	2.86	.89	.06	.03	1.39	.18	.31
$2,000–2,999	2.82	.91	.06	.01	1.36	.15	.33
$3,000–3,999	2.64	.92	.04	.02	1.22	.13	.31
$4,000–4,999	3.11	1.22	.08	.00	1.41	.05	.34
$5,000–5,999	2.91	1.22	.07	.06	1.25	.11	.21
$6,000–7,999	3.17	1.47	.05	.03	1.30	.05	.27
$8,000–9,999	3.26	1.63	.05	.04	1.02	.10	.44
$10,000 and over	3.42	1.80	.11	.17	1.10	.00	.24
West:							
Under $2,000	2.62	1.37	.05	.16	.68	.08	.28
$2,000–2,999	2.52	.91	.03	.24	.70	.17	.47
$3,000–3,999	3.23	1.38	.06	.15	1.04	.20	.40
$4,000–4,999	2.99	1.49	.08	.08	.92	.06	.36
$5,000–5,999	3.45	1.77	.05	.14	.97	.06	.47
$6,000–7,999	3.10	1.46	.05	.12	.99	.12	.36
$8,000–9,999	3.82	1.90	.11	.18	1.08	.16	.39
$10,000 and over	4.36	1.99	.15	.29	1.52	.14	.27

[1] Excludes one-person households.

Derived from Reports of Household Food Consumption Survey, 1955, (*40*).

TABLE 23.—*Farm households: Quantity of meat used at home per person, by income group and by region, one week in Spring of 1955* [1]

Region and income	All meat	Beef	Veal	Lamb and mutton	Pork	Variety meats	Luncheon meats
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
United States:							
Under $2,000	2.27	0.83	0.02	0.02	1.10	0.06	0.24
Under $1,000	2.01	.70	.02	.01	1.04	.07	.18
$1,000–1,999	2.56	.98	.02	.02	1.17	.06	.30
$2,000–2,999	2.96	1.19	.01	.02	1.28	.09	.35
$3,000–3,999	2.98	1.26	.03	.02	1.25	.07	.36
$4,000–4,999	3.30	1.58	.03	.01	1.26	.05	.38
$5,000–5,999	3.29	1.47	[2]	.05	1.31	.07	.39
$6,000–7,999	3.19	1.49	.03	.02	1.21	.06	.37
$8,000–9,999	3.55	1.48	.08	.03	1.44	.06	.46
$10,000 and over	4.16	2.19	.00	.13	1.40	.18	.26
Northeast:							
Under $2,000	3.33	1.67	.14	.04	1.08	.08	.32
Under $1,000	3.52	1.74	.15	.10	1.14	.09	.30
$1,000–1,999	3.17	1.60	.13	.00	1.03	.08	.34
$2,000–2,999	3.57	1.62	.01	.07	1.39	.11	.37
$3,000–3,999	3.20	1.52	.05	.02	1.13	.12	.35
$4,000–4,999	3.88	1.84	.04	.00	1.46	.08	.46
$5,000–5,999	3.35	1.52	.00	.09	1.19	.10	.45
$6,000 and over	2.87	1.27	.00	.25	.89	.12	.35
North Central:							
Under $2,000	3.09	1.42	.03	.02	1.20	.07	.35
Under $1,000	2.71	1.29	.02	.02	1.07	.07	.24
$1,000–1,999	3.40	1.52	.04	.02	1.31	.08	.43
$2,000–2,999	3.36	1.55	.00	[2]	1.37	.05	.38
$3,000–3,999	3.34	1.53	.01	.01	1.30	.06	.43
$4,000–4,999	3.77	1.75	.04	.00	1.46	.06	.45
$5,000–5,999	3.46	1.60	.01	.01	1.36	.06	.42
$6,000 and over	3.77	1.73	.05	.01	1.43	.08	.47

South:							
Under $2,000	1.86	.53	.01	.01	1.07	.06	.19
Under $1,000	1.69	.44	.01	[2]	1.02	.06	.15
$1,000–1,999	2.09	.64	[2]	.01	1.14	.06	.24
$2,000–2,999	2.52	.82	.02	.04	1.21	.12	.33
$3,000–3,999	2.52	.74	.02	.03	1.40	.05	.28
$4,000–4,999	2.49	1.12	.00	.00	1.11	.02	.24
$5,000–5,999	3.03	1.06	.00	.00	1.53	.10	.33
$6,000 and over	2.75	1.02	.04	.00	1.39	.04	.26
West:							
Under $2,000	3.41	1.82	.03	.11	1.01	.08	.36
$2,000–3,999	2.93	1.53	.07	.00	.83	.10	.40
$4,000–5,999	2.78	1.62	.00	.17	.64	.05	.31
$6,000 and over	3.55	2.27	.00	.01	.91	.11	.25

[1] Excludes one-person households.
[2] Less than 0.005 pounds.

Derived from Reports of Household Food Consumption Survey, 1955, (*40*).

All observations in the study related to 1955, when meat was abundant and low in price relative to the high employment and rising incomes of that year. Supplies of meat for consumption per person rose to a new high in 1955. Average civilian consumption, at 163 pounds, equalled for the first time the previous record established in 1908. While meat supplies in the spring of 1955 when survey records were taken had not quite attained the peak level achieved during the fall, they were comparatively large. Prices of meat were still on a decline that had begun in 1952—a decline that contrasted with the rising price level in the economy as a whole.

The survey reported meat used by families at home. It excluded all hotel and restaurant meals and institutional feeding. Its findings, therefore, distort slightly the true relationships of total meat consumption to consumer income, since higher income groups buy more of their meat as purchased meals than do lower income people. The distortion arises even though all quantity data were converted into a standard 21-meal week,[31] and it relates to both kind of meat and amount of expenditures. Meat diets at home and away from home are not identical, primarily because meals eaten away from home include more main meals and fewer breakfasts. The survey may understate total consumption of hams and chops, for example, and overstate that of bacon. Also, meat eaten in restaurants obviously is more costly than that eaten at home.

Because the urban population is by far the larger, urban data will be reported more fully in material that follows than will the data for use of meat by farm families.

Summary data on urban and farm consumption rates for families of various income levels, and by regions, are provided in tables 22 and 23.

Urban Consumption of Meat by Regions

Consumption of beef is positively correlated with income. Figure 17 shows this to be true for city families in all regions. The relationship is sharpest in the South and West.

Data in figure 17, as in figures 18 and 19, are plotted on "double-logarithmic" scales. These are ratio charts, which show comparative relationships. Two lines of equal slope (steepness) indicate equal proportionate relationships, regardless of how high or low they may be. In figure 17, for instance, the relationship of consumption to income in the West is seen to be about the same for beef, pork, and all meat, as the slopes are similar.

Data as plotted in figure 17 may be converted to average linear relationships by means of a least squares fit. Percentage relationships at the mean are in table 24. For beef, they show that a 10 percent higher income per family was associated with increases in beef consumption ranging by regions from 1.0 to 3.8 percent. These are not high percentages; they indicate an income elasticity for consumption of 0.10 to 0.38.

[31] That is, if a family reported only 18 meals at home during the survey week, the food data reported were "blown-up" by a 21/18 ratio so as to become the equivalent of a full 21-meal week.

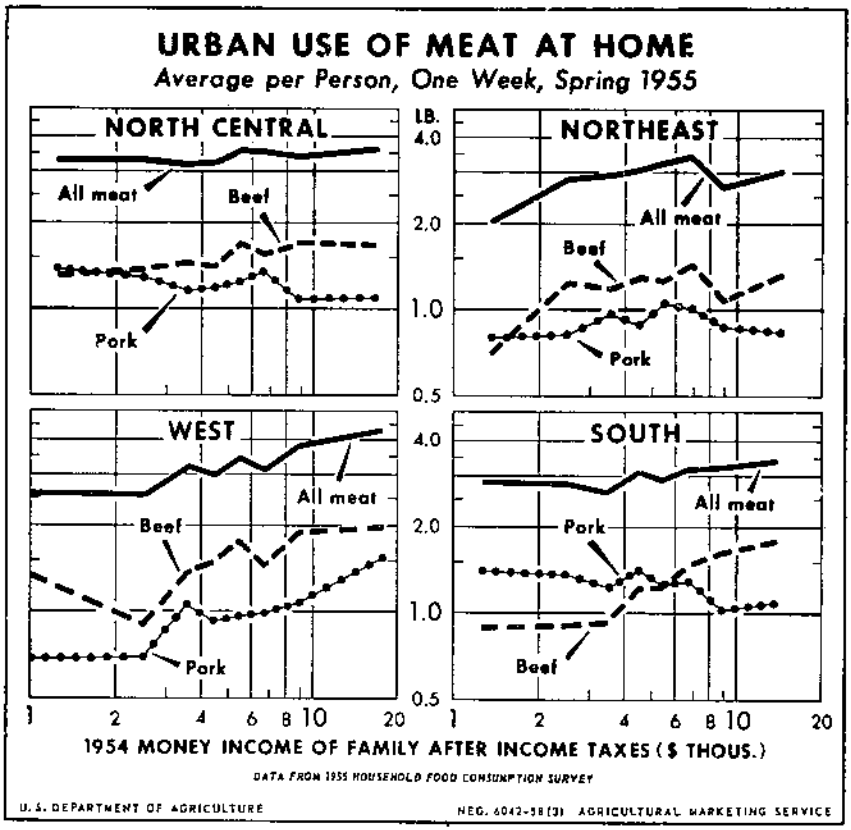

FIGURE 17

The South had the highest relationship of beef consumption with income, the North Central the lowest.

Pork is less a "status" meat than beef. Somehow, it does not command a superior place in the esteem—or the diets—of most families. Only in the West, where it is more of a rarity than elsewhere, is consumption of pork positively associated with income. In all other regions, the more well-to-do families did not choose to eat more pork than lower income families (fig. 17). A negative relationship is fairly pronounced in the North Central and South. In the Northeast, the consumption line is almost level; pork eating bears little relation to income there.

Consumption of both veal and lamb is highly associated with income (fig. 18). The sample was too small to afford highly accurate data by regions. However, it is clear that in the South and North Central lamb consumption is almost entirely confined to upper income classes. In the lamb-eating Northeast and West, all income groups share and the relation of consumption to income is less marked. The difference is seen in the smaller income-association factors of 1.9 and 2.7 in the latter two regions, compared with much higher factors in the South and North Central (table 24).

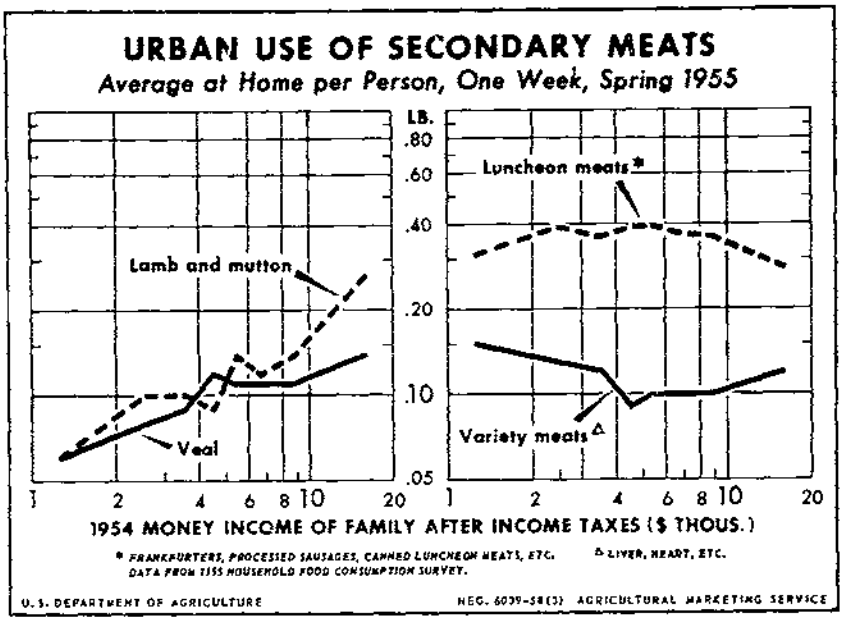

FIGURE 18

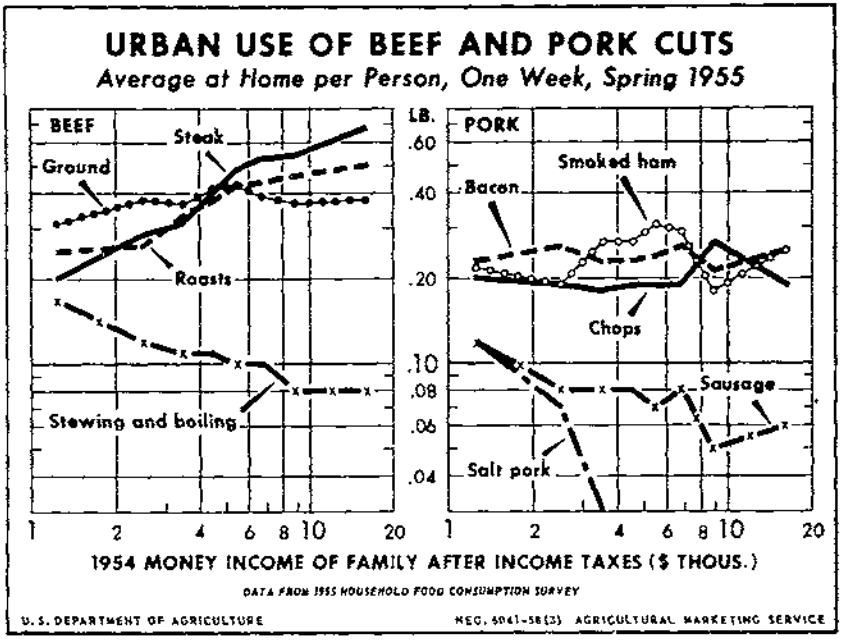

FIGURE 19

TABLE 24.—*Urban households: Percentage difference in quantity, price, and value of meat consumed per person for each 10 percent difference in income, one week in Spring of 1955* [1]

Region	All meat	Beef	Veal	Lamb and mutton	Pork
	Quantity per person				
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
United States	1.0	2.1	2.7	6.2	−0.3
Northeast	.7	1.2	2.0	1.9	[2]
North Central	.4	1.0	2.0	11.8	−.8
South	1.1	3.8	3.0	14.4	−1.2
West	2.1	2.1	5.8	2.7	3.0
	Price per pound [3]				
United States	1.6	1.6	.3	1.2	1.6
Northeast	1.3	1.6	.6	.9	.9
North Central	1.4	1.5	.2	2.1	1.3
South	1.6	1.2	1.4	2.2	2.0
West	1.3	1.9	−.2	.9	.9
	Value per person				
United States	2.6	2.8	2.8	7.8	1.3
Northeast	1.9	2.7	2.7	2.8	.9
North Central	1.7	2.5	2.3	13.8	.4
South	2.6	4.9	3.2	16.1	.6
West	3.6	4.0	6.0	4.0	4.3

[1] Simple regression relationships calculated by least squares. Percentage taken at the mean. Not all results will meet tests of significance.
[2] Less than 0.05 percent.
[3] Differences in price per pound reflect differences in price paid for each cut or product, plus differences in kinds of meat eaten.

Derived from Reports of Household Food Consumption Survey, 1955, (*40*).

Veal consumption also is closely associated with income. Its average relationship is not as close as for lamb, since it receives no extra boost in the South and North Central as lamb does (fig. 18).

Variety and luncheon meats are consumed in small yet significant quantities by all income groups, low and high alike. Interestingly enough, the curves of income relationships for these two meat groups show opposite patterns (fig. 18). For luncheon meats the curve is arched. Middle income families consume the most—more than low income ones and more than high. For variety meats (liver, heart, and so on) the curve is concave; extreme income groups appear to be the largest consumers. Consumption of variety meats may be up for low income families because those meats are relatively inexpensive.

The highest curve in each section of figure 17 shows income-consumption relationships for all meats combined, for city consumers. The curves have only a moderate upward slope. This

rather small effect of income results from the negative relationship for pork (except in the West). Otherwise the slope would be greater, inasmuch as beef, veal and lamb all bear a definite positive relationship to income.

According to data in table 24, a 10 percent difference in income of consumers makes a 1.0 percent difference in the U.S. average quantity of all meat consumed at home. This response to income varies from 0.4 percent in the North Central to 2.1 percent in the West.

As the survey data exclude meat eaten outside the home, doubtless some of the full impact of the effect of income on meat consumption is hidden.

Effect of Income on Meat Consumption

To considerable degree higher income consumers use their buying power to express their preference as to kind of meat they buy. In doing so they buy more expensive meat and spend more money. A clear instance is the more beef and less pork bought by the higher income groups. Beef is a little more costly than pork, and this alone adds to both average price and expenditure.

Moreover, higher income families eat the more expensive cuts of each meat. As can be seen in figure 19, they eat the most steaks and roasts. (Again, if restaurant meals were included their consumption of these two cuts would appear even greater.) Ground beef is about equally popular with rich and poor. Stewing and boiling beef, on the other hand, shows a clear negative relationship with income; its popularity is confined to low income families.

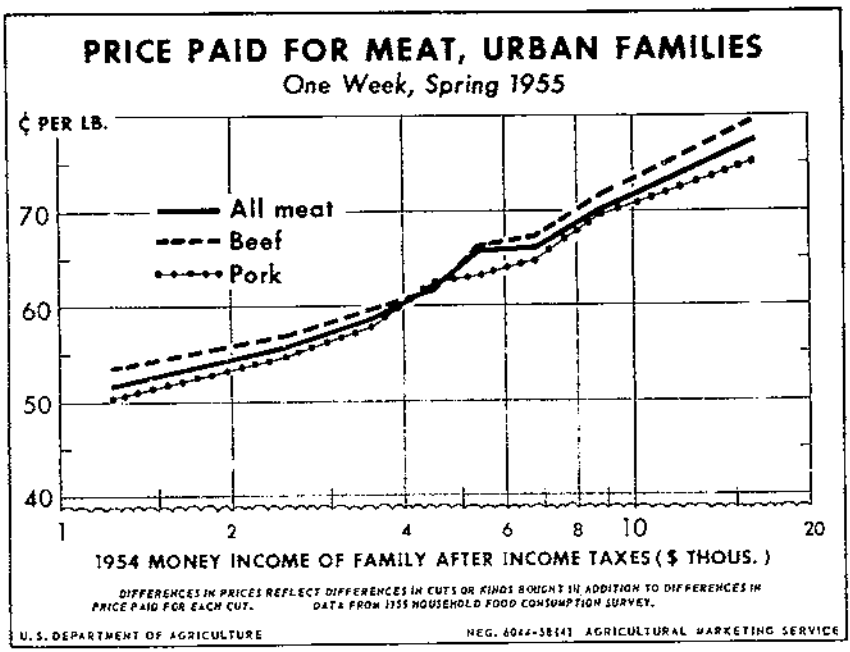

Figure 20

Among pork cuts, ham, chops, and bacon are used in about equal quantities by all income groups. Sausage is more a low-income than a high-income meat. Salt pork, of course, is eaten principally by low income families, primarily southern ones.

Figure 20 summarizes the national differences in prices paid by the various income groups. Clearly to be seen is the similar relationship for beef and pork. Beef prices are a few cents higher than pork but the difference is almost constant by income groups. Although high-income consumers may be unenthusiastic about buying pork, when they do buy it they are just as selective for its kind and quality as they are for beef.

Since both the quantity of meat consumed per person and the price paid for it are higher for the upper income families, the value of consumption rises even faster with income. Higher income groups spent considerably more money for meat during the 1955 survey week than low income groups.

Higher income consumers spent more money per person for each of the meats. They did so even for pork, although to lesser degree than for other meats. Expenditures for lamb bore an extremely high relationship to income. Those for veal were next, followed by beef (fig. 21).

On the average, for each 10 percent higher income, the value of beef consumption by city families was 2.8 percent higher. The value of pork was 1.3 percent higher. The comparable figure for lamb was 7.8 percent, for veal 2.8 percent (table 24).

This income-expenditure ratio for beef was especially high in the South and West, and lowest in the North Central. The ratio

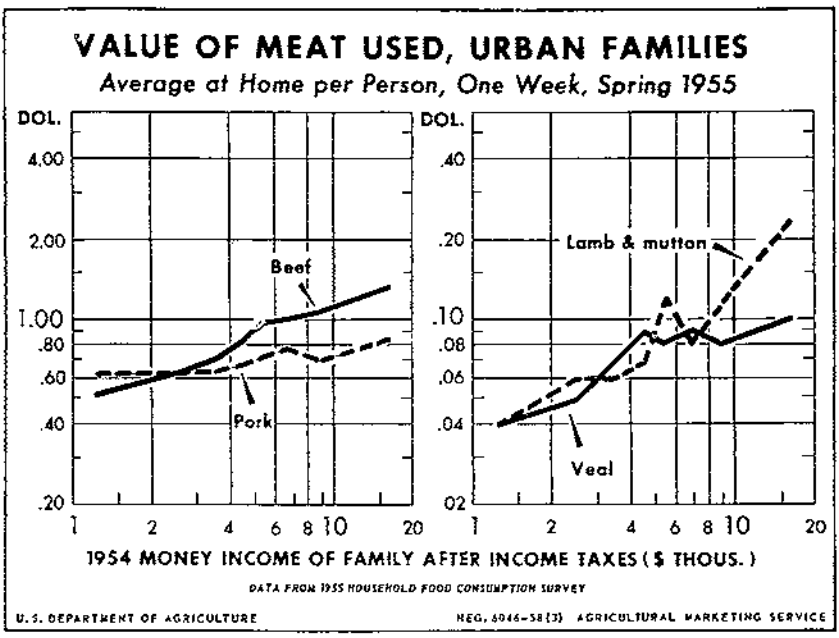

FIGURE 21

for pork was high in the West, low in the North Central (table 24).

It is thus clear that families who have higher incomes eat somewhat more meat: eat more beef, veal and lamb and less pork; eat the higher priced cuts of each meat; and choose the premium quality or otherwise highest priced selections of each.

In addition, the higher income families achieve a greater variety in their diet. Statistical evidence is the data in table 25 relating to the number of families using beef; pork; food preparations consisting chiefly of meat; and meat's strongest competitor, poultry. The table shows the percentage of families using only one of the four, and the percentage using two, three, or all four.

A substantial proportion of low income families on farms and a few in cities used only one of the four foods during the survey week. Not many higher-income families, even on farms, restricted themselves to one only. Of the top income group shown in the table, 61 percent on farms and 73 percent in cities used three, or all four, of the foods during week the survey was taken.

TABLE 25.—*Households using beef, pork, poultry, or mixtures chiefly meat: Percentage using one only or combinations of two, three, or four, farm and city households, one week in Spring of 1955*

Urbanization and income group [1]	Any beef, pork, poultry, or mixture chiefly meat	One kind only	Combination of—		
			Any two kinds	Any three kinds	All four kinds
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
Urban:					
Under $3,000	99.0	5.3	31.5	48.2	14.0
$3,000—4,999	99.9	3.2	28.2	47.4	21.1
$5,000 and over	99.9	2.8	24.4	51.5	21.2
Farm:					
Under $1,000	95.3	25.6	36.1	28.5	5.0
$1,000—3,999	98.5	11.9	40.3	37.3	9.0
$4,000 and over	99.8	5.3	33.6	48.3	12.5

[1] Money income, after income taxes.

NOTE: Component items may not add to totals because of rounding.

Derived from data furnished by Household Economics Research Division, Agricultural Research Service, U.S. Department of Agriculture.

Surveys similar to that of 1955 were taken by the U.S. Department of Agriculture in 1948 and 1942 also. From the three studies it is possible to clock any changes in the relation of meat consumption to income among the three years. Data for all three years are available for city consumers only.

The years themselves were not entirely comparable. The greatest difference was the big increase in the general price level and in consumer incomes first from 1942 to 1948, and then further in 1955. But it is possible to correct approximately for this difference by converting all income and price data into constant dollars. Other differences are not so easily reconciled. 1942 was

a war year; 1948 was a year of relatively small meat supplies, especially for beef, and relatively high prices. In 1955, supplies of beef were much larger than in 1948, and meat prices were lower—moderately lower in current dollars and down more as measured in constant dollars. These differences are seen in table 26. Consumption data in the table are those derived from estimates of total U.S. production and disappearance; they are not survey data.

TABLE 26.—*Meat: Consumption and retail price, Spring of 1942, 1948 and 1955* [1]

Spring of—	Beef			Pork		
	Consumption per person	Retail price	Price in constant dollars [2]	Consumption per person	Retail price	Price in constant dollars [2]
	Pounds	*Cents*	*Cents*	*Pounds*	*Cents*	*Cents*
1942 [3]	15.7	34.7	50.1	15.5	33.1	47.8
1948	15.3	75.1	73.4	16.5	60.0	58.7
1955	20.3	67.7	59.2	15.0	55.5	48.6

[1] United States average for April–June, based on production and price data of USDA and BLS.

[2] Converted to dollars of constant purchasing power by dividing by the Consumer Price Index (1947–49=100).

[3] Prices are estimated, as no published prices by months are available.

Derived from data furnished by Economic and Statistical Analysis Division, Economic Research Service, U.S. Department of Agriculture.

Differences in meat supplies and prices for the 3 years affect the relationships between meat consumption and income for those years. Ordinarily, in a year of relatively low prices the income-consumption curve is flatter than it is in a high price year. That is, when meat is cheap, its use is more similar between high and low income families than when it is more expensive. Thus, a more nearly level income-consumption curve would be expected in 1955 than in 1948. Figure 22 shows that the curve for beef is indeed slightly flatter in 1955 than 1948, but not very much so. The curve for 1955 differs from 1948 and 1942 chiefly in that it is higher.

For pork, on the other hand, the income-consumption relationship gives more evidence of change (fig. 22). Showing a small upward slope in 1942 and 1948, it had swung to a slow downsweep by 1955. The change, however, dare not be attributed to higher 1955 incomes alone. The gradual loss in demand reported in section beginning on page 16 was a factor. In all probability, the apparent rotation of the (urban) consumption curve for pork from a positive to a negative relationship with income is a genuine and lasting change. Pork has slipped to a subordinate standing with high-income consumers; and it has done so since so recent a year as 1948.

The curve of urban pork consumption by income in 1955 is higher than that of 1948. This conflicts with U.S. supply-and-distribution data, which show a smaller consumption in the spring

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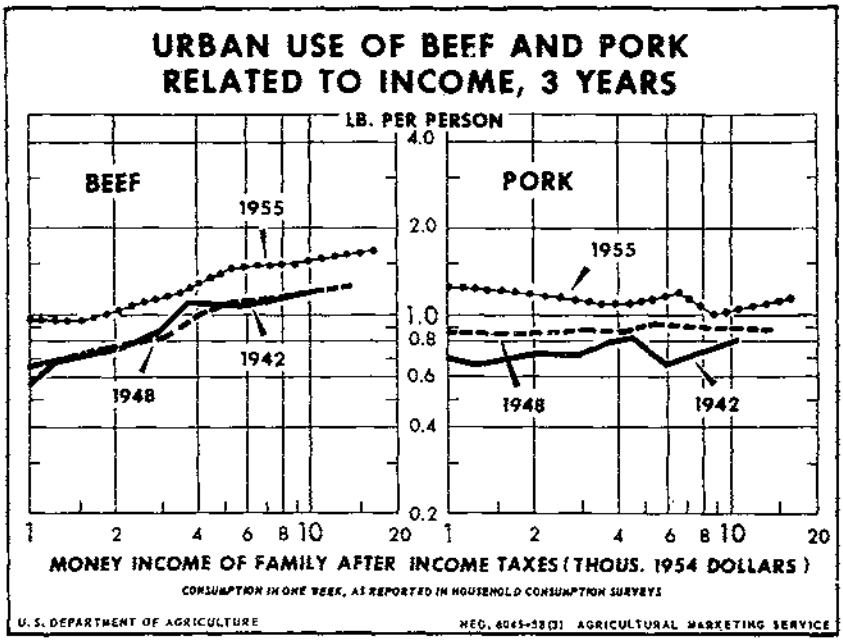

FIGURE 22

of 1955 than of 1948 (table 26). The difference may reflect errors in reporting survey data, or irregularity in classifying certain pork products (such as pork vs. luncheon meat). It may also be due to differences in coverage: survey data in figure 22 refer to meat used at home by city families; distribution data refer to total meat eaten by the entire population. Perhaps consumption of pork by farmers decreased enough between 1948 and 1955 to give a boost to urban consumption rates in the latter year.

COMPARISON WITH RESULTS OF TIME SERIES ANALYSIS

The outstanding conclusion to be derived from the data from the 1955 survey reported here is the following: that the pattern of relationship of meat use to consumer income as shown by those data is distinctly different from the relationship revealed by time series analysis.

Apart from conceptual differences referred to earlier, a direct comparison between the two studies is statistically not possible, since the budget study related *consumption* to income and the time series analysis related *price* to income. Nevertheless, because the relationship between supply and price for the entire 34 years was almost unitary for both beef and pork, and cross-elasticity of demand between the two is not extremely great, rough comparisons can be made between the budget and time series analyses.

Income elasticities seem clearly to be lower in the budget study than the time series analysis. The difference was fairly wide for both beef and pork. The coefficient of flexibility of beef consump-

tion on consumer income in the budget study was 0.21. The coefficient for beef price in the time series analysis was 0.57. For pork the reported difference was even wider: the budget study showed a negative coefficient of −0.03, but the time series result was a huge coefficient of +1.06. However, the latter is untrustworthy, as was noted in the discussion of section beginning on page 70, and the true difference is much less than the data indicate.

Even though time series and budget analyses are conceptually different and no close conformity in outcome is to be expected, the wide disparity between results leads to a question that is not at all academic. If analytical data are to be used to forecast the future prospects for the livestock industry, which set can be used more reliably?

The higher regression coefficients for time series analyses reemphasize the observation already made, that much of the influence of rising national income on demand for meat arises not in a "pure" relationship, but in a complex of forces associated with economic growth. If national income continues upward, it will have the same bearing on demand for meat as in the past insofar as that growth is linked with associate forces much as in the past.

The rather large coefficients for national income give some grounds for confidence. There is another reason to be reassured as to the prospects for livestock and meat. The Syracuse study (*24*) indicated that when a family experienced a rise in income, it then ate more meat than it would have eaten if its income had been constant at the higher level. Thus in a growing economy do dynamic considerations, happily, confound the static.

The 1955 budget study had a second result that is full of meaning and portent. In the cross-section analysis, families having the higher income used their extra buying power more to select the kind of meat they wanted than to buy more meat. Income had more effect on kind of meat eaten and on the price paid for it than on the quantity eaten.

When meat is already abundant and low priced as it was in 1955, rising consumer incomes place a premium on the preferred kind, cut and quality of meat. This suggests that producers of meat animals and processors and distributors of meat have much to gain in such a year by taking steps to provide the desired kind and quality of product. Those steps begin with more attention to breeding for carcass quality; extend through more feedlot feeding of cattle and lambs to enhance grade; and carry forward to both better preparation and processing of meat for distribution at retail, and wider use of standard grades in distribution. In a year of smaller supplies and higher prices of meat, the premium for quality would not be so great; but if, as seems likely, U.S. meat production per person will increase further, the lesson as to the prominence of quality seems worth heeding.

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APPENDIX I

Estimation of Average Retail Price for all Grades of Beef

The analyst who attempts to construct a series of carcass-average prices for all grades of beef finds only two techniques open to him. One is to impute values for many lower grade cuts to the single price quotation that relates to lower grades of beef, namely, hamburger. But there is not enough evidence that this will give reliable results over several years.

The other technique is to employ average prices as quoted for all grades of carcass meat at wholesale or of all live animals, and apply appropriate price spreads to them in order to construct estimates of retail prices. Admittedly, in using such a procedure a trustworthy regularity in behavior of marketing margins is assumed. There is some evidence that this assumption is not too far afield.

Data from the 1955 household consumption survey seem to indicate that the retail price of the beef content of processed meat products as paid by household consumers is nearly as high as that of fresh beef, when measured in equivalent weight terms. When compared with prices of carcass beef at wholesale at the same time, the carcass-to-retail spread appeared to have been about 5 percent wider for processed beef than for fresh.

Although the 5 percent figure is highly approximate, it does substantiate an hypothesis that price spreads on beef tend to be more nearly constant in cents per pound than in percent. Any tendency toward uniform percent markup practiced by retailers is offset by the extra processing much of the lower grade beef receives.

U.S. average prices of all grades of carcass beef at wholesale were arrived at by utilizing weighted average prices of all grades at Chicago and average prices of Choice grade for both Chicago and the U.S. The difference between Chicago and U.S. prices for the Choice grade made it possible to convert the Chicago price of all grades to a U.S. price of all grades. To this last price, a wholesale-retail margin was added. This margin was an average arrived at by applying the margin for Choice grade (*32*, p. 15) to production of the three top grades, and that margin plus 5 percent to production of the lower grades. Retail prices so computed appear in the column headed "Estimates based on prices of beef at wholesale," table 27.

The procedure is reasonably satisfactory for recent years. For earlier years, however, price data at Chicago are less comparable because grade and weight categories for reporting were different then and because estimates of beef production by grade for early years are less reliable. An alternate method is to use prices of all cattle rather than prices of all beef at wholesale, as a base

TABLE 27.—*Retail beef prices: Average of all grades per retail-equivalent pound, by two systems of estimation, 1921–60*

Year	Retail price per retail-equivalent pound [1]	
	Estimates based on prices of beef at wholesale	Estimates based on prices of live cattle
	Cents	*Cents*
1921		27.7
1922		25.6
1923		25.6
1924		25.4
1925		26.0
1926		28.8
1927		29.5
1928		33.2
1929		35.7
1930		32.4
1931		26.8
1932		22.1
1933		19.7
1934		20.4
1935		25.0
1936		25.6
1937		27.0
1938		26.8
1939		27.3
1940		26.8
1941		29.5
1942		32.5
1943		33.8
1944		29.1
1945		30.3
1946		38.3
1947		54.8
1948		67.7
1949	61.7	62.0
1950	69.2	69.3
1951	81.4	81.8
1952	76.9	76.5
1953	60.3	60.5
1954	58.7	58.5
1955	58.8	58.9
1956	58.3	57.8
1957	63.6	63.5
1958		75.1
1959		76.8
1960		74.2

[1] Beef sold in processed form is valued in terms of equivalent retail weight for fresh sale, not in terms of actual processed weight.

from which to build up retail price estimates. Such prices are available as a long series. They are the average cost to federally inspected packers of all cattle bought by them. A second marketing charge is required, that of live animal to wholesale carcass. Methods similar to those used by ERS in a 1956 beef margins report (*32*, pp. 9–13) were adopted in extending a live-wholesale margin for Choice steers and heifers to earlier years. In adapting this to all grades of cattle, it was assumed that the live-animal marketing and slaughtering cost is uniform per 100

pounds live weight. The cost per 100 pounds of carcass therefore was influenced by changing dressing yields.

The first product of this estimating procedure was an estimated value of beef carcass at retail. In deriving a price per retail pound, an average yield of retail cuts was employed. That yield was estimated to have been 82.5 percent in 1928 and to decline to 82.0 pounds by 1949, remaining at that figure thereafter. These yields represent average yields for each grade combined by means of approximate, and changing, grade distribution of beef production.

Prices so determined relate to prices at retail for all beef as sold, whether fresh or processed, per fresh-equivalent retail pound. That is, the retail weight unit is that of beef as it is normally sold fresh at retail. For example, the average prices include estimates for canned beef, the price of which includes the cost of canning but is expressed in terms not of a pound of canned beef but of the weight that would have been available at retail had the same beef not been canned but sold fresh at retail.

Price data estimated in this fashion are presented in table 27 under the heading "Estimates based on prices of live cattle."

The closeness of the two estimates affords a considerable degree of confidence in their accuracy. Although the series based on live animal prices is subject to more error than is the series derived from carcass prices, it seems to be fairly reliable.

APPENDIX II

Relationship Between Price-estimating Equations and Structural Demand Equations

Demand theory conventionally specifies that, for an individual consumer, the quantity of the commodity consumed depends upon its own price, prices of competing items, the individual consumer's income, and factors that reflect changes in tastes and preferences. Market demand, which is the concern here, is the summation of these individual demands and may be defined as follows:

$$Q_b = a_b + b_{11}P_b + b_{12}P_p + b_{13}Y + b_{14}L + u_b \qquad (13)$$

$$Q_p = a_p + b_{21}P_b + b_{22}P_p + b_{23}Y + b_{24}L + u_p \qquad (14)$$

where the Q's represent the aggregate per capita consumption of beef (Q_b) and pork (Q_p), the P's represent the market prices for beef (P_b) and pork (P_p), Y represents aggregate per capita consumer income, L represents price level, and the u's represent random disturbances that affect consumption of beef and pork.

If time series data on prices, quantities, and incomes are given, the statistical method used to estimate the coefficients in these structural demand relations depends on assumptions that are made regarding the type of functional relation that generates the observed data. As indicated on page 57, quantities of each meat consumed per capita can be treated as given variables in the statistical analysis. This means that a given combination of production of beef and pork results in a unique set of market prices that is simultaneously determined. Thus, if we are to estimate the coefficients in the demand equations (13) and (14), we must use a statistical method that allows for the joint determination of the three competing prices.

Equations of the sort discussed here are usually just identified. Hence, the reduced form method of fitting simultaneous equations can be used to estimate these coefficients.

The computational procedure used can be summarized in three steps: (1) Algebraically recombine and rearrange the variables in the structural demand equations in such a manner that each of the jointly determined variables (P_b and P_p) is expressed separately as a function of all the predetermined variables (Q_b, Q_p, L and Y) appearing in the structural equations of the system. (2) Fit these equations (commonly known as reduced-form equations) by ordinary least squares method. (3) Compute algebraically the structural demand coefficients from the estimates obtained in (2) above. Step 3 is essentially the reverse of step 1.

Reduced-form equations corresponding to the demand equations (13) and (14) are as follows:

$$P_b = \alpha_b + B_{11}Q_b + B_{12}Q_p + B_{13}Y + B_{14}L + v_b \qquad (15)$$

$$P_p = \alpha_p + B_{21}Q_b + B_{22}Q_p + B_{23}Y + B_{24}L + v_p \qquad (16)$$

The above reduced-form equations are equivalent to the price-estimating or forecasting equations fitted in this study.

The algebraic relationships between the demand coefficients and the "flexibility" coefficients in the price-estimating (reduced-form) equations are:

$$b_{11} = \frac{B_{22}}{B_{22}B_{11} - B_{12}B_{21}} \qquad b_{22} = \frac{B_{11}}{B_{22}B_{11} - B_{12}B_{21}}$$

$$b_{12} = \frac{-B_{12}}{B_{22}B_{11} - B_{12}B_{21}} \qquad b_{21} = \frac{-B_{21}}{B_{22}B_{11} - B_{12}B_{21}}$$

$$b_{13} = \frac{B_{12}B_{23} - B_{13}B_{22}}{B_{22}B_{11} - B_{12}B_{21}} \qquad b_{23} = \frac{B_{21}B_{13} - B_{23}B_{11}}{B_{22}B_{11} - B_{12}B_{21}}$$

$$b_{14} = \frac{B_{12}B_{24} - B_{14}B_{22}}{B_{22}B_{11} - B_{12}B_{21}} \qquad b_{24} = \frac{B_{21}B_{14} - B_{24}B_{11}}{B_{22}B_{11} - B_{12}B_{21}}$$

When the reduced-form equations are run with all variables expressed in logarithms, they immediately give the "price flexibilities." It is important to note that the reciprocal of the "price flexibility" for beef (B_{11}) equals the price elasticity for beef (b_{11}) only if B_{12} and B_{21} are zero. This will happen if other goods (in this case, pork) do not measurably affect the consumption of beef. The algebraic relation of the coefficients clearly indicates that the reciprocal of the cross price flexibility does not give the cross elasticity of demand. The same holds for the income coefficient.

Using equations (4.1) and (8.1) on pages 67 and 74 for the entire period 1921–41 and 1948–60, estimates of demand elasticities can be derived using the above relationships.

Reduced-form equations:

$$\log P_b = -1.430 - 1.059 \log Q_b - 0.237 \log Q_p + 0.955 \log Y + 1.288 \log L \tag{4.1}$$

$$\log P_p = 0.287 - 0.522 \log Q_b - 0.665 \log Q_p + 0.246 \log Y - 1.407 \log L \tag{8.1}$$

Demand equations:

$$\log Q_b = a_b - 1.147 \log P_b + 0.409 \log P_p - 0.995 \log Y - 0.903 \log L \tag{17}$$

$$\log Q_p = a_p + 0.900 \log P_b - 1.826 \log P_p - 0.410 \log Y + 1.410 \log L \tag{18}$$

The results show that the reciprocal of price flexibility may give a rough approximation of price elasticity when B_{12} and B_{21} are not zero. The price elasticity for beef is close to unity (−1.15), as indicated in section beginning on page 61. But that for pork is quite inelastic (−1.83), due perhaps to the omission of time from the equation. When time is included in the pork equation, the price elasticity approaches unity. The latter is the more realistic estimate.

TABLE 28.—*Procedure for estimating the number of fed cattle marketed, U.S., 1920–29*

Year	Receipts, Chicago		Cattle receipts, 65 markets	Chicago as percentage 65 markets	Percentage inspected slaughter bought at stockyards	Corrected returns, fed cattle, Chicago [1]	Fed cattle, Chicago as percentage all fed cattle marketed [2]	All fed cattle marketed [3]	Estimate based on stocker-feeder shipments	Compromise estimate
	All cattle	Fed steers								
	1,000 head	*1,000 head*	*1,000 head*	*Percent*	*Percent*	*1,000 head*	*Percent*	*1,000 head*	*1,000 head*	*1,000 head*
1941	2,035	987	15,228	13.4	75.6	1,852	31.2	5,935		
1940	1,926	924	14,077	13.7	75.1	1,707	32.6	5,232		
1939	1,818	899	13,896	13.1	75.7	1,723	37.3	4,624		
1938	1,885	879	14,076	13.4	76.9	1,620	35.2	4,604		
1937	1,981	727	15,135	13.1	78.9	1,336	37.2	3,590		
1936	2,234	898	15,711	14.2	81.0	1,484	35.1	4,227		
1935	1,972	708	14,986	13.2	83.6	1,219	42.3	2,880		
1934	2,727	1,002	19,679	13.9	82.4	1,663	45.7	3,641		
1933	2,067	997	12,347	16.7	83.5	1,359	35.6	3,819		
1932	2,006	987	11,831	17.0	84.6	1,304	37.1	3,511		
1931	2,287	1,111	13,486	17.0	87.3	1,423	39.2	3,630		
1930	2,239	1,081	13,798	16.2	88.2	1,438	39.2	3,673		
1929	2,388	1,079	14,337	16.7	88.9	1,381	38.6	3,578	3,100	3,600
1928	2,505	1,038	15,189	16.5	89.9	1,330	38.9	3,419	2,950	3,400
1927	2,872	1,247	16,258	17.7	89.9	1,488	39.2	3,796	3,100	3,600
1926	3,257	1,414	17,034	19.1	89.8	1,567	39.4	3,977	3,250	3,800
1925	3,023	1,220	17,117	17.7	90.7	1,443	39.7	3,635	3,250	3,600
1924	3,203	1,331	17,173	18.7	90.7	1,491	40.0	3,728	3,750	3,850
1923	3,157	1,393	16,999	18.6	89.6	1,589	40.2	3,953	3,750	4,000
1922	3,163	1,311	17,141	18.5	91.0	1,479	40.5	3,652	3,000	3,400
1921	2,793		14,310	19.5	91.5				3,250	3,450
1920	3,107		16,860	18.4	91.5				3,500	3,675

[1] A derived series, calculated to standardize the position of Chicago relative to 65 markets, and of public markets relative to total inspected slaughter.

[2] 1930–41, derived from next column; 1920–29, estimated as straight line extension of 1930–41.

[3] 1930–41, independently estimated; 1920–29, derived from percentages in previous column.

Derived from data furnished by Economic Research Service, U.S. Department of Agriculture.

TABLE 29.—*Selected source data for charts*

Year	Consumer price index (1947–49 = 100)[1]	Disposable personal income per person[2]		Production per person[3,4]		Ratio, production to deflated disposable income[3]		Ratio, retail price to Consumer Price Index[3]		Percent of cattle slaughtered under Federal inspection[5]		
		Actual	Deflated	Beef	Pork	Beef	Pork	Beef	Pork	Steers	Cows	Heifers
		Dollars	*Dollars*	*Pounds*	*Pounds*					*Percent*	*Percent*	*Percent*
1921	76.4	508	665	55.5	70.9	8.3	10.7	36.3	41.4			
1922	71.6	541	756	59.9	74.0	7.9	9.8	35.8	41.9			
1923	72.9	616	845	60.0	84.7	7.1	10.0	35.1	38.8	48.0	47.9	
1924	73.1	610	834	60.3	80.2	7.2	9.6	34.7	38.9	46.5	49.4	
1925	75.0	636	848	59.4	79.2	7.0	8.3	34.7	46.4	46.0	50.4	
1926	75.6	651	861	60.4	67.9	7.0	7.9	38.1	49.3	46.9	49.7	
1927	74.2	645	869	53.7	70.9	6.2	8.2	39.8	47.0	47.1	49.2	
1928	73.3	653	891	47.9	75.0	5.4	8.4	45.3	44.9	45.4	50.7	
1929	73.3	682	930	48.2	72.5	5.2	7.8	48.7	46.0	48.6	47.4	
1930	71.4	604	846	48.1	68.9	5.7	8.1	45.4	45.4	51.9	44.3	
1931	65.0	515	792	48.5	70.5	6.1	8.9	41.2	40.9	54.8	41.7	
1932	58.4	390	668	46.4	71.5	6.9	10.7	37.8	30.1	54.5	41.9	
1933	55.3	364	658	51.3	72.3	7.8	11.0	35.6	28.2	52.1	44.0	
1934	57.2	411	719	55.9	65.2	7.8	9.1	35.7	36.7	47.9	48.7	
1935	58.7	459	782	51.5	46.5	6.6	5.9	42.6	51.4	39.9	56.0	
1936	59.3	517	872	57.4	58.3	6.6	6.7	43.2	50.3	43.7	52.2	
1937	61.4	551	897	52.8	54.0	5.9	6.0	44.0	49.8	40.1	55.9	
1938	60.3	506	839	53.2	59.2	6.3	7.1	44.4	45.3	46.2	49.8	
1939	59.4	538	906	53.5	66.1	5.9	7.3	46.0	41.6	48.6	47.1	
1940	59.9	576	962	54.3	76.1	5.6	7.9	44.7	36.1	49.9	45.9	
1941	62.9	697	1,108	60.6	71.4	5.5	6.4	46.9	43.2	49.9	45.6	
1942	69.7	871	1,250	65.6	80.6	5.2	6.4	46.6	47.2	48.7	47.4	
1943	74.0	977	1,320	62.7	99.8	4.8	7.6	45.7	45.8	48.9	47.0	
1944	75.2	1,060	1,410	65.8	96.1	4.7	6.8	38.7	42.4	42.0	41.7	11.2
1945	76.9	1,075	1,398	73.4	76.5	5.3	5.5	39.4	41.7	45.8	39.1	11.2
1946	83.4	1,136	1,362	66.3	78.8	4.9	5.8	45.9	49.5	47.0	37.8	11.6

1947	95.5	1,181	1,237	72.4	72.9	5.9	5.9	57.4	63.6	44.9	38.8	12.6
1948	102.8	1,291	1,256	61.9	68.6	4.9	5.5	65.9	60.0	44.3	40.6	11.4
1949	101.8	1,271	1,249	63.3	69.0	5.1	5.5	60.9	54.8	53.6	31.6	11.3
1950	102.8	1,369	1,332	62.9	70.6	4.7	5.3	67.4	53.6	53.0	32.6	10.6
1951	111.0	1,473	1,327	57.2	74.3	4.3	5.6	73.7	53.3	52.0	33.7	10.1
1952	113.5	1,520	1,339	61.5	73.4	4.6	5.5	67.4	50.7	54.5	31.1	10.7
1953	114.4	1,582	1,383	77.7	62.7	5.6	4.5	52.9	55.5	53.6	31.7	11.6
1954	114.8	1,582	1,378	79.8	60.8	5.8	4.4	51.0	56.4	50.3	33.8	13.4
1955	114.5	1,660	1,450	82.1	66.5	5.7	4.6	51.4	47.9	48.8	34.9	14.0
1956	116.2	1,742	1,499	86.0	66.6	5.8	4.4	49.7	44.8	51.1	32.8	14.1
1957	120.2	1,804	1,501	83.0	60.9	5.6	4.1	52.8	50.1	51.5	31.1	15.3
1958	123.5	1,826	1,479	76.6	60.0	5.3	4.1	60.8	52.5	55.8	25.8	16.7
1959	124.6	1,905	1,529	76.7	67.7	5.0	4.4	61.6	45.8	55.4	22.0	21.2
1960	126.5	1,969	1,557	81.9	64.7	5.3	4.2	58.7	44.7	54.4	22.9	21.3

[1] *Statistical Abstract of the United States, 1958*, (*44*).
[2] Computed from data in *Statistical Abstract of the United States*, (*44*).
[3] Computed from data of Agricultural Estimates Division, Statistical Reporting Service, U.S. Department of Agriculture.
[4] Excludes meat produced from Government emergency slaughter during drouth years of the 1930's.
Livestock and Meat Statistics, (*39*).

U.S. GOVERNMENT PRINTING OFFICE: 1962—598786

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