A PARTIAL ANALYSIS OF THE DEMAND FOR BEEF
AT RETAIL IN WICHITA, KANSAS

by

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INTRODUCTION

Many of the elements that go into the making of a steak dinner or hamburger snack are controlled by a set of laws that are called technology. In terms of the meat that goes into this meal, this technology is in the form of a more or less constant set of relationships that govern the number of pounds of beef that will be returned from a given number of animals on a certain feeding program if they are fed certain feeds at certain times of the year and barring the difficulties of disease, drought, heat, cold, or other abnormalities. These laws also hold that a certain type of animal will yield a certain number of pounds of meat when slaughtered and that of this meat a certain number of pounds will be steak. The farmer knows these laws, the meat-packer knows them, and the housewife has some idea that they exist. They are very much in evidence and are widely used and what is still more comforting, they are—to a degree—reliable and constant.

Technological laws, however, are only one aspect of the production of meat in this age of specialization and highly efficient production. Before the man who is doing the producing of these steak dinners can make the very important decision of how many of what to produce, he must take into account the effect this production will have on his future well being. Since the meat he produces must be converted into the local medium of exchange before it can add to his disposable income, the producer needs to have available for his use some information
beyond the laws of technology. He wants to know as nearly as possible how many dollars this production will return to him.

The producer is not the only person interested in information about the meat industry. All those people who buy and sell meat and meat products at every stage from the producer to the consumer are vitally interested in this sort of information. They want to know the effects of prices, or price changes, and both product and factor changes. They want to know the probability of changes in production, what causes these changes, and how they can be predicted, if at all. One important aspect of the information they require of the researcher in economics is a valid estimate of the price of their product at the time this particular product will come on the market. The estimation of these prices is a major goal of livestock marketing research.

This long run goal implies many short run, intermediate goals, and many immediate questions. Is it possible to forecast the effect of a change in price on consumption? Which of the observed variables of the demand for meat is the causal variable— or variables? These questions and many more must be answered before the valid prices we are seeking can be estimated. The subject is complicated in that

... competent analysis of demand requires three things. First, the economist must have a thorough knowledge of the economic factors that affect the commodity and obtain adequate data on which to base the analysis. Second he must understand economic theory in general. Third, he must be able to use modern techniques of analysis. (10, Foote and Fox, p. 11)
A study of the demand for meat is of value because it enables the meat retailer to know how much his policies will effect the amount of meat he will be able to sell. A coefficient of the price elasticity of demand for beef will tell him how much change he can expect in the quantity of meat he sells if he increases his price a certain percentage. Thus, one of the objectives of this demand study is to estimate the coefficient of price elasticity of the demand for beef.

A second objective is to estimate the cross-elasticity of demand for products that have been included in this study and which are substitutes for beef. The importance of this may be seen by showing how a retailer can evaluate the effect of an increase in the price of pork on the demand for beef on the basis of such a cross-elasticity.

Perhaps the most comprehensive objective of all is to gather and analyze more information about the demand for meat in general and the demand for beef within the area and time specified by this study in particular. If this can be accomplished, the value of the over-all study will be well established.

REVIEW OF THE ECONOMIC THEORY OF DEMAND ANALYSIS

Economic Factors

Agriculture in general and the meat producing part of agriculture in particular is almost unique in the American economy today in that it is still largely a competitive industry.
This means that the producers themselves—the individual farmers—have little control over the price. This can readily be shown by the example of a farmer in the market trying to sell his animals. He has some control over the price he can get for his animals through his choice of the market through which he sells; for instance he may choose to sell his livestock to a livestock dealer, a local market, through a local auction, or through a terminal market. But his product cannot be differentiated easily and his selling and merchandising techniques have been largely unsuccessful. Thus, he takes the price set by the market as a whole and if he insists on a higher one he will find no buyers for his livestock.

A further complication is that the total demand at the farm level for these products is relatively inelastic. This causes changes in price to be drastic and rapid as quantity produced varies. Also the meat producer tends to be a small operator who depends on these products for his livelihood. His reaction to a change in price may be caused by his need for income rather than his economic analysis of the situation and he may produce more rather than fewer animals in response to a fall in price in the short run, thus aggravating the situation. (Samuelson, 31, p. 399.)

Working, (46, p. 2) in his study of the demand for meat, has shown that the major determinant of the price of meat in any given year is the amount of meat produced and that the price of
meat in past years, viewed in the light of future expectations, determines the amount of meat produced in any given year. Further, the amount of meat in storage is approximately equal from year to year, and the amount exported or imported has made up an insignificant percentage of total production in the past. Assuming no significant change in the amount of meat exported and imported, and that the amount of meat stored will continue to be insignificant when compared to total production, it can be said that the factor of predominant importance in the explanation of changes of the price of meat over time is the quantity of meat produced. (Working, 146, p. 2.) A further examination of the factors that affect the amount of meat demanded will show the complex relationships that exist between the factors of price, quantity produced, and quantity demanded.

Another major factor that must be considered in demand analysis is the income available to the meat consumers. It may be seen that the income level of the consumer will greatly affect his estimate of the utility of his money, his reaction to the price of meat, and thus the quantity of meat he will buy.

Changes in the population—the number of people who will be demanding meat—must also be considered in demand analysis. There are two aspects of population changes; changes in the number of people and changes in the makeup of the age groups due to a change in the birth and death rates. Both quantitative and qualitative population changes may materially affect the demand for meat.
The prices of the alternative items that may be substituted for meat must be considered as affecting the demand for meat. The relative price of these substitutes is a very important factor that must be considered by the meat buyer when he decides whether to buy meat or something else, and when he decides which particular cut of meat to buy.

The last class of factors that make up the demand for meat contains all those vastly subjective factors which make people choose one good in preference to another very similar good (similar in terms of measurable utility) and which we call taste. These tastes are extremely difficult to predict and to estimate and are very important in the analysis of every level of demand.

Theoretical Economic Relationships

In the examination of the demand for meat, it is necessary to construct a certain kind of model to meet the needs of each particular situation. But the building of these models must begin with the assumption that the market behavior of human beings is determined by some kind of utility consideration. (Schultz, 33, p. 9.)

It must be assumed that people are free to act as their motives prompt in the production, exchange, and consumption of goods and that every person is the final and absolute judge of his own welfare and interests. Analysis of individual behavior must take into consideration these determinisms of culture,
tradition, and power structure. Free will exists only because of these social determinisms, for without social organization there would be chaos and no one would be able to accomplish anything but a minimum of animal acts. Rose stated that free will does exist and that the economist may assume it, but he must recognize that it is relative to a certain type of social organization. This should be no restriction on economic theory, but rather should open new and more realistic possibilities to it. (Rose, 30, p. 204.)

Values and desires are ascertainable and even measurable; they have considerable stability. Sociologists and psychologists have regularly studied them and can contribute knowledge of them to the economist who can thereupon insert them into his model. It need not be assumed that human behavior is non-logical and that it is the job of the economist and sociologist to study this non-logical behavior. It can rather be assumed that practically all deliberate behavior is logical, but derived from premises that are by no means entirely materialistic and that these premises must be measured and specified. (Rose, 30, p. 204.)

It is assumed that the members of the society act with complete rationality. They are supposed to "know what they want" and to seek it intelligently. They are supposed to know the consequences of their acts when they are performed and to perform them in the light of the consequences. Rose points out that in the eighteenth and nineteenth centuries rationality was considered a mechanical process of working out the rules of Aristotelian logic as they applied in any given situation. Today it is known that a man can be rational—in the sense of making accurate predictions as to the consequences of his acts—without
always being strictly logical. The ability to carry on a fairly well organized social existence from day to day depends on the ability of most members of the society to predict with a sufficiently high degree of accuracy what the others will do under given conditions. This is the character of rationality, and not conformity to strict rules of logic. From this principle Rose deduces the conditions under which men will not act rationally; when they have not learned the characteristics of the culture and of the specific personality with which they are interacting; when they fail to perceive the relevance of a specific culture or personality characteristic for a given situation; when they have some block (volitional or not) against using their knowledge in a given situation. Thus, rationality is a function of the condition of the society as well as of the condition of a person. Those who require that people be rational as a premise for science may find it satisfactory that people can make accurate predictions even if they do not follow the strict rules of logic. In this way the economist finds rationality in a primitive society, swayed by superstition and other forms of illogical practice, as well as in a modern society. (Rose, 30, p. 202.)

Thus, it is well to admit at the outset that utility considerations are not likely to be either perfectly measurable or perfectly consistent (even in the case of an individual) over a period of time. It may not be valid to assume that utility is an exactly measurable quantity or even that it can be compared in different persons. But it must be assumed that there is some
degree of consistency in individual utility considerations. (Schultz, 33, p. 54.)

The assumption of utility provides both a rational foundation for the law of demand and for generalizations of this law which bring out the interdependence of various economic factors. It enables researchers in economics to classify commodities into useful and significant categories and to explain both the negatively and the positively sloping demand curve, thus providing the background needed for statistical work. (Schultz, 33, p. 54.)

Assuming some degree of rationality on the part of the consumer, it is possible to achieve some information about the tastes or preferences of the consumer. Once these are given there remains the technical problem of determining the quantities of various commodities he will purchase at various prices and incomes.

It is of basic importance to the theory of demand that the consumer be able to substitute one commodity for another, and that he be aware of that large class of commodities that are complementary to each other. If the consumer can substitute one commodity for another, then for any given expenditure he can find several combinations of the two commodities which are equivalent. These combinations of the two commodities may be represented by a continuous curve called an indifference curve. At a higher expenditure a new combination or group of combinations of the same pair of goods is more desirable than any
combination found on the first curve because each point now indicates a position where the consumer would have more of both goods. Any number of these curves may be drawn to represent all possible expenditures (Plate I, Fig. 1). (Stigler, 35, p. 67.)

If the necessary information can be obtained it is possible to determine the quantities of each commodity that a consumer will buy at various prices. If the family of indifference curves for each of the two commodities in question is known and the income of each consumer and the price of each commodity (which must not be affected by the purchases the individual consumer makes) is known, and other prices are assumed to be constant, then the series of intersections between price-ratio lines and individual indifference curves will secure a curve that will represent the amount an individual will demand at various prices (Plate I, Fig. 2). (Stigler, 35, p. 75.)

A market demand curve may be defined as representing the total quantities which will be taken by all consumers in the market at all possible prices. The process of building up a market demand curve is a simple one of multiplying the individual demand curves by the number of individuals in the market. By multiplying the quantity demanded at each price by the number of individuals in the market the quantity demanded in the market at that price will be secured. The market demand curve is a graphic representation of the points thus secured. If each individual has a different demand curve, these curves are summed horizontally rather than multiplied. (Stigler, 35, p. 91.)
EXPLANATION OF PLATE I

Fig. 1. The theoretical demand curve for beef.

Fig. 2. The theoretical relationship assumed to exist between the price of pork and the consumption of beef.
PLATE I

Quantity of beef

Price of beef

Fig. 1

Fig. 2
From the foregoing generalization of the theory of demand it follows that certain fundamental factors determine the quantity of each commodity that will be purchased at a certain price: (Stigler, 35, p. 90.)

1. The income of the consumer of consumers.
2. The prices of substitutes.
3. The consumer's tastes or preferences.
4. The number of consumers.

If it is assumed that the above listed factors are constant and the theoretical locus of those points gotten by changing price is examined and the amount demanded at each theoretical price is plotted, and if it is further assumed that this multiple evaluation could take place in a single instant of time, the result would be an individual's demand curve; a picture of individual demand. If a further assumption is made assigning values to the factors listed above the individual's demand may be shifted by these changes.

Fox has incorporated these factors into his model of the demand for meat (Plate II).

Techniques

If every factor that determines the price of meat could be discovered and labeled with exactly the amount of influence it has on price and every other variable involved, then it follows that it would be possible to arrive at a price that would be valid merely by taking the algebraic sum of all these factors or
EXPLANATION OF PLATE II

The Demand and Supply Structure for all Meat

Arrows show direction of influence. Heavy arrows indicate major paths of influence which account for the bulk of variation in current prices. Light solid arrows indicate definite, but less important paths; dashed arrows indicate paths of negligible, doubtful, or occasional importance. (Fox, 11, p. 41.)
by evaluating the geometric sum of all their vectors. The researcher would then have a model showing the magnitude and direction of reaction that would follow from an action in every case. And from this model he could get any information desired, for it would all be there. This model could be observed in any phase of the dynamic interaction and account for each and every change that would occur. In short, this would be a reproduction of reality from which valid information could be gotten. (Tinbergen, 36, p. 1.)

The complexity of such a model is staggering and since economic research is— at present— limited by time and space, demands for information must be limited both in the scope of the information sought and in the reliability of the answers accepted. Attempts, however, must be made to match the dream model in as many ways as possible. It must be admitted at the outset that there are many variables that cannot be considered in every model and many reactions that cannot be exactly evaluated and that the equations can never be worked rapidly enough to correctly predict every change in the factors involved. But research must be continued on the basis of the results achieved. The expectation is not perfection but progress. (Wold and Jureen, 45, p. 1.)

A closer examination of the idea of using a model to represent a set of relationships must be prefaced by definition of certain specific terms. A model is a theoretical system used to represent a physical system; an abstract representation of a
concrete situation. (Boulding, 3, p. 2.) A system is a set of objects together with relationships between the objects and between their attributes. (Hall and Fagan, 17, p. 21.) This definition must imply that a system has properties, functions, or purposes distinct from its constituent objects, relationships and attributes. Objects constitute an unlimited variety of parts of a system and they may be either physical or abstract. Attributes are the properties of the objects, and the relationships referred to in the definition are those that link together the attributes and the objects; that tie the system together and make it meaningful. A physical system is a set of real, (concrete) objects, attributes, and relationships while a theoretical or abstract system is a set of objects, attributes, and relationships that does not exist in the real or concrete. (Krech, 20, p. 139) Both physical systems and theoretical systems may be either static or dynamic.

Hall and Fagan pointed out two separate techniques for studying complex systems. The first was to neglect the minute structure and observe only the macroscopic details of the system. Another was to study in detail the behavior of certain subsystems. This division-of-labor approach to a central and extremely complex problem is widely used in economics.

In most deductive studies in the social sciences the starting point is the behavior of the individual. Each individual is conceived of as acting in a certain way determined partly by his psychology and his physical surroundings and partly by the
actions of others. If there are n individuals we may denote the action of individual i by \( A_i \) and the non-social determinants of his behavior by \( P_i \). Then the actions of the first individual may be discovered by examining a symbolic equation:

\[
A_1 = f(P_1, A_2, \ldots, A_n).
\]

There is one such equation for each individual. Together they constitute n equations in n variables, \( A_1, \ldots, A_n \). In general these may then be solved to express the actions of all individuals in terms of \( P_1, \ldots, P_n \). (Arrow, l, p. 31.). Given the reaction of every factor to changes in all the other factors and given the exogenous or outside factors, the information and the behavior of any element in the system can be estimated. Arrow labels this type of system the individualistic system. It is explicit in the main tradition of economic thought.

It is convenient many times in economic research to anticipate reactions in terms of a group rather than an individual. In order to do this it is necessary to make assumptions of rationality which is to say that each individual at a given moment of time is free to choose among several basic courses of action, and that he decides among them on the basis of their consequences and that he will make the same choice each time in the same situation. Thus, it must be assumed that people will maximize or minimize something. There are certain criticisms that have been leveled at this assumption of rationality, the most cogent being that there is a fundamental ambiguity in the basic concept. Individuals are conceived of as soon realizing
that their actions (in addition to their other consequences) will alter the obstacles faced by others thereby affecting their actions and in turn altering the obstacles controlling the choices of the original observer. Hence, his actions will be partly controlled by his realization of their repercussions on the actions of others. But the same statement is true of each other individual; thus, each will be concerned with the effect of his action on the others, and no determinant solution will be possible.

However strong the criticism against the assumption of rationality may seem, it still remains that there has been no single sweeping principle erected to equal or rival it. To the extent that formal theoretical structures in social sciences have not been based on the hypotheses of rational behavior, their postulates have been developed in a manner which may be termed ad hoc. Such propositions are usually drawn from introspection or casual observation, and they depend on the investigator's intuition and common sense. (Arrow, 1, p. 34.)

With these assumptions in mind, it is possible to derive a theory of relations of aggregates based on individual behavior which meets the criteria that suitable definitions of macro-economic relations must be based on individual behavior.

For at least two reasons no exact relationship will be seen between the variables measured in economics; (1) Not all the variables which are relevant are included in the analysis. Hosts of important factors which are too difficult to measure are
always omitted. (2) The variables observed are not measured precisely. In the statement of a relationship, then, not only must the explicitly enumerated variables be included, but an additional measurable variable, known as a disturbance, must appear. Such a relationship is said to be stochastic.

The disturbance in a given relationship is a random variable with a probability distribution which is the same for each time the variables are observed. It is usually also assumed that the disturbances at different times are independent. These concepts extend themselves naturally to all types of social laws. Arrow (1, p. 45) points out that the formulation of a generalization in social science is equivalent to an assertion about the probability distribution of certain disturbances.

In the social sciences there is a certain difficulty in the statistical analysis which does not seem to arise in the natural sciences. If, during the period of observation, neither supply nor demand shifted, the price and the quantity exchanged would not alter and there would be only one point from which to infer the supply and demand curves. This is obviously impossible since there are an infinite number of possible pairs of curves passing through the observed point. (Arrow, 1, p. 47.)

The method of scientific investigation that must be used in the social sciences calls for intensive a priori thinking to formulate a model, followed by the selection of a best-fitting structure from that model by appropriate statistical techniques. The most crucial step is the choice of a model. If little can
be said on purely a priori grounds about the nature of the investigation then the resulting model is unidentified, and further progress is stopped. The alternative procedure is to start with a very wide and vaguely stated model and investigate empirical data which seem to be relevant. By examination of these data more definite models will be suggested which will, in turn, provide the basis for further empirical research, and so forth. The choice between the alternative scientific tactics indicated depends on the stage of formalization of the underlying theory. Since the statistical methods rest heavily on the assumption that the model is correct, a serious error in formulating the model may invalidate all further empirical work based on it. (Working, 46, p. 18.)

In an estimate of demand from empirical data two types of models are particularly adapted for use; the time series analysis and the cross sectional analysis. Time series analysis is a method of observing relationships between certain defined variables over a period of time (which depends on the analysis of these variables over a period of time). Cross sectional analysis is a method of observing these same relationships over space (which depends on an estimate of consumption by family, individual, etc. in regard to income, price, geographical location, or other influencing factors). (Working, 46, p. 18.)

The optimum approach to a study of demand included a combination time-series, cross-sectional analysis conducted over as large an area as possible and through as great a time period as possible.
The time series method of analysis defines a number of relationships (one or more) mathematically, observes these variables empirically, and substitutes the mathematical values into equations and observes how closely the results follow the expected results that were achieved a priori. There are a number of ways the mathematical model may be constructed. A special type of time-series analysis is the systems of equations method which defines as exogenous those factors that can be observed to effect the price or quantity of the commodity in question, while those factors that cannot be observed to effect the price or quantity are called endogenous. Various assumptions are made as to the number of variables, the linearity of the relationship, and the relationships themselves, and then the system is solved simultaneously in order to define these relationships numerically. This method assumes not only that the observed variables are without error, but that the random shifts in supply or demand are due to omitted variables. (Working, 46, p. 23.)

As a statement of economic principle, a system of equations must be analyzed simultaneously to ascertain the underlying relationships between price, production, and consumption of agricultural commodities. However, modern econometric theory recognizes a special case in which a single least-squares equation gives an unbiased estimate of the demand curve. Minor departures from this case have been handled satisfactorily by single-equation methods; major departures, in general require the simultaneous fitting of two or more equations, if the object is to obtain
unbiased estimates of elasticities of demand and similar structural coefficients. If interest centers on predicting the value of one variable from given values of other variables and elasticities of demand are not required, single least squares equations are useful, even when the basic structure involves simultaneous equations. (Working, 46, p. 23.)

THE ECONOMIC MODEL

Over a sufficiently long period of time a dynamic relationship is assumed to exist between the quantity of meat purchased and those factors that effect the quantity of meat purchased. This dynamic model is assumed to be of the general form,

$$Q_m = f(P_m, P_{s_1}, \ldots, P_{s_n}, Y_{t_1}, \ldots, Y_{t_n}, T).$$

This model represents the hypothesis that the quantity of meat ($Q_m$) demanded is a function of: The price of meat ($P_m$); the prices of each of the many substitutes, ($P_{s_1}, \ldots, P_{s_n}$); the national income in several time periods, ($Y_{t_1}, \ldots, Y_{t_n}$); and the tastes of the collective consumers, ($T$). This model must be further identified by the indication of the appropriate time periods for each variable.

Within the assumptions that the tastes of consumers change very slowly and will not change enough during a short period to affect the results of a study, and that the prices of non-meat substitutes and complements will not change enough during the duration of a study to effect the results, and that national income—particularly total income over the area of the study—will not change during the time of the study, then it may be
further assumed that the quantity of meat purchased is a function of the price of meat, $Q_m = f(P_m)$. Under these conditions the relationships are considered to be static.

A meaningful study of the price of meat must carefully define not only this term but the term "quantity of meat purchased" as well. It was not an objective of this study to analyze the price of meat or the quantity of meat sold or demanded in terms of an aggregate or over-all price or aggregate quantity. It was rather intended to study these quantities in terms of the demand for a certain kind of meat. Thus, the term "price of meat" was broken down into the prices of certain kinds of meat such as beef, pork, and fryers. It follows that a study of the quantity of retail meat demanded must be made up of studies of the demand for beef, pork, and fryers. The period of time over which data was collected for this study was 10 weeks. It was assumed that the several factors known to affect the quantity of meat but not included or represented in the model did not change significantly during this period.

The Retail Demand for Beef

This model was assumed to have a negative relationship in which an increase in the retail price of beef would be reflected by a decrease in the quantity of beef demanded. "The elasticity of demand for beef is expected to be negative and differ significantly from zero." (Fox, 11, p. 35.) This static analysis proceeds by estimating the amounts that were demanded at
various prices and thus securing individual points on the demand curve for beef. A continuation of these points will trace a curve which was expected to provide a useful estimate of the partial demand for beef (Plate III, Fig. 1).

The Retail Demand for Pork and Fryers

The theoretical relationship between the price of pork and the quantity of pork demanded was considered to be very similar to the one thought to exist between the price of beef and the quantity of beef demanded; and the retail demand for fryers was thought to be similar to that of beef and pork. In each case this was thought to be a negative elasticity; that is, as the price of beef, pork, or fryers increased, this increase was expected to be reflected by a decrease in the quantity of beef, pork, or fryers demanded (Plate III, Fig. 2).

Cross Relationships

It was assumed that there were certain cross relationships between beef and pork, beef and fryers, and pork and fryers. These relationships, under the stated assumptions, were examined statically and individually.

It was expected that beef and pork and fryers were substitutes for one another. It would follow that a certain amount of pork could be used to replace a certain amount of beef and fryers, a certain amount of fryers to replace a certain amount of beef and pork, and a certain amount of beef to replace a
EXPLANATION OF PLATE III

Fig. 1. Shows a linear relationship between the price of beef and the quantity of beef demanded.

Fig. 2. Shows a linear relationship between the price of pork and the quantity of pork demanded.
PLATE III

**Fig. 1**

**Fig. 2**
certain amount of pork and fryers. On the basis of this assumption it was expected that not only was the quantity of beef consumed a function of the price of beef, but the price of pork and the price of fryers as well.

In Plate IV, Fig. 1, the curve I and II shows points of indifference between substitutes. Let OX represent the quantity of beef demanded, and OY represent the quantity of pork demanded, than each point on I and II represents a point where a certain amount of beef is worth exactly as much to the consumer in terms of utility as a certain amount of pork. In Plate IV, Fig. 1 price-ratio lines have been inscribed on the same graph showing the relationships between the prices of pork and beef. If the price of pork falls it can be seen that the consumer will be able to move to a higher indifference curve II and that at the changed price of pork the amount of pork will have changed in relation to the amount of beef demanded. In Plate IV, Fig. 1 it was shown that if the price of beef was varied thus changing the quantity of beef along the line OX while the price of pork is held constant, the amount of beef purchased would be expected to vary along the curve DD. Thus, the demand for beef is affected by the price of products that may be substituted for beef. This class of substitutes would be expected to include pork and fryers and a comparable relationship may be assumed to exist between beef and prok and beef and fryers. In each case the equation was a static one, $Q_b = f(P_b)$. 
EXPLANATION OF PLATE IV

Fig. 1. Indifference curves showing relationship thought to exist between quantity of beef and quantity of pork demanded. Straight lines show ratio between price of beef and price of pork. $Q_1$ is amount of beef demanded when price ratio AB exists. $Q_2$ is amount of beef demanded if price of beef falls and ratio AC exists. Curve D - D' shows demand for beef.

Fig. 2. The theoretical relationship and demand surface assumed to exist when both the price of beef and the price of pork are considered as affecting the quantity of beef consumed.
PLATE IV

Fig. 1

Fig. 2
Under the same assumptions it may be expected that the quantity of beef consumed would depend on the price of pork and the price of fryers. This would mean that a change in the price of fryers as well as a change in the price of pork and a change in the price of beef would be expected to be reflected by a change in the quantity of beef purchased. From such a model a partial demand surface could be obtained if enough observations were available for analysis. Within this sort of model and these assumptions a partial estimate of the demand for meat could be made. Plate IV, Fig. 2 shows a surface in which the dependent variable is the quantity of beef demanded and the two independent variables are the price of beef and the price of pork. A similar surface might be constructed incorporating the price of fryers.

EXPLANATION OF METHODS AND PROCEDURES

Objective

The objectives of this study were to derive the retail demand functions for beef and elasticities of demand for beef with respect to retail prices of ham and fryers. These estimates were to be made for the area of Wichita, Kansas.

The Sample

A sample consisting of 35 stores was selected in Wichita to represent each of the three types of ownership classifications,
i.e., independent stores, voluntary chain stores, and corporate chain stores, as well as size, and location. Each store was visited twice weekly by a representative of Wichita University who worked in cooperation with Kansas State College on this study and who personally supervised the filling out of the questionnaires. Data sheets were then mailed to Kansas State College.

Visits were made on Monday and Friday in order that the sample might be as representative as possible of a week day and a week end price. Since the meat sales on Friday and Saturday constitute approximately one-half of the total meat sold, the price figures for Friday were designed to represent a week end price and those data collected on Monday were designed to represent a normal week day price. (Purdue University, 29, p. 1.)

All quantity figures were taken on Monday. These data represented the wholesale meat ordered that week. It was determined by personal interview that little meat was held over by the individual stores from week to week. In every case the stores attempted to move the meat they purchased the same week in which it was purchased. This was done by merchandising, by grinding the slow moving cuts and moving them as ground meat, and if necessary, by lowering the price of the original cut. In some cases sales were encouraged by lowering the price of ground meat. Usually this was done as a last resort and as a part of an over-all reduction of the price of meat.

The data gathered were: (Appendix 1 and 2)

1. Retail prices of cuts of beef.
2. Retail prices of cuts of pork.
3. Retail prices of hams.
4. Retail prices of fryers.
5. Quantities of beef sold. (No. of sides of beef, average weight per side)
6. Quantities of hams sold. (No. hams, average weight per ham)
7. Quantities of fryers sold. (No. of fryers sold, average weight per fryer)

Data were obtained for a ten week period. In comparison with most demand studies, ten weeks is a relatively short period. A major reason for the selection of a short period was the elimination (or at least reduction to insignificance) of such factors as changes of income, changes of taste on the part of the consumers, and changes of population. It was recognized that this would place restrictions on the applicability of the results but difficulties in estimating the effects of such variables also restrict applicability.

Kuzents, in a recent critical review of demand studies says:

Can we be reasonably sure that the relations among the economic variables which we are attempting to measure are unaffected by concomitant changes in the social variables? The answer to this question is, probably, no, unless we restrict our analysis to a reasonably short period of time. (Kuzents, 21, p. 893.)

Baum, in a discussion of Kuzents' review says:

The dynamic problem of social change which limits the temporal validity of static models might be approached on a basis similar to some of the older
techniques of time series analysis; that is conduct a series of successive estimates based on a fixed but short time period (if possible, much less duration than the full available data) and subsequently analyze the movement of the estimates of the parameters through time. . . . . The use of shorter time periods for data (e.g., monthly instead of annual) may increase the possibilities of accomplishing this. (Baum, 2, p. 896.)

A special attempt was made to secure valid information by personal collection of data. A representative of Wichita University personally collected the data at the specified times. In spite of precautions taken there were certain weaknesses in the data. The sample size was somewhat reduced from the planned 35 to 29 by the failure of certain stores to cooperate. In some cases this was due to the store quitting business or changing hands and resulted in these data being so incomplete that they were thought to be unreliable and were discarded. There also were instances of incomplete reporting by other stores whose data were not discarded but were adjusted by inserting an estimate achieved on the basis of an average of the weekly retail price of beef. (The original data were obtained in such a way that prices of individual retail cuts may be investigated but such an investigation was not attempted in this study). Two weekly average retail prices of beef were determined by weighting prices of individual cuts by the percentage of the carcass that they represented,* one for Monday and one for Friday. These two prices were averaged and a single price

---

*The breakdown of carcasses into retail cuts, i.e., percentage, was worked out in collaboration with the Meats Section of the Department of Animal Husbandry and with butchers in retail stores.
used to represent each week. This average price corresponded to the average quantity sold.

The procedure used in determining beef prices could not be followed in the case of pork. Wholesale pork was not purchased in carcass quantities but rather by wholesale cuts such as loins, hams, bacon, and shoulders. Ham is a major component of pork. Since substantially complete price and quantity data were obtained from store operators, ham was used in this study to represent pork as a beef substitute.

Poultry meat also is considered to be a substitute for beef. In this study, essentially complete data were obtained on price and quantity of fryers sold by cooperating stores. Hence, fryers were used to represent poultry as a substitute for beef.

The basic data on price and quantity are shown in Table 1. The data that were adjusted and prepared for analysis were:
1. The over-all price of beef.
2. The quantity of beef demanded at retail.
3. The price of ham.
4. The price of fryer chickens.

The failure of some stores to cooperate was particularly unfortunate because in most instances the non-cooperating store was from the independent class of stores. This category of stores had been the most difficult to fill initially and a minimum of six had agreed to cooperate. Only three independent store operators cooperated throughout the ten-week period.
Table 1. The weekly price at retail and the quantities sold of beef, ham and fryers in Wichita, Kansas, for a 10 week period, March-June, 1955.

<table>
<thead>
<tr>
<th>Week</th>
<th>Beef Price (Per lb.)</th>
<th>Beef Quantity (1000 lbs.)</th>
<th>Ham Price (Per lb.)</th>
<th>Fryers Price (Per lb.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>57.2</td>
<td>36.9</td>
<td>56.6</td>
<td>49.9</td>
</tr>
<tr>
<td>2</td>
<td>57.7</td>
<td>40.8</td>
<td>55.7</td>
<td>52.7</td>
</tr>
<tr>
<td>3</td>
<td>59.0</td>
<td>39.7</td>
<td>55.0</td>
<td>50.6</td>
</tr>
<tr>
<td>4</td>
<td>58.8</td>
<td>36.0</td>
<td>55.4</td>
<td>50.8</td>
</tr>
<tr>
<td>5</td>
<td>59.4</td>
<td>37.4</td>
<td>59.4</td>
<td>50.0</td>
</tr>
<tr>
<td>6</td>
<td>58.9</td>
<td>40.8</td>
<td>58.7</td>
<td>49.4</td>
</tr>
<tr>
<td>7</td>
<td>58.8</td>
<td>38.4</td>
<td>60.9</td>
<td>49.3</td>
</tr>
<tr>
<td>8</td>
<td>59.7</td>
<td>35.9</td>
<td>65.7</td>
<td>48.9</td>
</tr>
<tr>
<td>9</td>
<td>60.5</td>
<td>36.9</td>
<td>63.2</td>
<td>49.7</td>
</tr>
</tbody>
</table>

Source: Survey of selected store operators taken in cooperation with Wichita University, March through June 1955 in Wichita, Kansas.

Hence, no attempt was made to carry out an analysis by type of store. Since data concerning quantity sold each week were applicable for the week before, there were no data available for the first week. Thus there were price data available for a full ten-week period but only corresponding quantity data for nine weekly periods.

The lack of cooperation further handicapped the study because the instances where the data were incomplete and were adjusted by estimated data consisting of averages tended to
weight the entire sample toward the average and remove some price variation that was expected. Since the actual variation of the quantities was recorded for that date, the data understandably revealed a tendency to leave some quantity variation unexplained thus limiting the precision with which estimates could be made on the basis of this sample.

The Procedure

The area of retailing which this sample attempted to analyze presented a particular problem of analysis because the meat was almost exclusively purchased in wholesale lots, broken down by the individual store and priced and sold as retail cuts. In order to obtain price and quantity of retail meat one of two approaches would ordinarily be available; either the wholesale cuts would be broken down and data obtained as to the quantity of each cut sold at retail, or the prices of each retail cut would be composited into an estimate of the retail price of the wholesale cuts.

The objective of the study dictated the approach taken. Since this analysis was concerned with demand for a particular type of meat, that is, beef, the retail prices of individual cuts were composited into an estimate of the average weekly retail carcass price of beef.

Since the objective of this study was to gather information of a very general nature about a market, about market reactions, and about a method of studying these market reactions and since
price forecasts were not required, a first difference analysis was not attempted. Further, since the price relationships studied were necessarily concerned with a very short period of time (ten weeks) and remained relatively stable in absolute terms as well as in terms of percentages, it was felt that little would be gained by converting these data to logarithms.

These data were analyzed using single equation techniques. When planning the analysis it was recognized that a complete description of a demand structure in a particular situation cannot be completely described except by an elaborate system of simultaneous equations. However, at the same time it was noted that a great many of these variables that were thought to affect the variable defined as the dependent variable—possibly the majority of these independent variables—were extremely difficult to define, or were beyond the scope of this study, or were thought to effect the dependent variable so slightly that the effect was negligible. Further it was felt that a system of equations might be taken to imply a much greater degree of accuracy than should be expected from the estimates yielded by a study of this sort. Fox, in a discussion of this same problem, comments:

During the past few years my work in the United States Department of Agriculture has involved a considerable amount of statistical demand analysis. The object of this work has almost invariably been to obtain numerical results which "made sense" in terms of the commodities and classes of economic agents involved—that is, results of structural significance. In all but a few cases I have used single-equation methods for estimating the desired coefficients. I accept the proposition that many economic phenomena must be
explained in terms of two or more simultaneous relationships. However, single-equation methods appear to be both practically and theoretically appropriate for estimating many structural relationships in the field of food and agriculture. (Fox, 12, p. 57.)

The situation discussed above was peculiarly applicable to the situation of this study, even to the point of the objective being logical rather than quantitative results. Thus, the techniques used were limited to single equation type analysis.

The Analysis

By means of least squares analysis functions were fitted to the various sets of data. A problem observed at this point was a dearth of variation in the price data recorded over the ten-week period. Weekly prices proved to show an extremely small variation from week to week and the total range of the variation over the whole time of the study was small in terms of percentages. An indication of total variation can be seen in Figs. 1, 2, and 3, and especially in Fig. 4.

In the initial attempt to discover relationships within these data scatter diagrams were plotted showing the quantity taken at the respective prices for each date. These diagrams are shown in Figs. 1, 2, and 3. Observation of these diagrams showed the relationships to be linear and they were analyzed as such.

The procedure at this point was to attempt to estimate general relationships and this was done by ignoring interrelationships and by examining the data in terms of the prices and
Fig. 1. Scatter diagram showing pounds of beef sold at corresponding prices. A - A' is line of regression of quantity of beef sold on price of beef.
Figure 2. Scatter diagram showing pounds of ham sold at corresponding prices. A-A' is line of regression of quantity of ham sold on price of ham.
Fig. 3. Scatter diagram showing pounds of fryers sold at corresponding prices. $A - A'$ is the line of regression of quantity of fryers sold on the price of fryers.
Fig. 4. Diagram showing the changes in the prices of beef, ham, and fryers from time period to time period.
quantities sold of each of the classes of meat considered. The quantity sold was considered the dependent variable and the price the independent variable in each case.

Since the study was to be chiefly concerned with beef, a pertinent functional relationship was as follows:

\[(1) \quad Q_b = (f)P_b \]

where \(Q_b\) is the quantity of beef demanded and \(P_b\) is the average price retail of beef during the same time period. The following equation shows the quantitative relationship found to exist:

\[(2) \quad Q_b = 52.95 - 0.2524P_b - 0.54428 \quad (r = -0.1727)\]

The relationship outlined in equation (2) is shown in Fig. 2. The negative coefficient from regression was as was expected and was taken to mean that an increase in the price of beef would be followed by a decrease in the quantity of beef demanded.

The corresponding price elasticity of demand for beef was found to be \(-0.39\). This coefficient is indicative of the reaction of the demand for beef to a change in the price of beef. A negative coefficient of \(-0.39\) meant that a one percent increase in the price of beef would be expected to be followed by a 0.39 percent decrease in the quantity of beef demanded.

The elasticity of the demand for beef was estimated on the basis of the following ratio:

\[(3) \quad e = \frac{\text{change in } P}{\text{change in } Q} \times \frac{5}{P}\]

The symbol "e" designates the coefficient of elasticity which is a ratio in this case determined for a single point at the center
of the demand function. The ratio is secured at that point by the use of the average $P$ and the average $Q$ ($\bar{P}$ and $\bar{Q}$).

The coefficient of correlation in equation (2) i.e., $-0.1727$ was found to be nonsignificant at the five percent level (significant only at the forty percent level) and the standard error from regression was i.e., $-0.54428$ found to be relatively high, which would indicate that the data did not fit the regression lines as well as had been expected.

In an investigation of the relationship between the quantity of beef sold and the price of ham it was assumed that the quantity of beef sold was some function of the price of pork, that pork was a substitute for beef, that ham could be used as a representative for pork as a meat substitute, and that the functional relationship between ham and beef was as follows:

\[(4) \quad Q_b = (f)P_h\]

Where $Q_b$ represents the quantity of beef demanded and $P_h$ represents the price of ham. The relationship found to exist was as follows:

\[(5) \quad Q_b = 55.39 - 0.2538 \, P_h \quad (r = -0.4864)\]
\[0.1311 \quad (e = -0.1896)\]

At this point an investigation was made in an attempt to discover the reason for the unexpected high standard error from regression and the non-significance of the results. It was thought that the lack of price variation found in the original sample was responsible for this lack of significance. This lack of variation is illustrated in Fig. 4 which shows the
price variation throughout the period of the study and emphasizes
the fact that the changes in price leave many of the changes in
quantity demanded unexplained.

The interrelationship found between ham and beef proved to be the opposite from that which was expected. The regression coefficient was found to be negative which would indicate that an increase in the price of ham would be followed by a decrease in the quantity of beef demanded. The negative coefficient in itself would indicate that ham was not competitive with beef. If this were the case, it would be almost certain that ham would not represent the entire class of "pork." Logic indicates and studies have shown that pork is a substitute for and is competitive with beef. (Fox, II, p. 1.) A more feasible explanation is that the regression coefficient was non-significant at an acceptable level (this coefficient was found to be significant only at the thirty percent level). Thus any inferences or implications are subject to question. Possibly ham is considered somewhat of a luxury item and actually does not compete with beef.

In an investigation of the relationship between the price of fryers and the quantity of beef demanded it was assumed that fryers were competitive with beef and that fryers could be used to represent a class of beef substitutes "other meat," and that the following relationship existed:

\[ Q_b = (f)P_f \]

where \( Q_b \) represents the quantity of beef demanded and \( P_f \).
represents the price of fryers. The relationship that was found to exist was as follows:

\[ Q_b = 18.71 + 0.3866 P_f \]

\[ 0.5807 \]

\[ (e = 0.07596) \]

\[ (r = 0.14415) \]

The correlation coefficient found in this relationship proved to be non-significant at the five percent level. The high error term showed that the data did not fit the regression line as well as had been expected. The price cross-elasticity of demand for beef when the quantity of beef demanded was considered a function of the price of fryers was found to be 0.076. This would indicate that a one percent change in the price of fryers would be expected to be followed by a 0.076 percent increase in the quantity of beef demanded. While non-significance of the regression coefficient renders the elasticity coefficient somewhat meaningless, these results were directionally as were expected. Fryers constitute a relatively small proportion of meat supplies and would not be expected to exert much influence on the demand for beef.

At this point an attempt was made to define the relationship between a group of variables in a functional description of the demand surface that existed at the time this study was made. The foregoing two-variable equations were exploratory in nature and left out of the definition so many variables that were thought to affect the dependent variables that non-significant results from these equations could not be taken to assure that the results would continue to be non-significant when all of the
factors were considered together, although it could be taken to hint in this direction. The next step in the analysis of these data was the consideration of the functional relationship:

\[
(8) \quad Q_b = (f) P_b + P_h + P_f
\]

It was thought that this equation would reveal the interaction of variables that had previously escaped analysis. The equation that was found to exist was as follows:

\[
(9) \quad Q_b = 27.38780 - 0.07675P_b - 0.11763P_h + 0.44189P_f \\
1.04906 \quad 0.33789 \quad 0.93828
\]

This equation shows the relationships found to be present within these data. The coefficients of correlation proved to be non-significant at the five percent level in every case, but in the case of the price of beef and the price of fryers the signs were in the direction expected. The price of ham was found to consistently react in a manner other than that which was expected from a beef substitute. The analysis shows that an increase in the price of ham would be followed by a decrease in the amount of beef demanded.

There were two facts of this analysis that were unexpected and for which some explanation must be sought. The first was the high standard errors from regression which were thought to be largely responsible for the numerical non-significance of the derived coefficients. These disappointing results were thought to have been influenced by the lack of variation found in the original data where the changes in price from week to week were found to be very small. These small price changes
would be expected to leave the changes in quantity largely unexplained. A possible factor in the small price changes was the failure of certain stores to cooperate fully. This would tend to weight the sample toward the average and leave quantity variations unexplained.

A second unexpected result was the failure of ham to react as a beef substitute was expected to react. Even though the correlation coefficients were found to be non-significant, some importance must be given to the fact that the price of ham consistently showed a negative correlation with the quantity of beef indicating that an increase in the price of ham would be followed by a decrease in the quantity of beef demanded—an opposite reaction to that expected.

A possible reason for this was the luxury status of ham. It is possible that the price of ham was high enough so that ham was not a good representative for pork. It would also follow (if the assumption were made that beef were the more desirable type of meat) that at the same time people increase the amount of beef they buy, they increase the amount of ham they buy. Thus the quantity of ham demanded and the quantity of beef demanded would increase and decrease together. This could have contributed to the dubious status of ham as a beef substitute.
SUMMARY AND CONCLUSION

Three sets of data were analyzed in this study in an effort to estimate the structure of the demand for beef. The data concerned beef, pork, and poultry. The initial data were processed, adjusted, and analyzed in an attempt to fit these empirical data into an abstract model constructed under certain a priori assumptions.

The price and quantity demanded of beef, and the price and quantity demanded of pork and the price and quantity demanded of fryers for a part of Wichita, Kansas, for a ten-week period (March through May, 1955) were collected for retail cuts of beef and pork and for fryer chickens. These data were processed and adjusted to yield an estimated average retail price for beef, ham, and fryers, and an average retail quantity sold of beef, ham, and fryers. These classes were designed to represent beef and beef substitutes and to do so as efficiently as possible.

Scatter diagrams were constructed in an initial phase of the analysis. These diagrams were designed to reveal the more obvious relationships and to be useful in labeling linear and non-linear relationships.

On the basis of the linearity observed in the scatter diagrams and on the basis of previous research done by well known authors in this and similar fields the analysis was carried on using linear, single equation methods. Regression lines were fitted to the scatter diagrams. A multiple regression analysis was made in an attempt to estimate the relationship
between the three independent variables—the price of beef, the price of ham, and the price of fryers—and the quantity of beef demanded at retail which was considered as the dependent variable.

In each attempt the coefficients discovered were non-significant and the standard errors from regression were high. However, the price of beef and the price of fryers yielded correlation coefficients that were directionally as had been expected. It was found that an increase in the price of beef was followed by a decrease in the amount of beef demanded and an increase in the price of fryers was followed by an increase in the quantity of beef demanded—the expected reaction, since it was expected that fryers would be a beef substitute.

The reaction of the quantity of beef demanded to changes in the price of ham was the opposite of that expected. It was found that an increase in the price of ham was followed by a decrease in the amount of beef demanded. This could have been caused by the price of ham being high enough to place it in a luxury class of meats and causing changes in the demand for ham to correspond with changes in the demand for other more desirable classes of meat. This being the case, it would follow that ham was not a beef substitute. Ham, on the same grounds, would not be a good representative for all classes of pork. Non-significance of statistical results, however, make such conclusions very dubious.

Since one of the sub-objectives of this study was to
estimate roughly the worth of a sample of this type, an attempt was made to survey the study and to ascertain whether or not the study would have been helped by changing the sample. It is possible that a sample over a greater period of time or a greater area would have improved the estimates presented, and a larger amount of information about a larger number of variables would have enabled more precise conclusions. It was thought that the conclusions were limited by the limited sample. Had the operators of the stores taking part in the survey cooperated fully it is possible that the results would have been more definite and the estimates from them more precise.
ACKNOWLEDGMENT

Grateful acknowledgment is extended to Dr. George Montgomery, Professor and Head of the Department of Economics and Sociology, and to the Department of Economics and Sociology of Kansas State College for the opportunity and assistance provided in making this study possible.

The author gives special recognition to his major instructor, Dr. John H. McCoy, Associate Professor, Department of Economics and Sociology, for his assistance and direction, and to Lawrence W. Van Meir who planned and directed the original survey and the collection of data.
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APPENDICES
## APPENDIX I

### Retail Price Information

<table>
<thead>
<tr>
<th>Date</th>
<th>Store No.</th>
<th>Cutting Information*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### I. Beef

#### A. Forequarter

1. Rib roast, 7 in cut
2. Blade rib roast
3. Blade chuck roast
4. Arm chuck roast
5. Short ribs
6. Plate beef
7. Brisket
8. Foreshank, center cut
9. Neck, boneless
10. Trimming used for grinding

#### B. Hindquarter

1. Heel of round
2. Round steak, bone in
3. Rump roast
   a. bone in
   b. bone out
4. Sirloin tip
5. Sirloin steak
6. Pinbone steak
7. Porterhouse, T-bone, club steaks
8. Flank steak
9. Boneless stew
10. Ground beef
11. Kidney

### II. Pork

#### A. Loins

1. Shoulder end roasts
2. Center cut pork chops
3. Rib end roasts

#### B. Boston Butts
C. Picnics

1. Cured ready to eat
   - 4 - 6 lb.
   - 6 - 8 lb.

2. Cured
   - 4 - 6 lb.
   - 6 - 8 lb.

D. Sliced packaged bacon
   (list 4 most important brands handled)

   1. [Blank]
   2. [Blank]
   3. [Blank]
   4. [Blank]

E. Hams

1. Cured ready to eat
   - 12 - 16 lbs.
   - 16 - 18 lbs.

2. Cured
   - 12 - 16 lb.
   - 16 - 18 lb.

F. Pork sausage (i.e., prepared in meat department from pork trimmings).

III. Other

A. Fryers

B. Minced Ham

* Please indicate any additional information that you might consider useful for this study such as cuts that are boned out for stew meat or grinding, any cutting tests you care to report, and cuts that may be retailed in a somewhat different manner (example—rib roast sold as rib steaks).
# APPENDIX II

## Quantity of Meat Sold at Retail

<table>
<thead>
<tr>
<th>For Week Ending</th>
<th>Store No.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Beef</strong></td>
<td></td>
</tr>
<tr>
<td>A. Full sides</td>
<td></td>
</tr>
<tr>
<td>Choice</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>B. Forequarters</td>
<td></td>
</tr>
<tr>
<td>Choice</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>C. Hindquarters</td>
<td></td>
</tr>
<tr>
<td>Choice</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>D. Chucks</td>
<td></td>
</tr>
<tr>
<td>Choice</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>E. Rounds</td>
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<tr>
<td>Choice</td>
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<tr>
<td>Good</td>
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</tr>
<tr>
<td>F. Loins</td>
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</tr>
<tr>
<td>Choice</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>G. Boned out grinding meat</th>
<th>Quantity</th>
<th>Inventory price</th>
<th>Week ending inventory</th>
</tr>
</thead>
</table>

| **II. Other meats** |           |
| A. Fryers           |           |
| B. Minced ham       |           |

| **III. Pork**       |           |
| A. Loins            |           |
| 1. 8 - 10 lbs.      |           |
| 2. 12 - 16 lbs.     |           |
| B. Boston butts     |           |

<table>
<thead>
<tr>
<th>Invoice Price</th>
<th>Pounds sold this week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### C. Picnics

<table>
<thead>
<tr>
<th>1. Cured ready to eat</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 4 - 6 lbs.</td>
<td></td>
</tr>
<tr>
<td>b. 6 - 8 lbs.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Cured</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 4 - 6 lbs.</td>
<td></td>
</tr>
<tr>
<td>b. 6 - 8 lbs.</td>
<td></td>
</tr>
</tbody>
</table>

### D. Sliced packaged bacon

(List most important brands handled)

<table>
<thead>
<tr>
<th>1.</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>2.</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>3.</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>4.</th>
<th></th>
</tr>
</thead>
</table>

### E. Hams (specify brands handled)

<table>
<thead>
<tr>
<th>1. Cured ready to eat</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 12 - 16 lbs.</td>
<td></td>
</tr>
<tr>
<td>b. 16 - 18 lbs.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Cured</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 12 - 16 lbs.</td>
<td></td>
</tr>
<tr>
<td>b. 16 - 18 lbs.</td>
<td></td>
</tr>
<tr>
<td>c. 18 - 20 lbs.</td>
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APPENDIX III

It was noted that retailers buy meat in wholesale lots, break it into retail cuts in their own stores and in almost every case sell retail cuts. One of the problems of this practice is keeping all the cuts moving at the same rate. A retailer who is not alert to this problem will find that his best cuts sell well, but that the less desirable cuts sell too slowly (or vice versa). The problem is (usually) that the more expensive cuts do not move as rapidly as do the rest of the cuts and since meat cannot be held for a great length of time the retailer normally takes steps to sell these slower moving cuts of meat. These steps may include special advertising, special merchandising, reducing the price and/or boning out this meat and selling it as ground meat. Special advertising and special merchandising are effective for minor imbalances, but when a large amount of meat must be moved the remedy is to either lower the price or sell it as ground meat—or both. The storekeeper is reluctant to lower his prices on his better cuts of meat in the shortrun and will almost always grind and sell them as ground meat before he will lower his price.

If the storekeeper finds that he must sell more ground meat than usual he will often lower the price of ground meat in order to move this greater amount of ground meat. On the basis of this observation it was submitted that a fall in the price of ground meat will precede a drop in the quantity of beef purchased at
wholesale and will be the first signal of a decreased quantity sold at retail. This hypothesis was investigated briefly and a positive correlation of 0.1872 was found between changes in the price of hamburger and the quantity of beef demanded at wholesale. The coefficient of regression was found to be 0.14714, and variance of the residuals 0.9006 and the estimated standard error of the regression coefficient 0.2918.

On the basis of the above information it could be said that some evidence was found of a positive relationship between the price of hamburger and the quantity of beef demanded, but that this relationship was not clear enough to use as a basis for any precise predictions. It is very possible that a decrease in the price of hamburger could be regarded as an indicator of a decrease in the retail demand for beef in the very short-run.
A PARTIAL ANALYSIS OF THE DEMAND FOR PEEF
AT RETAIL IN WICHITA, KANSAS

by

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B. S., Kansas State College
of Agriculture and Applied Science, 1954

AN ABSTRACT OF A THESIS

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The theoretical basis for the procedure used in this study of demand was found to lie within the utility decisions of the individual. The group, of which the individual is a member, exhibits measurable tendencies which can be viewed as indicative of individual value considerations and which can be used as a practical basis for the study of demand.

Through empirical demand analysis real values can be obtained for many of the theoretical relationships, and the answers to many of the questions regarding the structure of the market for the items in question can be discovered on the basis of these real functional values.

This study was an attempt to derive the demand function and the elasticity of demand for beef with respect to the price of beef, and to determine the functional relationship between beef and certain beef substitutes by using a static theoretical model. Prices of certain cuts of beef were obtained twice weekly from a sample of stores in Wichita, Kansas, during a 10-week period and data regarding wholesale quantities of meat sold by these stores were collected for the same period. Certain assumptions were made regarding the stability of income, changes of consumer tastes, changes in the production of both beef and beef substitutes and changes in the population during this short period, and within these assumptions these variables were non-significant values.

Pork and certain other processed meats were assumed to compete with beef. Pork was assumed to be the chief competing
commodity. Ham was chosen to represent all types of pork as a beef competing item and fryer chicken was chosen to represent "other meats".

The individual prices of each cut of beef were weighted on the basis of the percentage of the carcass which that particular cut represented and all these prices were composited to obtain a retail-carcass price for beef. Semi-weekly prices were then aggregated to obtain an average weekly price that would match those data concerning the quantity of beef moved by each store.

An average weekly price for ham was gotten by averaging the two prices reported for each type of ham each week and averaging the weekly price of all types into a single weekly price. The quantity data were the pounds of ham sold during this period. The weekly price of fryers was obtained similarly and was an average weekly price for fryers. The quantity of fryers sold during a particular week was used as the respective quantity figure. It was recognized that approximately half of the meat sold each week was sold on the week end. On this basis the week end price was given the same weight as was the week day price in the calculation of the average weekly price.

In the analysis of these data it was assumed that the quantity of beef sold was the dependent variable in each case. Preliminary analysis was made in each case in an attempt to determine linearity and other obvious basic relationships. These two-variable analyses were:
(1) \( Q_b = (f) P_b \)  
(2) \( Q_b = (f) P_h \)  
(3) \( Q_b = (f) P_f \)  

A pertinent equation was the relationship between the quantity of beef and the price of beef. A regression analysis on these data showed a price elasticity of beef of \(-0.39\). However, the coefficient from regression proved to be non-significant at any acceptable level.

A further analysis was made in which each of the variables that were analyzed in this study were included and from which some attempt was made to partially describe the structure of the demand for beef at this specific market for this certain time. The relationship assumed to exist was:

(4) \( Q_b = (f) P_b + P_h + P_f \)

Where \( Q_b \) represents the quantity of beef in pounds sold during a certain specified period in the market defined by the study, \( P_b \) represents the respective price of beef for this time and market, \( P_h \) represents the price of ham in the specified market and for the specified time, and \( P_f \) represents the price of fryers for the specified market and time. The equation found to exist was:

(5) \( Q_b = 27.38780 - 0.07675 P_b - 0.11763 P_h + 0.44189 P_f \)

\[ \begin{array}{c}
1.04906 \\
0.33789 \\
0.93828 \\
\end{array} \]

The interrelationship between the price of ham and quantity of beef demanded proved to be the opposite from that which was expected. The regression coefficient was found to be negative, which would indicate that an increase in the price of ham would
be followed by a decrease in the quantity of beef demanded. The negative coefficient itself would indicate that ham was not competitive with beef. If this were the case, it would be almost certain that ham would not represent the entire class of "pork". Logic indicates and other studies have shown that pork is a substitute for and is competitive with beef. A more feasible explanation is that the regression coefficient was non-significant at an acceptable level. Thus, any inferences or implications are subject to question. Possibly ham is somewhat of a luxury item and actually does not compete with beef.

The relationships between the quantity of beef and the price of fryers and the price of beef were found to follow the theoretical model directionally, however, the coefficients from regression were found to be non-significant at an acceptable level and inferences from these coefficients are subject to question.

The discovery of two outstanding and unusual facts deserves explanation at this point. The first is the high standard errors from regression which were thought to be largely responsible for the numerical non-significance of the derived coefficients. These disappointing results were thought to have been influenced by the lack of variation found in the original data where the changes in price from week to week were found to be very small. These small price changes would be expected to leave the changes in quantity largely unexplained. A possible factor in the small changes was the failure of
certain stores to cooperate fully. In such cases where the data were acceptable but not actually complete the average area price for that time period was used. This tended to weight the sample toward the average and leave quantity variations unexplained.

A second fact that was difficult to explain was the failure of ham to react as a beef substitute would be expected to react. Even though the correlation coefficients were found to be non-significant, some importance must be given to the fact that ham consistently failed to show the expected correlation coefficients with respect to beef. The most feasible explanation for this reaction was some combination of the luxury status of ham and the lack of significance discovered in the data, both of which could have contributed to the dubious status of ham as a beef substitute.

In the light of the results of this study, it would appear that a sample over a greater period of time and/or a greater area would have improved the estimates yielded, and a large amount of information about the larger number of variables would have enabled more precise conclusions. It is hoped that the results from this study can be used to guide future studies that can take advantage of the pitfalls discovered and more perfectly accomplish the same description of the demand for beef.