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 pro-
ducer 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 explan-
ation of changes of the price of meat over time is the quantity
of meat produced. (Working, 46, 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 be-
> havior 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 com-
plete 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 per-
form 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
accuate 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 suf-
ficiently 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 relevence 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 con-
siderations 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 founda-
tion 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 provid-
ing 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 combina-
tions 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 repre-
sent 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 in-
dividual 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
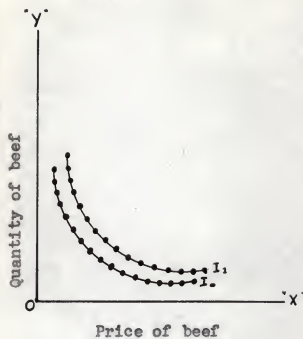consumption of beef.
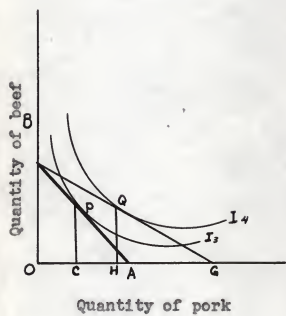
PLATE I

Fig. 1

Fig. 2

From the foregoing generalization of the theory of demand
it follows that certain fundamental factors determine the quan-
tity 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.)

PLATE II
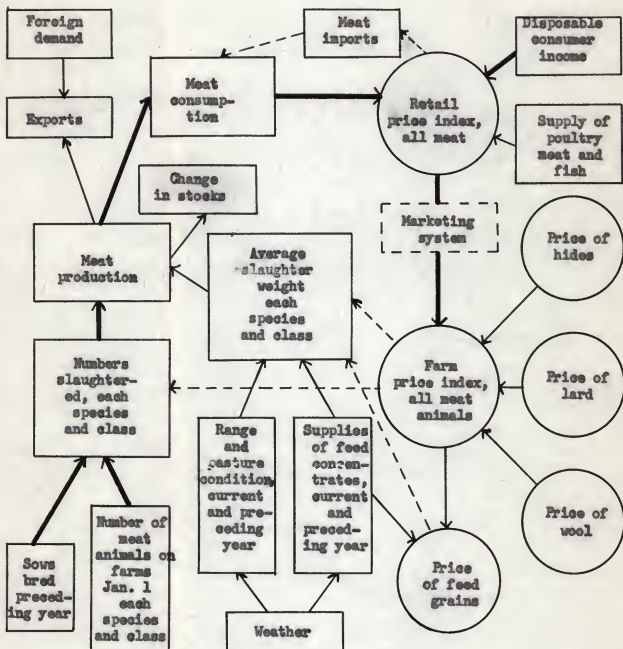
by evaluating the geometric sum of all their vectors. The researcher would then have a model showing the magnitude and direction of reaction that would follow from an action in every case. And from this model he could get any information desired, for it would all be there. This model could be observed 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. 4.)

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 relation-
ships 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, (con-
crete) objects, attributes, and relationships while a theoretical
or abstract system is a set of objects, attributes, and rela-
tionships 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 sub-
systems. 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:

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

There is one such equation for each individual. Together
they constitute n equations in n variables, $A_1\ldots\ldots\ldots A_n$. In
general these may then be solved to express the actions of all
individuals in terms of $P_1\ldots\ldots\ldots P_n$. (Arrow, 1, 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 antici-
pate 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 intro-
spection or casual observation, and they depend on the investi-
gator'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 relevent 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 in-
vestigation 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 relevent. 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 vari-
ables 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 com-
bination 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 rela-
tionships (one or more) mathematically, observes these variables
empirically, and substitutes the mathematical values into equa-
tions 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 simul-
taneously 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 euqations
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 struc-
tural 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 relation-
ship 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,
$Q_m = f(P_m, P_{s_1}....._n, Y_{t_1}....._n, T)$. 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 sub-
stitutes, $(P_{s_1}....._n)$; the national income in several time
periods, $(Y_{t_1}....._n)$; 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 pur-
chased" as well. It was not an objective of this study to
analyze the price of meat or the quantity of meat sold or de-
manded 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 sig-
nificantly 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
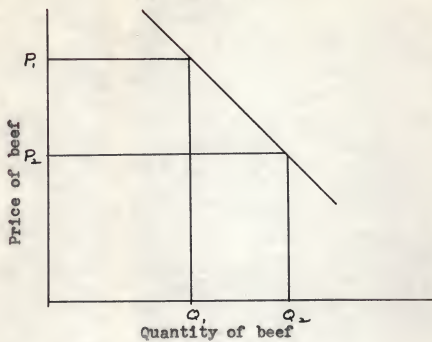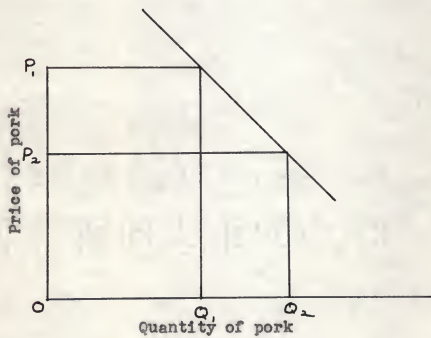demanded.

PLATE III

Fig. 1

Fig. 2

certain amount of pork and fryers. On the basis of this assump-
tion 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 O X represent the quantity
of beef demanded, and O Y 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 affect-
ed 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 de-
         manded 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
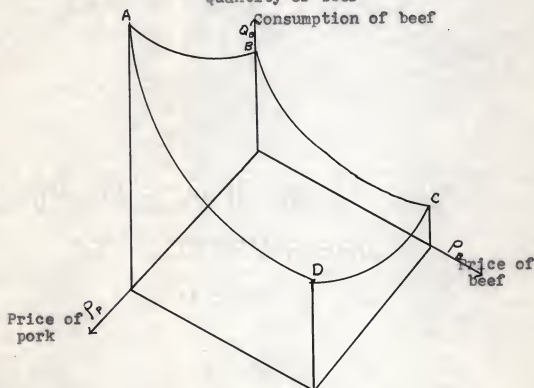   beef consumed.
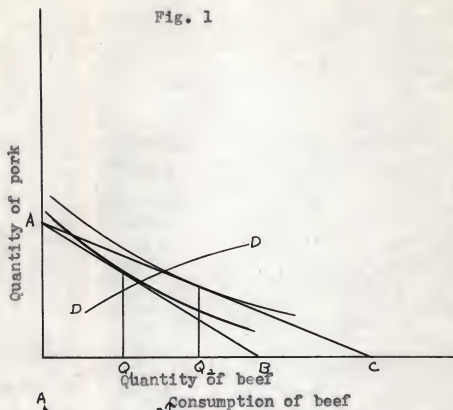
PLATE IV

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 question- naires. 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 repre- sent 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 out 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 sampe 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

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*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.

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

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 under-
standably 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 diffi-
cult 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 prob-
lem, comments:

> During the past few years my work in the United
> States Department of Agriculture has involved a con-
> siderable amount of statistical demand analysis. The
> object of this work has almost invariably been to ob-
> tain 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 rela-
tionships. 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 varia-

tion 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 interrela-

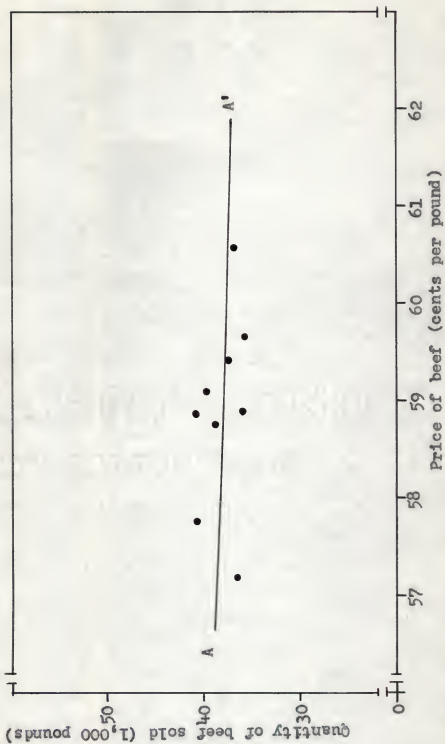tionships and by examining the data in terms of the prices and

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.
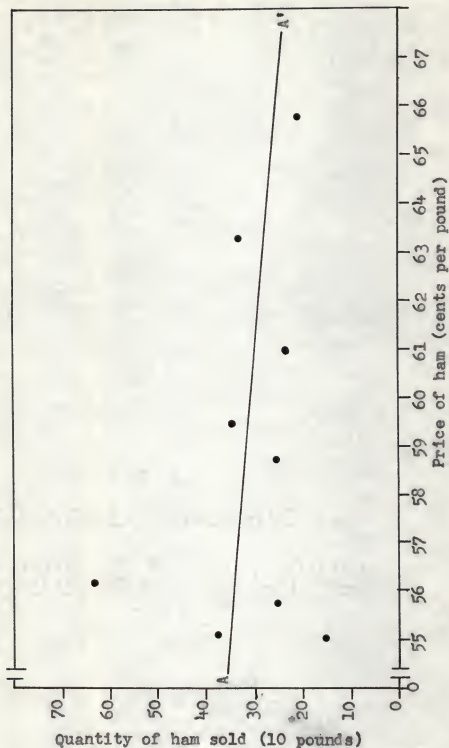
Fig. 2. Scatter diagram showing pounds of ham sold at corresponding prices. A - A' is line of regression of quantity of ham sold on price of ham.
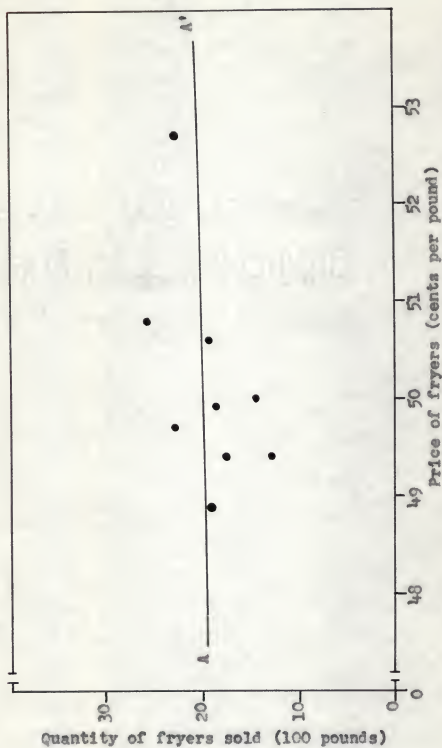
Fig. 3. Scatter diagram showing pounds of fryers sold at corresponding prices. A – A' is the line of regression of quantity of fryers sold on the price of fryers.
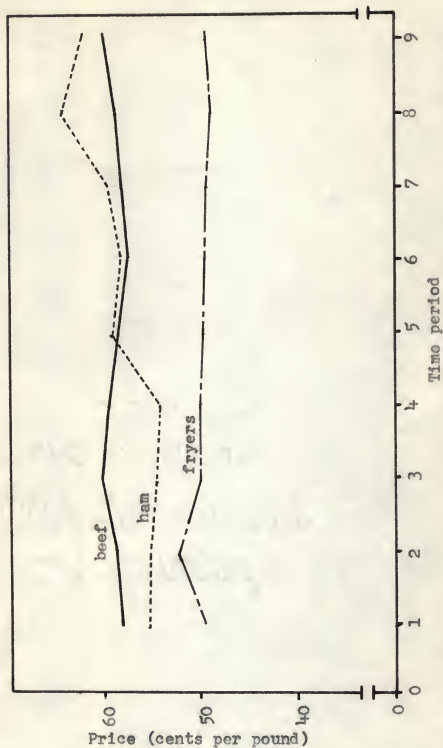
Fig. 4. Diagram showing the changes in the prices of beef, ham, and fryers from time period to time period.

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) $Q_b = (f)P_b$

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) $Q_b = 52.95 - 0.2524\ P_b$
$- 0.54428$ $(r = -0.1727)$

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 re-
action of the demand for beef to a change in the price of beef.
A negative coefficient of -0.39 meant that a one percent in-
crease 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) $e = \dfrac{\text{change in P}}{\text{change in Q}} \times \dfrac{Q}{P}$

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 ($\overline{P}$ and $\overline{Q}$).

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) $\quad Q_b = 55.39 - 0.2538\ P_h \qquad (r = -0.4864)$
$\qquad\qquad\qquad 0.1311 \qquad\qquad (e = -0.1896)$

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, 11, 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:

(6) $Q_b = (f)P_f$

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:

(7) $Q_b = 18.71 + \dfrac{0.3866}{0.5807} P_f$ $(e = 0.07596)$
                                        $(r = 0.4415)$

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 con-
sidered 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 in-
crease 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 relation-
ship 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 inter-action of variables that had previously escaped analysis. The equation that was found to exist was as follows:

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

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 con-sistently 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 un-
explained. 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 con-
sistently 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 con-
cerned 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-signifi-cance 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.

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APPENDICES

APPENDIX I

Retail Price Information

Date _____   Store No. _____

	Retail Price	Cutting Information*

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 stead
      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

	Retail Price	Cutting Information*

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. _____
    2. _____
    3. _____
    4. _____

E. Hams
    1. Cured ready to ear
       12 - 16 lbs.
       16 - 18 lbs.
    2. Cured
       12 - 16 lb.
       16 - 18 lb.

F. Pork sausage (i.e., pre-
   pared 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

For Week Ending _____   Store No. _____

		Number	Av. Weight	Inv. Cost	Week ending inventory	Use
I.	Beef					
A.	Full sides Choice Good					
B.	Forequarters Choice Good					
C.	Hindquarters Choice Good					
D.	Chucks Choice Good					
E.	Rounds Choice Good					
F.	Loins Choice Good					

		Quantity	Inventory price	Week ending inventory
G.	Boned out grinding meat			

II.	Other meats			
A.	Fryers			
B.	Minced ham			

		Invoice Price	Pounds sold this week
III.	Pork		
A.	Loins		
	1. 8 - 10 lbs.		
	2. 12 - 16 lbs.		
B.	Boston butts		

	Invoice price	Pounds sold this week

C. Picnics
    1. Cured ready to eat
       a. 4 - 6 lbs.
       b. 6 - 8 lbs.
    2. Cured
       a. 4 - 6 lbs.
       b. 6 - 8 lbs.

D. Sliced packaged bacon
(list most important
brands handled)
    1. _____
    2. _____
    3. _____
    4. _____

E. Hams (specify brands
handled)
    1. Cured ready to eat
       a. 12 - 16 lbs.
       b. 16 - 18 lbs.
    2. Cured
       a. 12 - 16 lbs.
       b. 16 - 18 lbs.
       c. 18 - 20 lbs.

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 prac-
tice is keeping all the cuts moving at the same rate. A re-
tailer 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 ex-
pensive 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 preceed 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 whole-
sale. 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 BEEF
AT RETAIL IN WICHITA, KANSAS

by

WILLIAM CALVIN MOTES

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

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AN ABSTRACT OF A THESIS

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requirements for the degree

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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) $Q_b = 27.38780 - 0.07675 \ P_b - 0.11763 \ P_h + 0.44189 \ P_f$
$ 1.04906 0.33789 0.93828$

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 conslusions. 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.