DEMAND ANALYSIS FOR SELECTED AGRICULTURAL PRODUCTS IN THE STATE OF SAO PAULO

A THESIS

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By

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CHAPTER I

INTRODUCTION

Agricultural Economic Development has been defined as a process by which agriculture of a country or state becomes more efficient or productive. The measurement of this development may be based on some indexes, the most common of which are output per unit of land, the total production per man, the improvement in the efficiency in processing, transporting and other marketing facilities.

At the present time, the agricultural sector of the State of Sao Paulo presents performance which enables one to classify it, if not fully developed, at least far from some which might be considered underdeveloped. The total production per man has been increased. The same may be said for production per unit of land, the infra-structure in transportation and marketing facilities shows improvement and increasing quantities of products are moving through the marketing channels each year. The use of new technology in production is well spread throughout the state farms.

This development has been done under peculiar conditions during the last 15 years. The fast rate of

urbanization and the general condition of inflation in the economy are factors which we can assume have been influencing the evolution of the sector as well as the basic structure in what agricultural production is performed. In fact, agricultural economists agree that agriculture in the State of Sao Paulo is in a stage of transition with significant changes in its structure.[1]

All these factors call our attention to the necessity for developing basic research in agricultural economics in order to detect the various determinants of the actual structure of agricultural production and its interrelation with other sectors of the Sao Paulo's economy. Within the field of agricultural economics, research in agricultural prices plays a major role, since it deal with elements which have direct relation to allocation of resources and farmer's income.

The aim of this study is to bring some understanding of the conditions of demand for selected agricultural products that can help farmers to decide about expected price conditions of their product, and policy makers to

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[1] R. A. Dias and C. C. Fraga, "Conditions and Trends in Sao Paulo's Agriculture," Agriculture in Sao Paulo, X (May June, 1963), pp. 2-4.

develop realistic suggestions about price policies under the changing picture of Sao Paulo's agriculture.

In a demand study, it can be used, the theoretical approach, which has found extended use, to illustrate market behavior. It is based on the observation that there is on one side a quantity of certain commodities, and on the other side, people who want it. Demand for the commodity expresses people's wants at different price levels.

In a competitive economy, it is assumed that buyers will purchase more of one good at lower prices than at higher prices. This fact has been so universally accepted that although there are some minor exceptions, it is known as the Law of Demand. This Law states that the Quantities that potential buyers are willing to purchase, at a given place and a given time, varies inversely with the prices. Translated into a more useful statement to farmers, the law says that the greater the quantity of a commodity offered for sale, the lower will be the price per unit at which the entire amount can be sold.

Almost all product offered for sale in the market follows the rules of the Law of Demand, but the

behavior of each commodity in response to a price change varies a great deal. For some commodities, a small change in price will bring about large increases or decreases in the amount sold, while others may show only slight change in volume with a change in price. The extent that quantities sold change in response to price changes is known as elasticity of demand.[2]

Although it is a very useful device to understand the difference between demand of various goods as well as price making forces in the market, the hypothetical approach has very little practical application in the current market conditions. It has two major assumptions: that all outside influences remain unchanged so only price and quantities are the variables and that individual consumers behave rationally in the market. These two assumptions render this approach a static theory without direct application to changing conditions since actually the above cited conditions do not exist in the market.

Applying static economics to changing market conditions will allow one to derive only a theoretical

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[2]Some theoretical aspects of demand and elasticity will be presented in Chapter III.

demand curve. By definition, this approach takes demand at a given point in time and place and, when this quantity-price relation is plotted in a graph, other points in the curve have to be predicted. This becomes guesswork since there are a great number of lines with different slopes which can be drawn through a point.

The dynamic[3] condition of a demand curve is obtained when time is used to explain it. Some situations do not repeat year after year in the same manner, but in two different periods of time, it is possible to measure different reactions to various prices and quantities. This is done by statistical means. The equating of supply and demand over a period of time will show the behavior of the buyers in the market under various conditions of these two variables. By selecting a specified period of time such as average daily, monthly, or yearly quantity-price relationships, the points can be plotted in a graph and a line fitted which represents the actual supply and demand relations observed during the

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[3]The meaning of dynamic conditions when applied in this study should be understood that the observed values of the variables changes over time. It can not be misinterpreted with the idea that the model changes its parameters and structures over time.

period of analysis. The curve derived by this means can be called a comparatively static demand curve, that is, each observation represents different equilibrium conditions over time. Those factors which make demand change over time are called demand shifters, for instance income level, competing goods and consumption habits. A comparatively static demand structure includes not only relationship between price and quantity, but also the relationship of these two factors while the demand shifters vary through time. It is assumed that this relationship within the demand structure is stable through extended time periods. In this way, experience observed through data of past behavior may be useful in anticipating what can be expected in the future. This procedure may be used to hold the demand shifters constant and observe the true demand relationship.

The statistical approach is not an alternative to the hypothetical approach; it is only used to substantiate further the hypothetical approach.

The general outline of this study presents; the introduction explaining general aspects and justification of choice of statistical approach; the second chapter

pointing out the general purposes of the study; the third chapter presenting historical and basic concepts in demand theory; the fourth chapter explaining the methodology and procedure to derive comparatively static demand curves, which is one of the most important chapters because it shows how the theory is applied to practical problems and how data is adjusted for the various determinants of demand; the fifth chapter presenting statistical findings which will be quantified in statistical models so that estimates of the effect of price and quantity variations can be obtained; the sixth chapter analyzing implications of statistical findings; and the two last chapters presenting conclusions and bibliography.

The present work brings together some economic and statistical information concerning the demand elasticities and price structures of several important crops in the State of Sao Paulo.

Since agricultural output is planned and produced before the price is set by the market, the value of this type of research should prove helpful to producers.

CHAPTER II

PURPOSES OF THIS STUDY

The general purpose of this study is to estimate, by statistical means, demand curves for selected agricultural products in the State of Sao Paulo and to analyze the major factors affecting this demand so that an estimation of future demand and prices can be made. A specific objective of this study is to derive statistical parameters which will enable the estimation of price and income elasticities for different crops in the State.

A second objective of this study is to supply additional information to the policy formulators of the State of Sao Paulo so that they can make more realistic suggestions for the refinement of future agricultural price policies.

A further design of this study is to provide a methodological basis for further investigations into demand for agricultural products.

CHAPTER III

SOME ASPECTS OF DEMAND THEORY

A. HISTORICAL

A summary of the major events which are responsible for the development of the actual framework in theory of demand reveals that, by the time of J. S. Mill, the concept of demand was quite clear. Its logical role in the economy, however, was still obscure. The "classical economics" gave secondary importance to theory of demand to explain price behavior. The value theory or price was generally made to depend on what it cost to produce the commodity in question.

Although the classical school recognized different utilities and their relation to the value of goods, it did not refer to "marginal" or total utility.

Early developments in marginal concepts came with Gossen[4] and Jevon[5] in the period 1854-1871. The former

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[4]Herman H. Gossen, The Development of the Laws of Exchange among Men and of the Consequent Rules of Human Action, (1854).

[5]W. S. Jevons, Theory of Political Economy, (2nd. ed.; London: MacMillan & Co., 1886).

gave his major contribution to economics in an explanation of the subject which later became known as the principle of marginal utility and its application to value and price. Jevon, not only developed the theory of marginal analysis, but changed the emphasis of it to study demand. He based the explanation of value upon utility.

During the two decades 1871-1891, the so called "Austrian school," led by Karl Menger,[6] fully developed the marginal utility economics.

By this time, Alfred Marshall, who was a critic of classical economics in the strict sense, synthesized the cost of production theory of the classical school with the marginal utility theory of the Austrians and developed a new theory recognized as neo-classical economics.

In his Principles of Economics,[7] published in 1890, Marshall developed and popularized the concept of demand. He stated that there is a Law of Demand of such a nature that larger quantities will be purchased at lower prices then at higher prices and that "The one universal rule to

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[6]Karl Menger, Foundations of Political Economy, (Vienna: 1871).

[7]Alfred Marshall, Principles of Economics, (London: MacMillan & Co., 1890).

which the demand curve conforms, is that it is inclined negatively throughout the whole of its length."[8] Marshall used the Law of Diminishing Marginal Utility to explain the Law of Demand in a condition of partial equilibrium, that is, the relation of various quantities purchased at different prices were analyzed on the assumption that all other factors which can influence demand were held constant.

The next important theoretical contribution toward the development of demand came from the members of the Lausanne school, commonly known as the mathematical school. The members of this school, particularly Pareto,[9] objected to the partial equilibrium theory of Marshall and the assumption that utility is something measurable. Pareto utilized the indifference curves[10] of F. Y. Edgeworth[11] in place of the usual demand curve. The new in-

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[8] Alfred Marshall, Principles of Economics, (London: MacMillan & Co., 1920), III, p. 99.

[9] V. Pareto, Manuel d' Economie Politique, (Paris: V. Giard & E. Briere, 1909).

[10] An indifference schedule consists of the various combinations of two goods which will yield a consumer the same total satisfaction. There is a family of curves, each one representing one level of satisfaction.

[11] Francis Y. Edgeworth, Mathematical Psychics (London: C. K. Paul & Co., 1881).

difference curves were to replace utility postulates by postulates based upon observable behavior and the nature of the demand schedule was to be determined under the general equilibrium approach. Despite attempts by Pareto and other subsequent writers, no success was achieved in developing an indifference map from a whole series of indifference curves by means of empirical data.

In the last thirty years, further light to understanding of demand is due to the writings of Hicks and Allen.[12] They developed the indifference analysis. The major assumption of this theory is that consumers have a scale of preferences and there are areas or pairs of commodities to which consumers are indifferent. In this analysis, they substituted the Diminishing Marginal Utility concept for the Principle of Diminishing Rate of Substitution.[13]

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[12] J. R. Hicks and R.G.D. Allen, "A Reconsideration of The Theory of Value," Economica, I (February and May, 1934), pp. 52-76, 196-219. See also, J. R. Hicks, Value and Capital, (2nd.Ed. Oxford University Press, 1946) and J. R. Hicks, A Revision of Demand Theory, (New York: MacMillan & Co., 1956), p. 189.

[13] This principle states that as additional units of one commodity are added, the marginal rate of substitution of this commodity for the other falls, that is, progressively less of the other commodity will be necessary to replace units of the first in order to maintain the same satisfaction.

At the present time the explanations for the Law of Demand rests upon these two Principles - The Diminishing Marginal Utility and The Diminishing Rate of Substitution. To some extent, the two methods supplement each other. Both theories assume that commodities are divisable into small units, that consumers are rational and that they seek to maximize satisfaction. In short, both theories employ precisely the same equilibrium conditions.[14]

B. BASIC CONCEPTS

1. Individual demand

The demand of an individual buyer for a product is a schedule of the quantities of the product the person would buy at various possible alternative prices in a certain interval of time. If it would be plotted in a graph these quantities and prices and connect those points by a continuous line, the result would be a demand curve.

2. Market demand

Normally, in a particular market there is a great number of buyers, each one with his individual

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[14] H. H. Liebhafsky, The Nature of Price Theory, (Illinois: The Dorsey Press, Inc., 1963).

demand schedule. If we add all these schedules, we will have the total quantities that would be purchased by all buyers in a particular market at various prices, and in a given interval of time. This concept is known as market demand or just demand.[15]

3. Isolation of the influence of prices upon quantity demanded.

The quantities that buyers will take off the market depend upon a number of considerations beside the prices which must be paid. It depends upon buyer's income, preferences, accumulated wealth, prices and quantities of other goods, and expectation of future prices. In a particular demand schedule these factors are assumed to be given and fixed in order to isolate the net effect of price changes upon quantity purchased.

4. Changes in demand.

A change in demand must be clearly distinguished from a change in quantity demanded resulting from a price change. A change in demand implies a shift in the schedule and generally is caused by the givens cited above. On the

[15] In the case of a homogeneous product offered for sale, this concept of market demand is more precise than in the case of product differentiated. When buyers have their preferences for brand or particular producers, this concept although still useful, becomes less precise.

other hand, a price change influencing quantity purchased does not involve a change in the level of the schedule but merely movement along an existing curve from one point to another.

5. The nature of demand schedule.

According to the Law of Demand, the nature of demand schedule, both individual and total, is such that larger quantities will be purchased at lower prices than at higher prices. The derivation of this law by logical analysis came from the assumptions that a. consumers try to maximize satisfaction, b. consuming units have limited income, c. as additional units of a good are purchased, the power of these units to satisfy wants decreases, and d. changes in the amount purchased of one good do not induce changes in the want-satisfying power of other goods.

There are two approaches to the explanation of the Law of Demand - The Marginal Utility Approach and The Indifference Curve Approach.

The derivation and explanation of the Law of Demand by these two approaches are left to the textbooks.[16]

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[16]For a most comprehensive explanation about the subject see: John F. Due and Robert W. Clower, Intermediate Economic Analysis, (Illinois 4th. ed.: Richard Irwin, Inc., 1961).

In short, both approaches employ the same assumptions to prove that as the price of a commodity declines, the quantity taken will increase mainly as a result of two different effects - the income effect and substitution effect. The first, because as price reduces, it frees purchasing power and allows consumers to buy more of this good without sacrifice of other goods, and the second, because a reduction in price encourages relative substitution of this commodity for others whose price remain unchanged.

6. Elasticity of demand.

The typical demand schedule displays an inverse relationship between price and quantity. Although a series of price reductions for any good will ordinarily induce a corresponding series of increases in quantity bought (tastes, purchasing power, price expectations, and other prices remaining unchanged), the rate at which quantity responds to price may vary widely. A 10 per cent reduction in the price of one commodity might bring about 20 per cent increase in its quantity sold, whereas for another product a 10 per cent reduction might be accompanied by a rise of only 2 per cent in sales. The

demand for the first good is much more responsive to price changes than that for the second. It is generally said that the the first product has a more elastic response to percentage change in price. The rate of response of total expenditure for a good to change in its price are known as the elasticity of its demand.

The definition of elasticity of demand is phrased in terms of percentage changes in quantity per unit percentage change in price, and it is related to the slope of demand curve. Elasticity may be stated as a number without units obtained by dividing the percentage change in quantity demanded by the percentage change in price. The basic formula is[17]

$$E = \frac{\frac{\text{change in quantity}}{\text{Quantity}}}{\frac{\text{Change in price}}{\text{Price}}}$$

If the absolute value of this relation is less than one, the demand is called inelastic, if it is more than one, the demand is called elastic and if the value is one, the demand has a unitary elasticity.

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[17] A minus sign precedes all the values obtained because price and quantity change in opposite directions. In practice, however, it is usually omitted.

The ease and degree of substitutability of one product for another is the basic determinant of elasticity of demand for a particuler commodity. The consumer behavior related to degree of substitutability depends upon a series of factors - absolute physical need for one product and not another, durability of the product, social or psychological factors affecting consumption habits, religious customs, and the level of income itself.

Commodities with inelastic demand are often those which fall into the classification of necessities and which have few substitutes. The consumer wants them and is relatively insensitive to price changes. Food, as a whole, has inelastic demand.

Commodities with elastic demand are often those whose use is not directed by necessity or habit and which have several substitutes. Consumers response for such products is more sensitive to price changes. Luxury goods fall into this category.

Elasticity may change in all segments of a demand curve and may also change through time. For example, demand for an agricultural commodity may be inelastic when

the price is very high, elastic when the price in the middle range and inelastic again when the price is extremely low.

The most important implication of demand elasticity is its effect on total outlay, that is the total amount of money received from selling different quantities at varying prices. For a product with unitary elasticity of demand, as a result of a cut of 10 per cent in prices, the quantity taken would increase 10 per cent and the total returns from sales under the new situation would be exactly the same as before the price cut. For a commodity with a elastic demand, the quantity taken would increase more than 10 per cent and the total returns from sales would be greater than before. However, for a commodity with an inelastic demand, something less than 10 per cent more of the commodity would be taken and the total returns would be less.

7. Level of the demand schedule.

Earlier in the chapter we noticed that a particular demand schedule, for the period which is relevant, assumes that some related factors remain unchanged. Actually these factors are not fixed and their changes determine the shifts

in the level of the demand schedule.

a. Consumer preferences - the intensity of consumer preferences have influence in the quantity purchased. Individual preferences are conditioned by many elements.[18] Such as customs and traditions, reactions of individual choices to various alternatives, etc. One of the significant factors in determining demand for a good is the relative preference for this good compared with other goods. Thus, changes in relative preferences results in shifts of the demand schedule. Changes in occupation, number of dependents, state of health, etc., alter preferences and consequently demand.

b. Income - changes in income is one of the most important factors affecting purchases of various goods. Some goods, such as basic needs, show very little response to income changes. They are acquired whether consumers income is high or low. However, with other goods, the response to income changes are substantial. The degree of response of consumers purchases to an increase in their income is known as income elasticity.

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[18] Explanation of consumer preferences goes far beyond the scope of economics and for the purpose of this study they must be assumed to be given.

Generally speaking, income elasticity is positive since the increment in income enables consumers to satisfy their wants more fully by the acquisition of additional goods. However, a group of goods, known as inferior goods have negative income elasticity. Consumers buy less of these products as income increases, substituting for them higher priced and better quality goods.

c. Prices of other commodities - the influence of prices of other commodities in the demand for a particular commodity depends upon the degree of substitutability of the latter for the former. Price levels of close substitutes have more influence than others that are not directly substitutable. For instance, it would be expected that the price of apples is more affected by the price of pears than by the price of gasoline. If the prices of other goods, especially close substitutes, changes, they will shift the demand schedule for the particular good. The measure or the degree of influence of prices of other goods in the demand for a particular good is known as cross-elasticity of demand.[19]

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[19]Cross elasticity of demand is the relation of percentage change in the quantity demanded of one good which occurs in response to a particular percentage change in price of another good, the price of the first good remaining constant.

d. Expectation about future prices - this factor is important in determining the height of the demand schedule. Consumers react buying more quantities in anticipation of a price increase, or if a decrease in price is expected, they may reduce current purchases drastically. This influence has effect for a given interval of time because consumers cannot indefinitely buy in advance for future wants or postpone indefinitely the satisfaction of their actual wants if the expected price change fails to happen.

e. Number of potential buyers - the population growth has a significant influence on the level of the demand schedule, generally increasing demand. Other factors related are the reduction of imports and the trade barriers, making possible the access to all people to the market.

CHAPTER IV

METHODOLOGY OF ANALYSIS

A. The Economic Model

An economic model consists of a set of relationships between observed variables and a set of assumptions developed by the investigator concerning the nature of variations in the data which are not explained by the systematic relationship.[20]

The structural equations used in this study are those related to behavior of certain commodities in the market. Behavioral equations describe "a certain type of economic decision taken by a category of economic agents."[21] Demand and supply curves are examples of these equations.

In a dynamic market situation, demand for agricultural commodities is not only a function of prices and quantities, it should be taken as a function of general

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[20]Karl A. Fox, Econometric Analysis for Public Policy, (Iowa: The Iowa State College Press, 1958).

[21]T. C. Koopmans, "In Statistical Inference in Dynamic Economic Models," Cowles Commission for Research in Economics, Monograph No. 10, 1951.

factors explained by economic theory, specific factors peculiar to each commodity in a given period, and factors which are beyond the scope of economic theory such as sociological and psychological factors, but which cannot be disregarded in economic analyses.

In this work, it is assumed that the determinants of demand for agricultural commodities are:

1. Prices of specific commodity, Pf.
2. Quantity produced of specific commodity, Qp.
3. Price of competing goods, Pc.
4. Real Income, I.
5. Urbanization, U.
6. Population.
7. General level of all other prices.
8. General business conditions.

The equation that describes the economic relation stated in the model is:

$$Pf: Qp, Pc, I, U$$ [22]

Price of the specific commodity is considered an endogenous variable, that is, its values are determined by the structure. All other variables, 2 through 8, are considered exogenous or pre-determined, their current respective values are not influenced by current respective values of the other variables in the structure, in other words, their values are determined outside the structure.

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[22] A colon may be read "depends on" a comma may read "and". It is assumed that data are adjusted for the other determinants of level of demand, that is, population and general level of prices.

Generally, farm products satisfy the requirements of the model. With most of agricultural commodities, production is pre-determined in a sense that it is determined by economic factors existing at planting time and by exogenous factors occurring during stages of production such as weather conditions, and diseases.

For most of the important farm crops, producers are not in a position to control marketing by means of private agreement. For such crops the total quantity in the field is generally harvested and this harvesting production is for all purposes pre-determined.

Income is pre-determined in a sense that consumer's income is not influenced by current commodity prices. In relative terms, in countries where the level of income per capita is low, people spend more for food than in rich countries, but in analyzing a specific commodity we can assume that its prices do not affect consumer's income. Also, in countries where great part of population is engaged in agriculture, a change in prices of one important crop may affect farmers income and consequently a large part of consumer's income. However, this is not the case of the State of Sao Paulo which is largely an industrial economy and where the most important agricultural

commodity does not account for more than 17 per cent of farmer's total income. Changes in consumer's income are chiefly determined by changes in the level of investment and government expenditures.

One of the assumptions of this model, is that consumption equals production thus, it is a pre-determined variable. The lack of data on consumption brought the necessity to assume this identity.

Price of specific commodities is chosen to be the dependent variable. It is assumed that for the state as a whole, total production or consumption is more likely to be a given or pre-determined variable and the market price adjusts to it.

The model stated in this form can be called an uniequational complete model because it has only one endogenous variable and it is assumed that there is no correlation between the disturbances and the "independent" or pre-determined variables. Only the endogenous or "dependent" variable in this model reflects the effect of disturbance terms.

This economic model being complete permits the investigator to derive from it, equations to be used, with

a certain degree of accuracy, for analytical purposes and prediction.

B. The Statistical Model

Often research workers find it necessary to make additional and usually arbitrary assumptions about certain aspects of the structure of the model. These assumptions are required because the knowledge of economic and commodity behavior is not sufficient for the statistical analysis. The decision about the algebraic form of the relations is one example.

We refer to the set of structures consistent with all the specifications of the investigator (both economic and statistical) as the statistical model.[23]

1. Level where demand will be determined.

Different demand curves can be derived for one commodity depending upon the stage of marketing in which they are measured. There are demand curves for final consumers, retailers, wholesalers and farmers. In this study, however, it is the demand for farmers which it is

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[23] Richard J. Foote, Analytical Tools for Studying Demand and Price Structures, U.S.D.A Agricultural Handbook No. 146, (Washington D.C.: Government Printing Office, 1958), p. 7.

measured, using prices and production data at local farm market. The reason for the emphasis on direct demand at farm level is that for many agricultural commodities this is the most reasonable procedure to follow Agricultural commodities are largely raw materials which pass through several transformations before they reach the final consumers and to aggregate all those indirect demands is a rather difficult work since at the present time no data are available for it. For example, corn is transformed into livestock, manioc into starch, and sugar cane into granulated sugar. For other products such as rice and beans which are sold to consumers in the same form that they are produced, there are other kinds of demand curves, but they can be appropriately estimated at the level of local farm market.

2. Evaluation of data to be used.

Statistical demand curves are derived for the following products: corn, rice, potatoes, beans, tomatoes, oranges, onions, fat cattle, hogs, sugar cane, peanuts, manioc and castor beans. These products in 1962 were responsible for two-thirds of the gross income of Sao Paulo's agricultural sector.

Some important products such as coffee, cotton, bananas, eggs, and milk were not analyzed because their demand is influenced by factors for which data were not available. The first three products being export products, have their demand curve as a function of production of the country, production of other countries, international prices, tariffs and other minor factors. An attempt was made to derive demand curves for eggs and milk but the results were not significant. The quantity-price series available for these products were not appropriate to derive statistical demand curves at farm level.

The price series utilized in this research is the Average Price Received by Farmers in the State of Sao Paulo, published monthly and yearly by Rural Economics Division,[24] of the Secretary of Agriculture in Sao Paulo. This price that farmers receive at their local market is an average for all classes and grades produced within the State. It is weighted according to production and sales

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[24]For a detailed explanation of the methodology used to compute these prices see: R. A. Dias, "Computation of Average Prices Received by Farmers," Agriculture in Sao Paulo, VII (February, 1960), p. 37.

estimation of both surplus producing and deficit regions during the marketing season. The quantity series used in this study are those computed by Rural Economics Division for each crop year. Production data are estimated by statistical methods using a sample of farms in the State. There are three crop reports per year, each one revising the previous and preliminary figures. Besides the crop-report, Rural Economics Division has a number of correspondents who give their estimations of average yield in their communities. These weighted averages are compared with the crop-report in order to release the final production estimates.[25]

Data about personal disposable income for the State from 1948 to 1960 are those estimated and published by Getulio Vargas Foundation. Data for the last three years 1961 to 1963 were estimated by extrapolating the linear trend.

Data for urbanization are those presented in the Bulletin Agriculture in Sao Paulo X, Nos. 5 and 6. The figures were computed by Rural Economics Division from raw

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[25] For a complete explanation of crop-report estimation in the State of Sao Paulo, see: M. Zaroni, "Crop Estimation for the State of Sao Paulo," Agriculture in Sao Paulo, VII, (March, 1960), p. 45.

data of the Statistical Department of the State of Sao Paulo.[26]

The series of quantities produced, prices, income, and urbanization are the best available in the State for this kind of analysis. They can provide a sufficient degree of accuracy to yield good approximations of the true dynamic demand curve at local farm level. Even for products such as rice and beans whose local production is short in relation to the needs of consumers in the State, the results at local farm level should be representative.

3. Unit of time.

The nature of farm enterprise requires production to be measured on a yearly basis. The annual production cycle for most agricultural commodities and the importance of weather variations within the seasons mean that identical supply and price conditions seldom persist for more than a year at a time. The amount produced and to be placed in the market are partially based on decisions made by farmers in advance to the harvest and marketing season. Generally, the size of the crop in a particular year will

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[26] Dias and Braga, Op. cit. p. 19.

set the yearly price. For these reasons, yearly production and yearly average price data is used representing the specified time period for each separate measure.

4. Period to be analyzed.

The data on these thirteen products covers the period 1948 to 1963. However, this period shows changes in the conditions of the economy, probably too great to constitute a homogeneous period for the analysis. Data on general index of prices and urbanization suggest that the basic structure on which the analysis is based has undergone a significant change.

The parameters of the demand equation must represent the average relationship between variables under homogeneous conditions. Since the demand shifters are held constant in order to observe their relations to price and quantity, the choice of a representative period to permit an application of past behavior to a prediction of future behavior is very important.

The analysis for the majority of the products covers the last ten years. It was found that this short recent period best fit the dynamic homogeneous conditions necessary to compute the true value of the parameters.

5. Variables that cause demand shifts and their adjustments.

Theory of demand says that in order to isolate price-quantity relationships in dynamic demand curves, it is necessary to include in the analysis variables which cause the curves to shift back and forth through time. Some of these demand shifters are present in the model as specific variable whereas others are taken into account in the model by adjusting prices, quantities, and income data.

As was shown in chapter III, the major demand shifters are:

a. Consumer preferences, tastes, habits.
b. General level of prices.
c. Population.
d. Consumer's income or other measure of the general level of demand.
e. Price of competing goods.

a. Consumer preferences, tastes and habits.

Since most agricultural commodities are staple in production, it is assumed that tastes and preferences for them do not change very rapidly.[27] It follows that demand shifts are primarily determined by the other factors.

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[27] H. Schultz, The Theory and Measurement of Demand, (Chicago: The University of Chicago Press, 1938), p.143.

Quantity-price relationships are affected by consumption habits which are generally assumed a non-quantitative variable. Its influence can result in a shift of demand curve, other things being equal. Because of its characteristics, this variable has been treated in several ways in analysis of demand. One of the most common methods is to use time as a "catch-all" variable to explain this source of variation and other sources not explicitly introduced. The presence of time as a "catch-all" variable in a model assumes that there is a residual trend and the time variable represents this affect.

Upon examining the data of the rate of urbanization in the State of Sao Paulo, it was decided to use urbanization data in the place of time as a variable to explain changes in consumption habits. Theory of Economic Development describes that one characteristic of the process of economic growth is the increasing rates of urbanization which brings changes in consumption habits. Generally, there are shifts of consumption from one group of food to another, for instance, vegetable protein to animal protein.

For this analysis, the inclusion of urbanization data in the place of time, should lead to better results, because being a quantitive variable, the interpretation on its effect is more logical, compared with the interpretation of time effects.[28]

b. General level of prices.

A double in all prices and income variables do not have the same effect in quantity consumed. Since price levels change and purchasing power of the money varies year to year, it becomes necessary to adjust the year to year variation in income and prices, to a common base index, in order to compare successive year prices and income.

By dividing the prices of any commodity and income by an appropriate price index year by year, it is possible to convert current (yearly) prices and values to real price and real income, that is to money units of substantially constant purchasing power during the period. This adjustment is called deflation.

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[28]The statistical analysis indicated that this assumption was correct because time and urbanization presented a extremely high degree of intercorrelation leading to the assumption that both variables have similar effects on prices.

The choice of a price index becomes a difficult problem because there are many indexes that can be used and unfortunately there is no altogether accurate way of measuring the changes in the value of money.

Among the indexes available, the choice was the Index No. 2 of Getulio Vargas Foundation,[29] published monthly in the magazine Economic Conjuncture. This index representing many goods and services is more accurate in reflecting the changing purchasing power of money than the series of agricultural prices index. This is true because development in productivity of agricultural industries may be significantly different from the aggregate of other industries.

c. Population.

Since most agricultural products are used for food or clothing, the demand for these products will depend greatly on the population of the area of consumption. In Sao Paulo, population has been steadily increasing thus increasing the demand for food. The volume of agricultural

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[29]This index is a weighted average of all wholesale prices, cost of living and cost of civil construction.

production today is larger than 15 years ago, but today there are more mouths to feed. Other things remaining unchanged, an increase in population, shifts the demand curve to the right.

Generally in demand analysis, the manner to take the effect of this variable into account is to place all quantity and income data on per capita basis. In this way, the effect of population is eliminated.

d. Consumer's income or other measure of the general level of demand.

Consumer's income is one of the most important factors to determine the level of demand function. Prof. Karl Fox stated "the disposable income of domestic consumers has proved to be the best over-all indicator of demand of agricultural products consumed by them." [30] Changes in consumers income leads to a higher or lower expenditure for farm products and thus, affects the demand for these products.

In order to isolate the effect of income changes in the demand for the products selected for this study,

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[30] Karl A. Fox, "Factors Affecting Farm Income, Farm Prices and Food Consumption," Agricultural Economics Research, III, No. 3 (July, 1951).

this variable will be adjusted for the influence of population and general level of prices. Data will be placed in the models under the form of real income per capita.

Some agricultural commodities which are used chiefly as industrial raw materials require other measurement of the general level of demand in the place of income. Products such as corn, castor beans, etc., may not be directly affected by the level of consumer's income since they are not demanded for direct human consumption. The attempted solution for this problem was the adoption of an index of general business conditions to replace the income variable in the model for such products.

This index is the total income of the State of Sao Paulo published by Getulio Vargas Foundation, deflated by the General Index of Prices, and its values based on the average 1948-1952 = 100. [31] This index is not the ideal one, but it is assumed that it can show the switches of industrial demand back and forth, according with the conditions of the State's economy.

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[31] The value of this index as well as all other data related to the statistical analysis are presented in Appendix A.

e. Price of competing goods.

Theoretically, the consumption of an agricultural product depends not only upon its own price, but also upon the price of competing commodities.

The effect of price of competing goods is conditioned by the degree of substitutability of these goods by the commodity being analyzed. The choice of competing commodities to be placed in the models, is based upon previous economic relationships between them. Price levels of close substitutes are more likely to influence each other, than others that are less substitutable. For instance, it is more reasonable to assume that, in the common diet, pork competes more with beef than with rice.

Demand studies usually take either price or particular quantity of competing goods as a separate variable. Both lead to similar results. In this work, prices of competing goods are taken as a separate variable in each model. The price series are less subjected to errors of measurement and their values should represent the average price of the entire supply of the products in the State, no matter whether the products were produced in Sao Paulo or imported to fulfill deficits of consumption necessity.

Data for each variable data are adjusted by variations in the general level of prices.

6. The algebraic form of the relations.

Theory does not tell one how the variables are related. Generally researchers must specify the relationships assumed to exist, which might be either additive, multiplicative or reciprocative.

Linear arithmetic and logarithmic equations are the principal functional forms used in economic analysis. Both equations are used in demand analysis, but the choice of the appropriate one involves certain a priori assumptions. In this work it is assumed that the relationship among variables are additive, thus a linear arithmetic function is fitted to the data.

It is assumed that linear arithmetic functions give results which, when translated to demand curves, makes more sense at the extreme values than do the results obtained from logarithmic equations.[32] This is true because the price-quantity relationship for agricultural products vary in a relative small range thus being more adequate to be fitted by straight lines than by curvilinear

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[32]Foote, Op. cit. p. 37.

lines; and also, no data being available for extreme values, we have little interest in them concerning predictions.

The additive form fitting the equation is:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \ldots + b_nX_n$$

Where Y is deflated price of the commodity, X_1 is the consumption per capita of the commodity, X_2 is the deflated price of the competing goods, X_3 is the real income per capita and X_4 is urbanization.

C. Statistical Procedure.

1. Least squares versus simultaneous equations approach.

Least Squares and simultaneous equations are the two standard methods used in quantative measurement of demand. Both methods lead to satisfactory results depending on the nature of the economic problem.

The least Squares method was the most used before 1950, after that in the next decade, some analysts[33] concluded that this method was completely outmoded and that quantitative measurements of economic relationships should

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[33]Based on: Trygve Haavelmo, "The Statistical Implications of a System of Simultaneous Equations," Econometrica, XI, (January, 1943).

be done by a system of equations which would allow for simultaneity of the realtions. Around 1960, comparisons between results of analysis done by both methods, proved that if the least squares method meet some relative rigid requirements, it can provide results which are as consistent as those obtained by simultaneous equations.

At the present time, there are extensive writings on the subject and almost all conclude that if the rather rigid requirements are met, least squares give statistical measurements of regression coefficients which are a close approximation of the true parameters of the structure.[34]

2. The least squares approach.

Usually in this method one variable is selected as a dependent variable and one or more as independent variables. Then, this variable is expressed as a function which is usually linear. Its parameters are then estimated such that it would minimize the sum of squares of residuals on the dependent variable. The usual regression model is

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[34] Among others, we found particularly interesting: F.V. Waugh, "The Place of Least Squares in Econometrics," Econometrica, XXIX (July, 1961) pp. 386-396. Carl F. Christ, "Aggregate Economic Models: A Review Article," American Economic Review, XLVI, (1957) pp. 385-408. H. Wold and P. Faxer, "On the Specification Error in Regression Analysis," Annals of Mathematical Statistics, pp. 265-267.

of the following nature:[35]

$$Yt = A_o + \sum_{i=1}^{r} B_i X_i t + et$$

$$t = 1,2,3, \ldots n$$
$$i = 1,2,3, \ldots r$$

This method of approach has a wide application in social as well as physical research but the requirements of it should be met in order to have unbiased estimations. The theoretical assumptions of this model are:

a. There should be one dependent variable in the model and only one; there must be no doubt what is the cause and what is the effect;

b. All variables are normally distributed;

c. The relations among variables are linear;

d. The residuals are normally distributed and they are independent;

e. There must be disturbance error only in the dependent variable;

f. The average value of the error term should be zero;

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[35] G. Tintner, Econometrics (New York: John Willey & Sons, Inc., 1952), Chapter 5.

g. There should be constant and finite variance;

h. There must be no correlation between the independent variables and error term.

Due to symmetric properties of economic data, these requirements are not always met and this fact brings the three major objections to the least square method: 1. The selection of regression line is arbitrary; that is, coefficients are different depending on which variable is considered dependent, 2. not always the residuals are independent and normally distributed, 3. the statistical coefficients are not the true parameters.

The first and third objections are not relevant for the uniequational model if the primary objective of the researcher is to predict structural coefficients from his equations. The second is the most relevant because it is the most difficult requirement to be met. However, there is a statistical test to detect this problem. By the Durbin-Watson test,[36] we can check if there is serial correlation among residuals.

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[36] J. Durbin and G. S. Watson, "Testing for Serial Correlation in Least Squares Regression," Biometrika, XXXVIII (1951), pp. 159-177.

According to Fox,[37] for a single uniequational model, least squares estimates will coincide with maximum likelihood[38] estimates if the disturbances are normally distributed.

Based on the economical and statistical considerations explained above, it was decided to use in this study multiple regression analysis fitted by the least squares method.[39]

3. Statistical estimations in the uniequational complete model.

Economic theory tells one which variables should be related to a given variable for the purpose of explaining its variation; this is the economic model. Statistical theory permits one to formulate assumptions of the form of these relations; this is the statistical model. Multiple regression techniques enable one to determine and express this relation; this is the statistical procedure.

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[37] Fox, Op. cit. p. 43.

[38] Maximum likelihood is a commonly used mathematical procedure for obtaining formulas to estimate statistical coefficients. Coefficients are derived in such a way as to maximize a likelihood function.

[39] A understandable explanation of the least squares criterion is presented by H. M. Blalock, Jr., Social Statistics, (New York: McGraw-Hill Book Company, Inc., 1960), pp. 279-285.

Multiple regression analysis is one of the most valuable tools to measure association between variables. It is used to indicate in a equation the fundamental relationship among variables, that is, the expression of the degree of change in one variable associated with a given change in other variables. It also determines the degree of accuracy of estimation of the dependent factor based on the known values of the independents variables. And yet, multiple regression analysis provides an abstract measure of the proportion of the variability of the dependent variable which is attributable to the variation of the independent factors as well as enables the detection of the relative importance of each of these factors to explain the variation of the dependent factor.

All these measures are important in demand analysis and they are presented for each model. But before the analysis for individual commodities is presented the meaning and interpretation of some statistical constants computed in this research will be explained. It is expected that this can help the reader less familiarized with multiple regression techniques to understand the use of the constants.

a. Regression coefficients - the line which represents the average relationship between dependent variable (price of the commodities) and independent variables (price of competing goods, income and urbanization) is called regression line. The slope of the regression line, that is, the regression coefficients, shows the average number of units increase or decrease in the dependent factor associated with each increase of a specified unit in the independent variable. The size of the coefficient depends not only in the degree of the relation between dependent and independent factors, but in the units that they are stated.

b. Standard error of estimate - it defines the degree of variation in absolute terms about the line of relationship. This measure enables the determination of the probability that the observed value will fall within specified limits of an estimate based upon the equation of relationship, and compare how nearly the estimation agree with the values actually observed for the variable being estimated. This constant is stated in the same units as the original dependent variable, and its size can be directly compared with those values.

c. Coefficient of determination-R^2 - this measure indicates how much of the variation in the dependent factor can be explained by or estimated from all of the independent factors acting together. This coefficient is a ratio and as such it is an abstract number, which is divorced from the absolute terms of the given problem. The values of this coefficient fall within a limited range and it can be compared only with similar statistics derived from similar problems.

There is a logical validity in the sequence of computation of the constants cited above. This sequence yields first a least squares equation of average relationship, secondly a measure of errors involved in basing estimates from this equation, and thirdly an arbitrary mathematical measure of the degree of relationship. This method is called the least squares procedure.[40]

The measures of regression discussed above deal with the descriptive level only. But such measures, describing relations found in particular samples, are of interest to us primarily as basis for estimates of population parameters and of for test of hypothesis. The

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[40]F. M. Mills, Statistical Methods . . . (3rd. ed., New York: Holt, Rinehart and Winston, 1955).

question is whether the value of regression coefficient is significant or not; whether there is evidence that variables are related or not, etc.

In order to answer these questions, powerful tests of significance may be computed to evaluate the measures. The t-test is calculated to test the significance of the regression coefficients and the F-test is computed to test the significance of the R^2 in explaining variation in dependent factors. The hypothesis to be tested is that the regression coefficients and R^2 values do not differ significantly from zero.

The basis of all significance tests is the calculation of the probability of observing the same evidence in a hypothetical case of no correlation or no explanation.[41] The lower this risk, the greater is the significance of the evidence and it is natural to refer to the calculated risk as the significance level of the results. It is common to use 1 or 5 per cent as the level of significance. If a certain coefficient is significant at a level of 5 per cent, we can interpret it as,

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[41] Daniel B. Suits, Statistics: An Introduction to Quantitative Economic Research, (Chicago: Rand McNally & Company, 1963) Chapter VI.

only 5 times in one hundred times, a coefficient of this size can be observed as a result of chance.

Two other constants, Beta coefficients and intercorrelations are presented as additional information to facilitate the analysis.

a. Beta coefficients - the significance of the strength of relationship between independent and dependent variable is given by the values of t ratio. However, if the coefficients of correlation are to be used to compare various independent variables as to their relative abilities to produce changes in the dependent factor, it is necessary to correct them for the fact that there will be differences in unit of measurement. One variable can be measured in tons, other in units of money, etc. Beta coefficients are the expression of each coefficient in terms of its standard deviation. In this form they can be compared and the strongest variable producing change in dependent variable, can be found.

b. Intercorrelations - the correlation between independent variables in the same statistical model is called intercorrelation. High intercorrelations between independent variables gives less accuracy in the estimation

of the parameters of demand equation. Put in another way, when two variables are highly interrelated, the second will be explaining the same variation as the first since there will be considerable overlap. If they are uncorrelated, they will each explain a different portion of the total variation. The desired pattern in a model is a high intercorrelation between dependent and independent factors and small association between independent factors.

CHAPTER V

THE DEMAND FOR

SELECTED AGRICULTURAL PRODUCTS

The presentation of statistical findings for the selected 13 products follows the general classification adopted for Rural Economics Division in its studies. According to it, the 15 products are classified in two major groups, (a) Food products, subdivided in vegetable and animal origin and (b) Raw material for industry. The order of presentation within each group is based on the relative importance of the commodity as a producer of cash receipts to farmers.

The general outline of the following is:

A. Food Groups

1. Vegetable Origin
   - Corn
   - Rice
   - Potatoes
   - Beans
   - Tomatoes
   - Oranges
   - Onions

2. Animal Origin
   - Fat Cattle
   - Hogs

B. Raw Material for the Industry

- Sugar Cane
- Peanuts
- Manioc
- Castor Beans

CORN

Corn is the second most important crop in the State of Sao Paulo. In 1962, it ranked second in total acreage, with slightly less area than coffee. It also was the second most important product with respect to gross case income of farmers, representing about 10.3 per cent of the total.

Corn is the chief raw material used in producing livestock. The great part of volume produced is fed to livestock, mainly to hogs, cattle, poultry, work animals and other types of livestock. Part of the crop is used by the industry to make commercial products such as feed for livestock, starch, syrup, corn oil, alcohol, corn mean, prepared foods, etc. It is also used in relatively small quantities to human foods on the farm or country cities, and for exports.

In view of the fact that corn in Sao Paulo has many uses, the demand for it must be defined in its broad sense, as the aggregate of the quantities which will be utilized for all purposes. The demand measured at local farm market level should better represent this aggregate demand and it is easier to compute.

It was decided to neglect the exports[41] and inter-state trade. This last, because there is no data to quantify it. Thus, the total corn consumption was considered to be approximately measured by the State's total production. It is assumed that this trade will not materially affect the major findings of this investigation.

The general assumption of this economic model is that the price of corn is not only determined by the size of crop in the State of Sao Paulo, but by other factors such as the price of manioc, a competing good, and the strength of industrial demand. Time was used as a variable to explain a number of factors not explicitly stated in the model such as, trend in corn productivity, increased substitution of work animals by machinery, etc. However, it was dropped because the time variable was highly correlated with other independent variables.

The findings are those obtained for the period 1954-1963. This period produced a better fit in the analysis than the 16 year period, 1948-1963. Changing structural conditions in the economy may have affected

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[41] According to datas of Rural Economics Division, exports in the period 1954-1962 were insignificant. See Agriculture in Sao Paulo, VIII, No. 3, p.19 and X, Nos.5,6., p. 48.

the results of the analysis for the long period. Therefore, the more recent period is judged to be a more appropriate base from which to quantify prices relationships and predict future price behavior.

$$Y = 75.139 - 0.637X_1 + 0.067X_2 + 0.474X_3 \quad (I)$$

$$(4.616)^{***} \quad (1.956)^{**} \quad (1.773)^{*}$$

$$R^2 = 0.791^{***} \qquad Sy = \$8.20$$

Where Y stands for the deflated price of corn in cruzeiros per bag of 60 Kilos, X_1 stands for the quantity consumed per capita, stated in Kilos per person, X_2 stands for deflated price of manioc stated in cruzeiros per ton and X_3 stands for the index of business conditions (1948-52=100).

The price and quantity relationships for the period 1954-63 are plotted in Figure 1 and by means of a linear function a demand curve is fitted to the data. In this figure, the price of corn was adjusted to the means of manioc and index of business conditions.

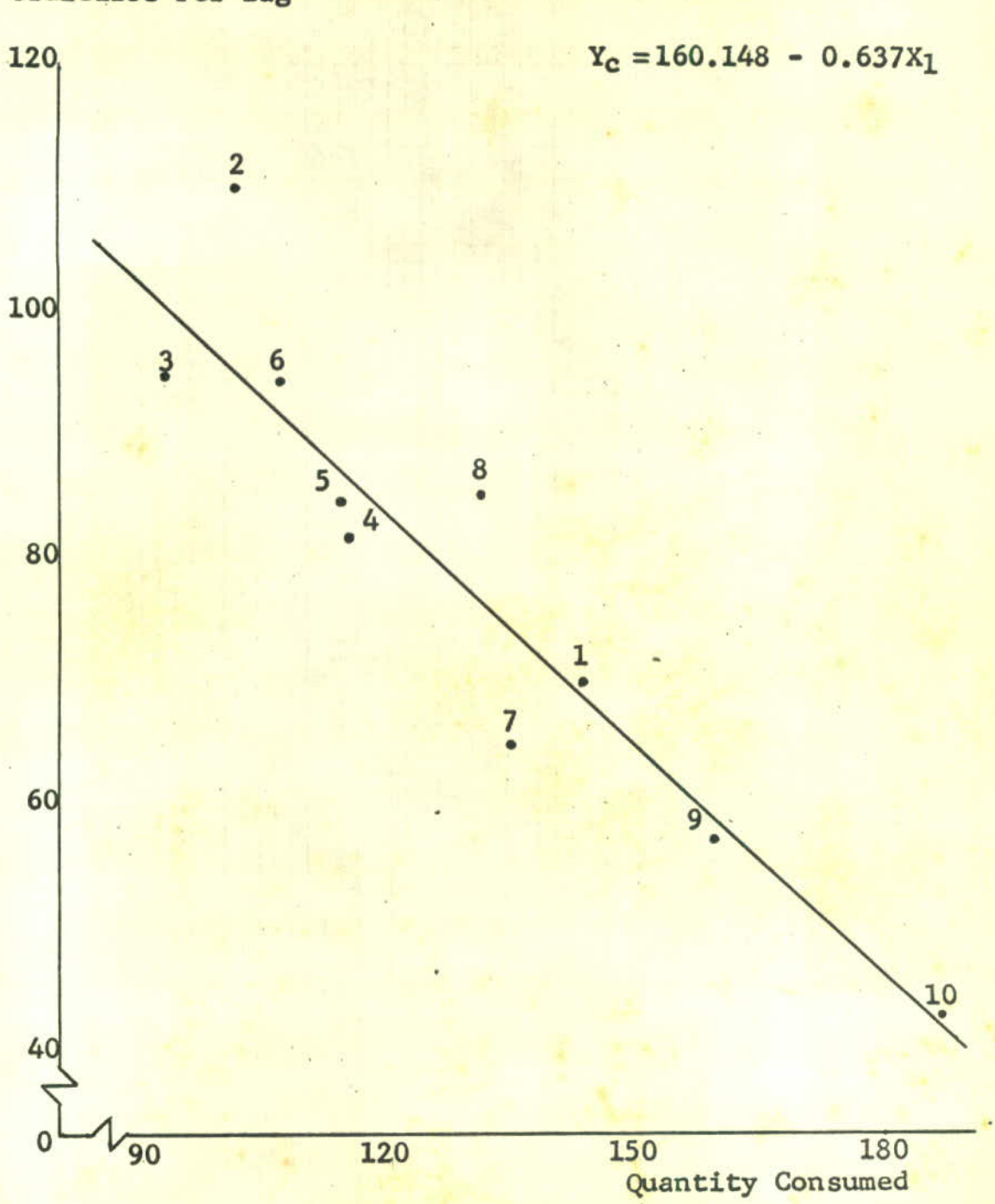

Figure No. 1. Corn: Relationship of the Yearly Quantity Consumed, to the Adjusted Price, Sao Paulo, 1954-1963.

The interpretation of the demand equation is as follows; if the quantity consumed of corn changes one unit, the deflated price of corn will change 0.637 units in the opposite direction with all other variables remaining constant. If the deflated price of manioc changes one unit, the deflated price of corn will change 0.067 units in the same direction, other variables remaining unchanged. If the index of business conditions changes one unit, the deflated price of corn will move 0.474 units in the same direction. The value of 75.139 showed in the equation does not have an economic interpretation, it only has a mathematical interpretation. It means the level of the regression line or the value of dependent variable when all independent variables take on the value of zero.

The values under each coefficient are the t-values. The statistical significance of each one is given by the number of asterisks.[42] The interpretation of the t values should be in the following terms, for instance, the coefficient of X_1 is significant at the level of one per

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[42] Four asterisks means significance at a level of 1 per cent, three means significance at a level of 5 per cent, two means significance at 10 per cent and 1 significance at 20 per cent.

cent, and this means that a coefficient of this size can occur as a result of chance only 1 time out of 100 times. The small the level of significance the more reliable and accurate is the coefficient as a measure of the relation between the dependent and independent variables. A useful tool in the economic interpretation of the statistical results in a model are the signs of each coefficient. According to demand theory there is an expected relation among variables. For example the negative sign of the coefficient of quantity produced agrees with demand theory that is, as the price of one product rises the quantity taken will decrease. The sign of X_2 deflated price of manioc, show that corn and this product are competitive in consumption. As the price of manioc increases, there is a reduction in the consumption and an increase in consumption of corn which then makes the price of corn increase. The sign of the X_3, index of business conditions, agrees with the economic assumption of the model, that is, if the business conditions are good, the industrial demand should strengthen and also the demand for corn. Thus, both variables should move together as the model implies.

The amount of intercorrelation between independent variables can affect the results of an analysis, generally lowering the reliability of the coefficients. If independent variables are high intercorrelated the assumption of independence of variables may be violated. On the other hand, a desired result is a strong intercorrelation between the dependent factor and independent ones. This fact implies that the independent factor explains great part of the variation in the dependent factor. The coefficients of simple correlation for this analysis are the following:

	X_1	X_2	X_3	Y
X_1	1.000	0.548	0.668	-0.725
X_2	-----	1.000	0.416	-0.068
X_3	-----	-----	1.000	-0.216
Y	-----	-----	-----	1.000

Greatest intercorrelation were of index of business conditions and quantity of corn and the same variable with manioc. This is an inevitable result since the strength of industrial demand should be related to those variables mainly in a period of constant economic growth.

In this analysis, of the factors that affect prices of corn, per capita consumption of corn, deflated price of manioc and the index of business conditions explained 79.1 per cent of the variation in the prices of the product for the period 1954-1963. The F test for this coefficient of determination showed that it is significant at a level of 5 per cent. The interpretation of the F test is that, a degree of association among the variables of this size will be obtained as a result of chance only 5 times in 100 times. Thus, it can be assumed that the variables have an economic relation between them as was isolated in the model.

The Beta values give the relative importance of each variable in the model to explain variation in corn prices. The computation of these values showed that quantity produced of corn is the most important variable to explain the corn prices. Secondly is the index of business conditions and the least important in the model is price of manioc.

Table 1. Corn: Comparison of Actual Annual Prices and Annual Prices Estimated From the Demand Equation, 1954-1963. (Cruzeiros Per Bag, 1948-1952 = 100)

Year	Actual Farm Market Price	Estimated Farm Market Price	Residuals
1954	60.00	59.40	0.60
1955	99.00	86.60	12.40
1956	88.00	94.90	- 6.90
1957	77.00	82.80	- 5.80
1958	83.00	84.80	- 1.80
1959	90.00	88.20	1.80
1960	62.00	71.10	- 9.10
1961	90.00	81.40	8.60
1962	82.00	83.40	- 1.40
1963	56.00	54.30	1.70

Source: Equation I and Table 18, Appendix.

It can be noted that in two times the direction of year to year variation of estimated prices do not agree with the direction actually observed, this was for the years 1955-56 and 1961-62.

The standard error of estimate gives the idea of how close the estimated values agrees with the actually

observed values. For this equation, its value equals CR$8.20 cruzeiros per bag. This statistic means that 67 per cent of the estimated values will fall within ± $8.20 of the observed value. In fact, the table shows that 7 times in 10, the differences between observed and estimated fell within this range.

The demand for corn at the farm market level was found to be price inelastic. Recalling what was shown in Chapter III, the term elasticity refers to the change in quantity neither causing or caused by, but associated with a given change in price.[43] The computed price elasticity for corn showed that on the average a one per cent change in the price of corn was associated with 0.9 per cent[44] change in the opposite direction of the quantity consumed. Also, a one per cent change in business conditions were associated with 0.8 change in the same direction of the quantity consumed.

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[43] G. S. Shepherd, Agricultural Price Analysis, (5th ed; Iowa State University Press, 1963).

[44] The value of price elasticity was computed at the mean of the other variables. A minus sign should precede the figure but it is omitted because all elasticities are negative since price and quantity have an inverse relationship.

To the agricultural sector this fact means that successive price declines were accompanied by an decrease in total revenue (price times quantity) derived from the sales of corn at farm level. As successively lower prices prevail at farm level, purchases by wholesalers tend to increase at a rate slightly less than the rate at the price decline. Conversely, successively higher prices bring about less than proportionate declines in sales rates and the total revenue increases as the price increase.

The meaning of business conditions elasticity is that as the general conditions of economy strengthens, the industrial demand will strengthen which will bring about increases in total output.

RICE

In 1962, rice ranked seventh among the major agricultural products in Sao Paulo in total gross cash income and fourth in total acreage. In that year it represented about 8.3 per cent of the total gross cash income of the Sao Paulo farmers.

Despite its great importance as an agricultural crop, Sao Paulo is an importer of the product. There are no data available about the total consumption of the State, but it is estimated that it imports an additional 20 per cent of its total production to satisfy consumer's needs.

The major use of rice is for food. To be ready for consumption, the product must pass through a milling process. It is estimated that great part of the crop is sold by farmers directly to millers. After the grain is processed, the millers sell the product to the major consumption centers.

In this study, the demand for rice is measured at the local farm market. The period covered in the analysis is 1954-1963.

The initial economic assumption in the model is that the price of rice is affected by the quantity of rice produced, the price of beans, the price of potatoes, urbanization and personal income. The price of beans and urbanization were found not significantly affecting price of rice, so they were dropped from the model. Income per capita was left in the model despite its statistical insignificance because it is one of the most important variables, which effect must be analized.

The final equation which represents the demand for rice is:

$$Y = 370.430 - 2.335X_1 \quad 1.418X_2 \quad 0.061X_3 \qquad \text{(II)}$$

$$(-2.261)^{**} \quad (3.118)^{***} \quad (1.406)$$

$$R^2 = 0.783^{***} \qquad Sy = \$22.20$$

Where:

Y = deflated price of rice, cruzeiros per 60 Kilos.

X_1 = consumption per capita of rice, Kilos per person.

X_2 = deflated price of potatoes, cruzeiros per 25 Kilos.

X_3 = real income per capita, cruzeiros per person.

The quantity-price data of rice for the years 1954-1963 are plotted and a demand curve is fitted to them as indicated in Figure 2.

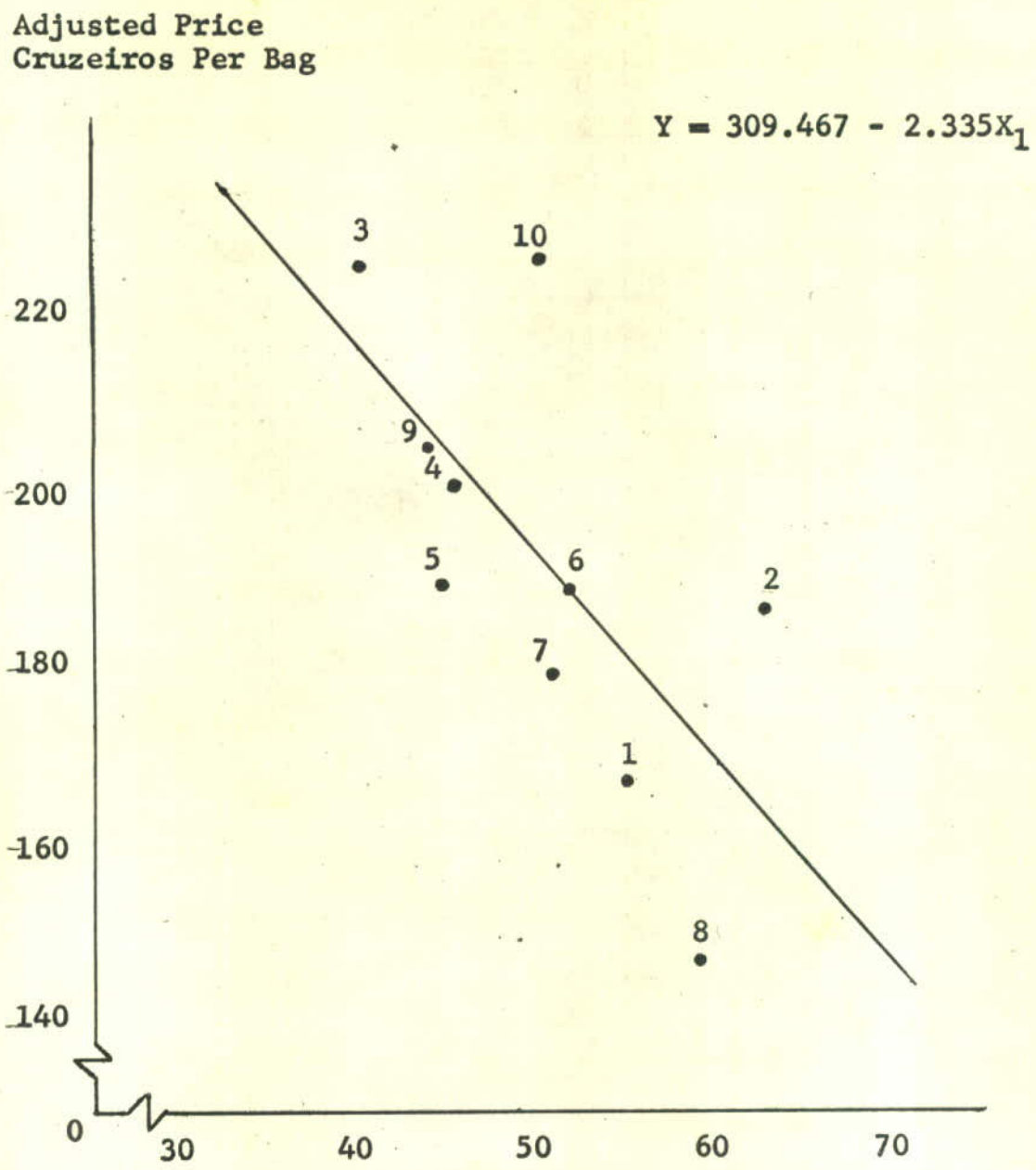

Figure 2. Rice: Relationship of the Yearly Quantity Consumed to the Adjusted Price, Sao Paulo, 1954-1963.

The interpretation of the demand equation should be in the following terms: if consumption per capita of rice changes one unit, the deflated price of rice will change 2.335 units in the opposite direction, other variables remaining constant; if the deflated price of potatoes changes one unit, the deflated price of rice will change 1.418 units in the same direction, other variables remaining unchanged; and if real income per capita changes one unit, the deflated price of rice will move 0.061 units in the same direction, other variables being constant.

The values under each coefficient are the respective t values. The level of significance of each one is given by the asterisks.

The signs of the coefficients for the independent variables are in accordance with economic theory. That is, it was observed an inverse relationship between price and quantity of the product, and a positive relation between price of potatoes and price of rice. This last fact means that both products are competitive. They substitute for each other. When the price of rice rises the quantity of potatoes demanded increases and competition increases its prices. One interesting observation was the positive relation between income and price of rice. This means that

people are eating more rice as their income increases.

The intercorrelations among the variables in the model was found to be:

	X_1	X_2	X_3	Y
X_1	1.000	-0.105	0.050	0.511
X_2	-----	1.000	0.229	0.721
X_3	-----	-----	1.000	0.437
Y	-----	-----	-----	1.000

It can be observed that there is no serious intercorrelation among independent variables but the dependent variable (price of rice) is relatively highly associated with the three independent variables.

In this analysis of the factors that affect prices of rice, per capita consumption of rice, deflated price of potatoes and personal income explained 78.3 per cent of the variation in the prices of the product for the period 1954-1963. The F test shows that the coefficient of determination R^2 equal to 0.783 is significant at a level of 5 per cent.

The computation of the Beta values indicates that the price of potatoes is the most important variable

in this model to explain the variation in the price of rice, the second most important is the production of rice and the least income per capita.

In order to give an idea of the accuracy of the demand equation to predict prices of rice, the estimated prices were computed from the equation and compared with actual observed prices.

Table 2. Rice: Comparison of Actual Annual Price and Annual Price Estimated From the Demand Equation, 1954-1963. (Cruzeiros Per Bag, 1948-52 = 100)

Year	Actual Farm Market Price	Estimated Farm Market Price	Residuals
1954	208.20	221.90	-13.70
1955	174.20	150.50	23.70
1956	196.40	187.10	9.30
1957	196.20	194.50	1.70
1958	214.90	231.30	-16.40
1959	169.60	169.40	0.20
1960	144.40	155.40	-11.00
1961	128.20	152.90	-24.70
1962	238.90	241.30	- 2.40
1963	250.30	217.00	33.30

Source: Equation II and Appendix Table 19.

It can be noted that the direction of year to year movement of prices estimated from regression equation is almost the same as those observed for the actual prices. The disagreement in the direction of movement was observed for 1956-57 and 1962-63. It also can be noted that the residuals are randomly distributed and this is one of the necessary findings if the assumption of linearity between variables is to be met.

The computed standard error of estimated has a value of $22.20 cruzeiros per bag, this means that 67 per cent of the time predicted price of rice for any particular year will fall within the limit + or - $22.20 about the observed price. The table shows that 7 times in 10, the differences of estimated values fell within the standard error of estimate.

The demand for rice at farm market level was found to be price elastic. On the average, a one per cent change in the price of rice was associated with 1.6[45] per cent change in the opposite direction of the quantity

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[45] The value of price elasticity was computed at the means of the other independent variables.

consumed. Also, rice is income elastic, that is, a one per cent change in personal income was associated with 4.3 per cent change in the same direction of the quantity consumed.

The implication of this price elasticity is that farmers can expect an increase in total revenue associated with the sale of additional production. In other words, the price of rice will fall less than the size of crop increases. Thus a larger crop will be worth more than an average crop.

POTATOES

In 1962, potatoes were responsible for 3.6 per cent of farmer's gross income, ranking 10 among the major crops of the State. In acreage this crop occupied the 12th place.

Potatoes are not one of the most widely grown crop in the State. Most of the crop that moves through commercial channels is from specialized producing areas, generally located near the capital of the State which is the major outlet for the product. Due to cost of transporting potatoes over long distances the crop has to be grown within comparatively short distances from the market.

In the last 16 years, potatoes were the crop which presented the highest increase in yields. This resulted principally from crescent specilization in production and improvements in cultural methods used.

Potatoes are used commercially for seed, for processing into starch, flour, alcohol and other manufactured products, however, this use is a relatively

unimportant outlet for potatoes. Table consumption is the primary market for the potato crop. The human consumption is in direct form since no further manufacturing process is necessary to convert the crop into a food.

One of the characteristics of the potato crop is its short season to complete production. There are two seasons during the year which potatoes can be grown. These are the so-called rainy season potatoes and dry season potatoes. For the purposes of this study, the two crops will be added to represent the average yearly production. Also, prices of both crops will be averaged to get the annual average price received by farmers.

Despite the lack of data, it is generally accepted that the State is an exporter of potatoes. This interstate trade amounts to 10-15 per cent of the total crop. In taking production as an approximation to consumption it is necessary to define the demand for potatoes in its broad sense, as the aggregate of the quantities which will be utilized for all purposes including export, at a given price.

The economic model for potatoes assumes that the price of the product is affected by the size of the crop,

and by the price of competing goods in the various outlets such as rice, beans, manioc and pork.

Differently from corn and rice, potatoes is a product which demand has been affected by structural changes in the economy over the long period. Results of the analysis showed that the long period, 1948-1963 is the best to explain the demand for potatoes. The computed demand equation for the period 1948-1963 is:

(III)

$$Y = 129.81 - 5.930X_1 + 0.214X_2 - 0.088X_3 + 0.144X_4 + 0.664X_5$$

$$(-4.135)^{***} \quad (2.010)^{**} \quad (-1.602)^{*} \quad (2.409)^{***} \quad (2.369)^{***}$$

$$R^2 = 0.710^{***} \qquad Sy = \$16.12$$

Where Y stands for deflated price of potatoes stated in cruzeiros per bag of 60 Kilos, X_1 stands by consumption per capita of potatoes stated in Kilos per person., X_2 equals deflated price of rice stated in cruzeiros per bag of 60 Kilos, X_3 stands by deflated price of beans in cruzeiros per bag of 60 Kilos, X_4 equals deflated price of manioc stated in cruzeiros per ton and X_5 stands by deflated price of hogs stated in cruzeiros per 15 Kilos.

The demand curve for potatoes for the period 1948-63 is shown in Figure 3.

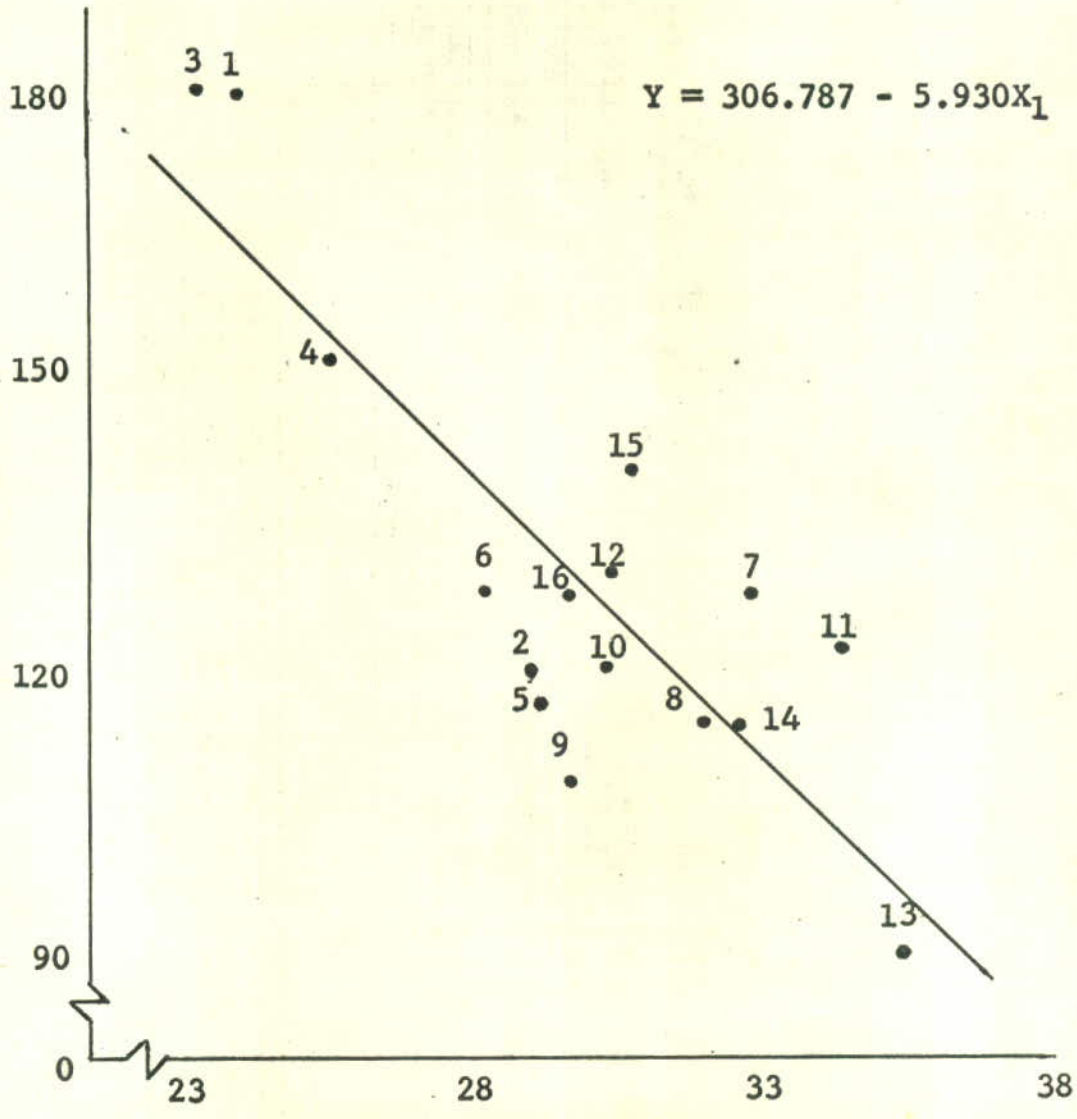

Figure No. 3. Potatoes: Relationship of the Yearly Quantity Consumed to the Adjusted Price, Sao Paulo, 1948-1963.

It can be noted that with one unit change in the quantity consumed of potatoes the price of it will change 5.930 units in the opposite direction. For the competing goods, one unit change in deflated prices of rice, manioc and hogs were associated with 0.214, 0.144 and 0.644 units change in the deflated price of potatoes in the same direction. The sign of variable X_3 showed that beans is not a competitor in consumption for potatoes. They are complementary. That means as the price of beans increases, there is a reduction in its consumption and a same effect on consumption of potatoes, which then makes the price of potatoes decrease. The equation showed that the association was a one unit change in price of beans brings about 0.088 units change in deflated price of potatoes in the opposite direction.

No serious intercorrelations were found among independent variables as can be noted in the coefficients of simple correlation for this analysis.

	X_1	X_2	X_3	X_4	X_5	Y
X_1	1,000	0.231	0.194	-0.059	0.406	0.599
X_2	-----	1.000	0.335	0.441	0.263	0.212
X_3	-----	-----	1.000	0.333	0.160	-0.068
X_4	-----	-----	-----	1.000	0.519	0.388
X_5	-----	-----	-----	-----	1.000	0.211
Y	-----	-----	-----	-----	-----	1.000

The quantity consumed per capita of potatoes and the deflated prices of rice, beans, manioc and pork explained 71.0 per cent of the variation in deflated prices of potatoes. This value for R^2 was found to be significant at 5 per cent level.

The most important variable in the model to explain potatoe's price was the consumption per capita of potatoes, followed by price of manioc, price of pork, price of rice and the least important was beans.

The comparison between current observed and calculated prices for the period 1948-1963 is shown in Table 3.

Table 3. Potatoes: Comparison of Actual Annual Prices and Annual Prices Estimated from the Demand Equation, 1948-1963. (Cruzeiros Per Bag, 1948-52 = 100)

Year	Actual Farm Market Price	Estimated Farm Market Price	Residuals
1948	166.20	150.80	15.40
1949	105.80	120.60	-14.80
1950	177.00	162.30	14.70
1951	128.60	133.20	- 4.60
1952	114.40	131.20	-16.80
1953	169.40	180.90	-11.50
1954	151.10	134.20	16.90
1955	109.40	111.30	- 1.90
1956	106.70	128.30	-21.60
1957	117.90	124.50	- 6.60
1958	123.40	103.70	19.70
1959	118.90	115.60	3.30
1960	103.80	109.50	- 5.70
1961	112.40	110.80	1.60
1962	147.00	131.50	15.50
1963	136.80	140.20	- 3.40

Source: Equation III and Appendix Table 20.

The computed standard error of estimate was $16.10. This standard error is smaller than for corn and rice. It can be seen that 4 out of 16 times or 75 per cent of the predicted values fell within the range of the standard error of estimate.

The Durbin Watson test was computed for this product in order to test the independence of the residuals over time. The results $d' = 2.306$ and $4 - d' = 1.694$ were found to be inconslusive[46] for 16 observations.

The price elasticity of demand for potatoes at farm level was found to be inelastic. On the average, a one per cent change in the price of potatoes was associated with 0.7 per cent change in the quantity consumed in the opposite direction, after allowing for the influence of other variables. The behavior of the potato market showed that in terms of total revenue associated with sales of the crop, farmers may expect a smaller total revenue resulted from an increase in potato prices. As the crop increases in size, the price of potatoes will drop more than the quantity increases. On the other hand, an increase in price will bring about increasing total revenue.

[46]To an explanation of this test see: J. Friedman and R. J. Foote Computational Methods for Handling Systems of Simultaneous Equations, Agriculture Handbook No. 94, (USDA; U.S. Government Printing Office, Washington, D.C., 1962).

BEANS

Beans ranked 12th in the farmer's total cash income for 1962 being responsible for 2.8 per cent of the total. It is a short season crop which permits growing two crops per year, the dry season and rainy season beans. Adding the average of both crops, beans ranked seventh place in total acreage.

This product is not grown commercially in the State. A great part of its production comes from small patches and from home gardens, which sometimes are not in the official estimates. As a consequence and because it is highly affected by weather conditions, beans has the smallest index of increase in yield when compared with other crops.

The utilization of beans is almost all for human consumption. It needs no further processing to be consumed. Generally, the prices farmers receive for beans are those from the sale of beans to wholesalers. The price and production to be used in this analysis are the average for both season's crops.

The state of Sao Paulo imports beans for its consumption needs. The gap between production and consumption is large (may be more than one fourth of the total) but there are no data available to estimate it. In this analysis, production will be used as an estimate of consumption of the State.

The demand for beans at farm market will be assumed to be affected by the quantity of beans consumed, the deflated price of rice, the real income per capita and the degree of urbanization.

The period covered in the analysis of demand for beans is the long period, 1948-1963. The statistical results showed that this period gives a better fit to the demand equation.

The computed demand equation for 1948-1963 is:

$$Y = 2{,}113.954 - 11.295X_1 + 0.703X_2 - 0.289X_3 + 8.148X_4 \quad \text{(IV)}$$

$$(1.835)^{**} \quad (2.053)^{**} \quad (3.472)^{***} \quad (2.547)^{***}$$

$$R^2 = 0.700^{****} \qquad Sy = CR\$58.12$$

Where

Y = deflated price of beans in cruzeiros per bag of 60 Kilos;

X_1= consumption per capita of beans in Kilos per person;

X_2= deflated price of rice in cruzeiros per bag of 60 Kilos;

X_3= real income per capita in cruzeiros per person;

X_4= degree of urbanization taken as percentage of population in the urban areas.

The demand curve fitted to the data is shown in Figure 4.

$Y = 444.083 - 11.295X_1$

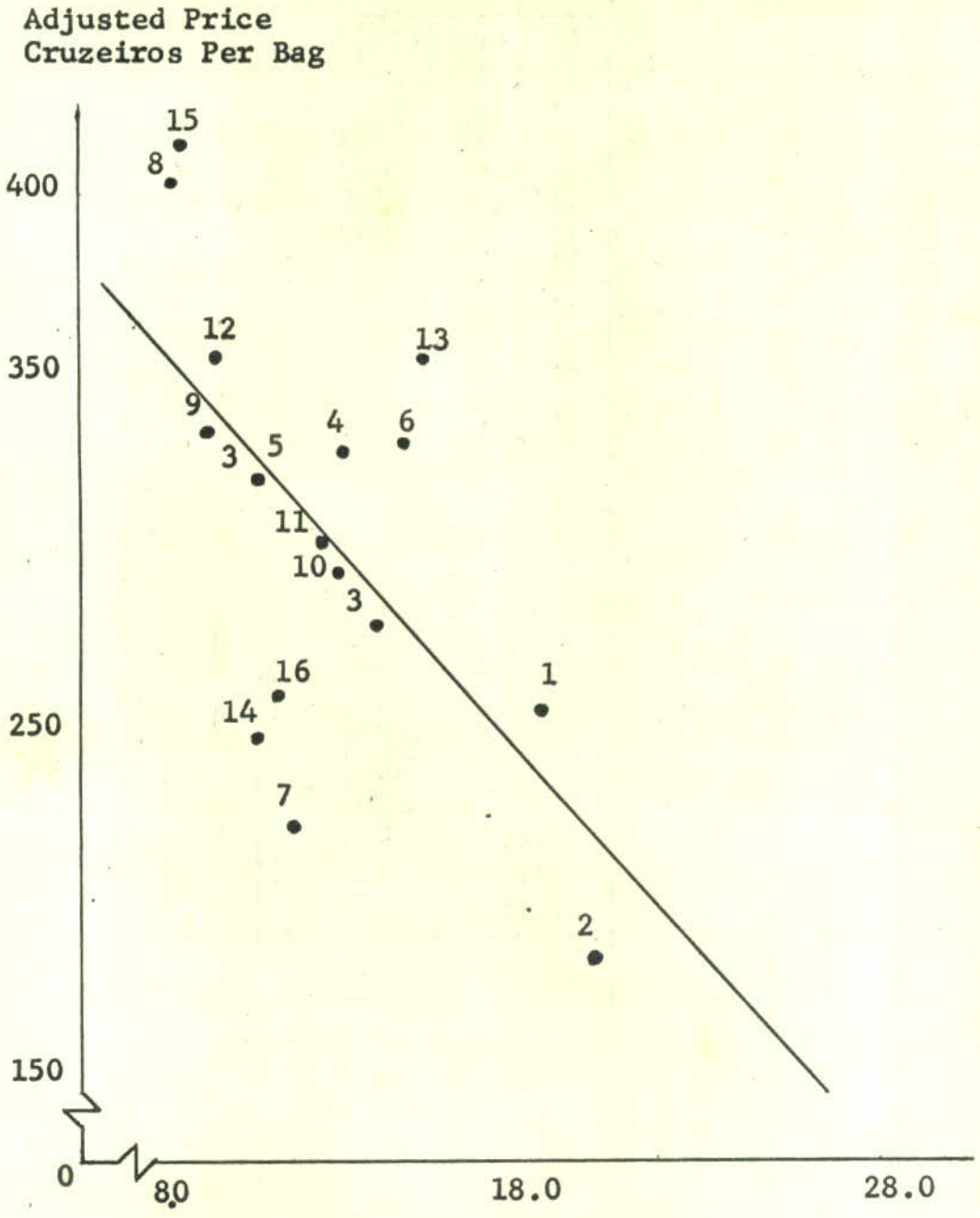

Figure 4. Beans: Relationship of the Yearly Quantity consumed to the Adjusted Price, Sao Paulo, 1948-1963.

On the average and other variables remaining constant, a change in one unit in quantity consumed of beans was associated with 11.295 units change in the opposite direction in the price of beans. One unit change in the deflated price of rice brought about 0.703 units change in the opposite direction of beans prices, a change of one unit in real income per capita was accompanied by a change of 0.289 units of beans prices in the same direction and one unit change in the degree of urbanization was associated with 8.148 units change in the same direction of the deflated price of beans.

There are some relationships among the variables in this model which must be analyzed under the point of view of economic theory. First, beans and rice are complementary products as it was expected to be; together both are present in the daily diet of Brazilian people. Second, income brought about a positive relation to prices of beans, this means that as people earn more they are eating more beans. Thirdly, as the degree of urbanization increases, people demand more beans, thus the price increases. This latter is an interesting finding since it was expected a change in consumption habits as the

degree of urbanization increases, that is, the consumption of beans, rice, corn meal, manioc meal, would tend to change to more rich food as animal protein, etc.

The coefficients of simple correlation for this analysis is:

	X_1	X_2	X_3	X_4	Y
X_1	1.000	-0.049	-0.551	-0.581	-0.359
X_2	-----	1.000	0.289	0.280	0.335
X_3	-----	-----	1.000	0.437	-0.146
X_4	-----	-----	-----	1.000	0.579
Y	-----	-----	-----	-----	1.000

No serious intercorrelations affected the results of the analysis.

This study found that the comsumption per capita of beans, the deflated price of rice, the real income per capita and the degree of urbanization, explained 70.0 per cent of the variation in beans prices. This coefficient was significant at the level of one per cent.

According to the Beta values, real income per capita is the most important variable to explain variation in the price of beans. The second most important was the degree of urbanization, the third was the quantity of beans consumed and the least important in the model was price of rice.

Table 4. Beans: Comparison of Actual Annual Prices and Annual Prices Estimated From the Demand Equation, 1948-1963. (Cruzeiros Per Bag, 1948-1952 = 100)

Year	Actual Farm Market Price	Estimated Farm Market Price	Residuals
1948	267.50	248.60	18.90
1949	125.60	163.10	-37.50
1950	121.90	133.90	-12.00
1951	133.00	106.30	26.70
1952	164.00	171.30	- 7.30
1953	236.00	185.90	50.10
1954	118.10	211.80	-93.70
1955	256.30	206.80	49.50
1956	276.80	285.10	- 8.30
1957	227.20	234.40	- 7.20
1958	135.90	132.40	3.50
1959	345.80	331.90	13.90
1960	314.50	234.40	80.10
1961	188.00	268.20	-80.20
1962	426.10	362.60	63.50
1963	267.00	326.70	-59.70

Source: Equation IV and Appendix Table 21.

It can be noted that four times the estimated equation was wrong to predict the direction of movement of price from one year to the next. Also, it is noted that the equation has a large standard error of estimate which brings about large variability of the estimated prices compared with current observed values.

The test of independence of variables was made for this model. The Durbin Watson test value d' was 1.937; and 4-d' was 2.053; those values for 16 observations were significant, that is, the variables in the model have no serial correlation.

The demand for beans at farm market level was found to be price elastic. On the average, a one per cent change in the price of beans was associated with 1.96 per cent [47] change in the quantity of beans consumed in the opposite direction. The quantity of beans consumed was found to be income elastic. On the average a one per cent change in income was associated with 16.9 per cent change in the quantity produced in the same direction.

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[47] Elasticity was computed at the mean of X_2, X_3 and at the last value observed for X_4, since this variable showed a continuous upward trend.

According to demand theory, a commodity may have elastic demand at extremely low prices or extremely high prices and an inelastic demand at an average price. This is the case of beans, which in these last years has experienced extremely high prices, situated above the average price observed in the beginning of the period. The results showed that at this high prices the demand for beans is price elastic. The computed value of income elasticity for beans was found to be extremely high.

TOMATOES

Tomatoes are one of the most valuable commercial vegetable crops grown in the State. Farm sales for fresh and processing markets had the value of CR$8.60 billion cruzeiros in 1962, occupying the 14th place. It also ranked 13th in acreage.

Tomatoes are grown on commercial truck farms for fresh market shipments to relatively distant markets, and on truck-crop and general farms, for processing. Besides there are the home gardens for home consumption and commercial market gardens for sale fresh in nearby markets.

This product is utilized chiefly for fresh market sales, but there is a considerable amount of it utilized for processing into paste, sauce, catsup, pulp, juice, etc. The fresh tomatoes is consumed in salads, sandwiches, etc. and the processed in cooking, beverage and preparation of other foods.

Total tomato consumption is taken as the domestic production. Imports and exports of this product are estimated to be unimportant in relation to the production of the State. Losses through spoilage and waste in the

marketing system are neglect because no data is available to permit allowance for these factors in this analysis.

The demand for tomatoes will be defined as the aggregate of both outlets. The average price received by farmers should be a good indication of the demand for tomatoes since it represents the average price in all markets for all grades.

The economic assumption of the model is that the average price receivedby farmers for all tomatoes is determined chiefly by total consumption per capita, by the price of competing vegetables and as potatoes and onions and by the degree of urbanization. Real income per capita was dropped from the model because it was insignificant in explaining price variation for tomatoes.

The period covered in the analysis is from 1954-1963. The final demand equation is:

$$Y = -6.550 - 1.166X_1 + 0.302X_2 - 0.246X_3 + 0.963X_4 \quad (IV)$$
$$(1.507)^* \quad (1.929)^* \quad (1.761)^* \quad (1.050)$$
$$R^2 = 0.612 \qquad Sy = CR\$7.38$$

Y = deflated price of tomatoes in cruzeiros per box of 28 Kilos;
X_1= consumption per capita in kilos per person;
X_2= deflated price of potatoes, cruzeiros per bag of 60 kilos;

X_3= deflated price of onions, in cruzeiros per 15 kilos;
X_4= degree of urbanization taken as percentage of population in urban areas.

A linear curve was fitted to the data of price and quantity of tomatoes, as shown in Figure 5.

On the average, other variables remaining constant one unit change in the per capita consumption of tomatoes was associated with 1.166 units of change of deflated price of tomatoes in the opposite direction; a one unit change in deflated price of potatoes was associated with 0.302 units of change of deflated price of tomatoes, in the same direction; one unit change of deflated price of onions was associated with 0.246 units of change in deflated price of tomatoes in the opposite direction and one unit change in degree of urbanization was associated with 0.963 units change in deflated price of tomatoes in the same direction. The t values shows that the coefficients have low reliability since they are significant at low level, 20 per cent.

According to the equation, onions are a complementary product for tomatoes. This is true principally for home cooking.

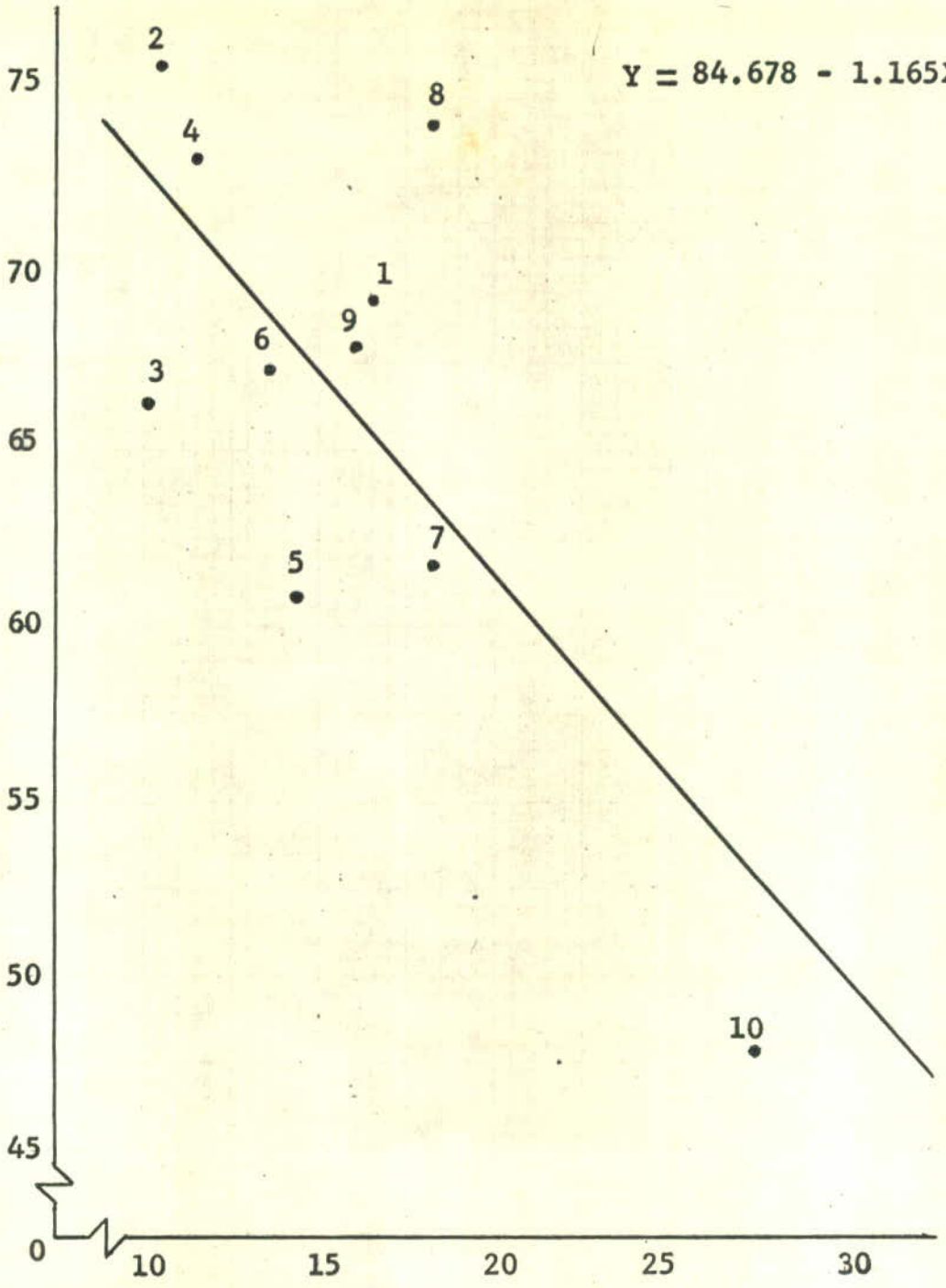

Figure 5. Tomatoes: Relationship of the Yearly Quantity Consumed to the Adjusted Price, Sao Paulo, 1954-1963.

The coefficients of simple correlation for this analysis are:

	X_1	X_2	X_3	X_4	Y
X_1	1.000	0.313	0.136	0.753	-0.225
X_2	-----	1.000	0.084	0.138	0.381
X_3	-----	-----	1.000	0.080	-0.503
X_4	-----	-----	-----	1.000	-0.020
Y	-----	-----	-----	-----	1.000

There is a relatively high intercorrelation between the degree of urbanization and the quantity of tomatoes consumed. The four independent variables explained about 61.2 per cent of the variation in prices of tomatoes. The F test showed that this value was not significantly different from zero.

The most important variable in the model to explain prices of tomatoes was the quantity of tomatoes consumed followed by deflated price of potatoes, degree of urbanization and the deflated price of onions.

The comparison of actual and estimated change in prices of tomatoes during the period 1954-1963 is shown in Table 5.

Table 5. Tomatoes: Comparison of Actual Annual Prices and Annual Prices Estimated From the Demand Equation, 1954-1963. (Cruzeiros per box 1948-1952= 100)

Year	Actual Farm Market Price	Estimated Farm Market Price	Residuals
1954	65.90	63.50	2.40
1955	63.40	59.30	4.10
1956	59.40	64.50	-5.10
1957	66.20	64.20	2.00
1958	45.10	53.00	-7.90
1959	57.70	58.80	-1.10
1960	54.70	57.20	-2.50
1961	62.50	51.40	-11.10
1962	77.70	75.70	-2.00
1963	53.20	57.90	-4.70

Source: Equation V and Appendix Table 22.

Eighty per cent of the estimated values fall within the range of + or - the value CR$7.38 which is the standard error of estimate.

The price elasticity at farm level of tomatoes was found to be elastic. On the average, a one per cent change in the price of tomatoes was associated with 3.6 per cent

change in the production per capita.

Demand for all tomatoes as indicated by this analysis, was relatively highly elastic at farm level, but in view of the relatively large variation in price which was unexplained by the analysis, further research is needed to confirm this.

ORANGES

In 1962, oranges were responsible for 1.7 per cent of total cash income of agricultural sector and it occupied the 9th place in acreage.

The State's orange production is concentrated in specialized areas which provide adequate type of soil and weather required for the crop.

Oranges are chiefly used for human consumption both in fresh or processed forms. The processing industry was recently installed in Sao Paulo and it produces principally juices and other concentrates. Since it is a new industry the outlet for processing is relatively unimportant compared with the fresh market. According to a study made in the field it is estimated that processed oranges accounts for only 8.9 per cent of the total.[48]

The State of Sao Paulo exports part of its crops to foreign markets. No data, are available at the moment to quantify this trade for the whole period.[49] Also, part of total production is lost through waste on the farms and

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[48] J.M. F. Lima "Citrus, Balance for 1963 and Perspectives for 1964", Agriculture in Sao Paulo, XI, (March April 1964) p. 52.

[49] It was about 14.8 per cent of the total in 1963. Op cit. p. 52.

spoilage in the marketing system.[50]

Since no statistical information related to all these factors affecting total consumption is available for the entire period covered in the analysis, it is assumed that total production equals total consumption of the State.

The general economic assumption of the orange model is that the deflated average price received by farmers is affected by the quantity consumed of oranges and consumer's income.[51]

The demand equation for 1954-63 is:

$$Y = 53.284 - 0.290X_1 + 0.011X_2 \qquad \text{(VI)}$$

$$-(5.080)^{****}(1.644)^{*}$$

$$R^2 = 0.814\ ^{***} \qquad Sy = CR\$3.48$$

Where Y stands for deflated price of oranges, stated in cruzeiros per box of 40 kilos, X_1 is consumption per capita, kilos per person and X_2 is real income per capita per person in cruzeiros.

The orange demand curve fitted to the data is shown in Figure 6.

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[50] It was about 13.7 per cent of the total in 1963. Op cit. p. 52.

[51] No significance was found for urbanization in the model.

$Y = 38.215 - 0.290X_1$

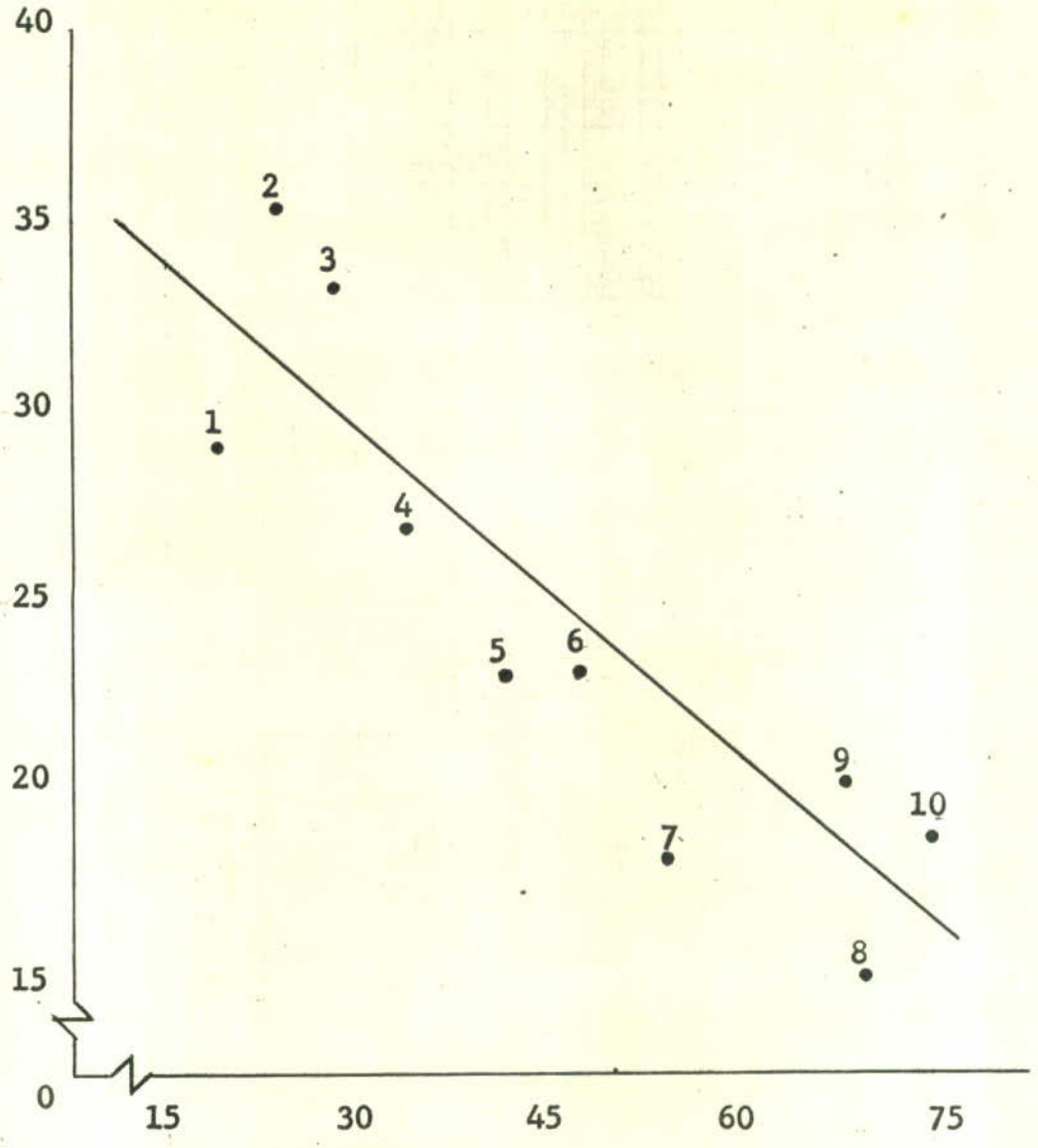

Figure 6. Oranges: Relationship of the Yearly Quantity Consumed to the Adjusted Price, Sao Paulo, 1954-1963.

On the average, and the other variable remaining constant, a one unit change in quantity consumed of oranges brought 0.290 units change in deflated price of oranges in the opposite direction and a one unit change in real income per capita and was associated with 0.011 units change in deflated price of oranges in the same direction. Income was positively related to orange prices, this means that as income increases, total demand for oranges is increasing.

Consumption per capita of oranges is highly correlated with prices of the product. This fact is noted in the coefficients of simple correlation for the analysis.

	X_1	X_2	Y
X_1	1.000	-0.111	-0.862
X_2	-----	1.000	0.362
Y	-----	-----	1.000

Both consumption per capita and consumer's income explained about 81.4 per cent of the variations in orange prices. This value was found to be highly significantly different from zero. Consumption per capita was found to be more important to explain prices variations in the

model than real income per capita.

Estimated prices from the demand equation and its comparison to actual observed prices is shown in Table 6.

Table 6. Oranges: Comparison of Actual Annual Prices and Prices Estimated from Demand Equation, 1954-1963. (Cruzeiros per box, 1948-52=100)

Year	Actual Farm Market Price	Estimated Farm Market Price	Residuals
1954	29.10	32.40	-3.30
1955	36.60	32.20	4.40
1956	32.20	28.50	3.70
1957	26.50	27.60	-1.10
1958	27.60	30.30	-2.70
1959	20.70	21.60	-0.90
1960	16.70	20.10	-3.40
1961	14.40	16.70	-2.30
1962	20.40	17.70	2.70
1963	19.60	16.80	2.80

Source: Equation VI and Appendix Table 23.

The demand for oranges at farm level was found to be price elastic. A one per cent change in the price of oranges was associated with 1.8 per cent change in the quantity consumed in the opposite direction. Thus,

successive price declines were accompanied by an increase in total revenue (price times quantity) derived from the sales of oranges at the farm level. As successively lower prices prevailed at farm level, purchases per wholesalers - dealers tended to increase at a rate slightly higher than the rate at the price declined. Conversely, successively higher prices brought about more than proportionate declines in sales rates, and the total revenue diminished as the price increased.

Oranges have a demand which is income elastic at farm level. On the average, a one per cent change in income was associated with 6.8 units change of the quantity consumed in the same direction.

ONIONS

Commercial onions are an important minor crop compared with other crops in the State. In 1962 it ranked 18 in the total gross cash income of farmers being responsible for 0.37 per cent of it. It also ranked 14th in total acreage.

Production of onions come from commercial farms around the major consumption centers. In addition to the commercial supply it is estimated that relatively large quantities of onions are produced in farm and market gardens.

Onions do not need further processing to be consumed. They are used for home consumption mainly in home cooking, sandwiches, sauces, etc.

It is estimated that the quantity exported or imported are relatively unimportant compared with the size of domestic commercial crop. The more perishable the crop, the more close consumption approximate production for the year. Thus, except for some shrinkage and waste in the marketing channels, consumption equal production of the State.

The demand for onions is defined as influenced by the size of crop, the price of competing goods and consumer's income.

The period covered by the analysis is 1954-1963 and the derived demand equation is:

$$Y = -138.15 - 26.548X_1 - 0.127X_2 - 0.374X_3 + 0.046X_4 \quad \text{(VII)}$$

$$(-2.369)^{**}(-1.863)^{**}(-2.350) \quad (1.350)$$

$$R^2 = 0.721 \qquad Sy = CR\$12.61$$

Where

Y = deflated price of onions in cruzeiros per 15 kilos;

X_1 = consumption of onions per capita, kilos per person;

X_2 = deflated price of beans in cruzeiros per bag of 60 kilos;

X_3 = deflated price of rice in cruzeiros per bag of 60 kilos;

X_4 = real income per capita in cruzeiros per person.

A linear demand curve is fitted to price-quantity data as shown in Figure 7.

The interpretation of the demand equation is the same as the latter products, care must be taken to have the right values for the coefficients. This model shows that, as it was expected, beans and rice do not compete with onions, they are complementary products in consumption. Also it can be noted that deflated price of onions is positively correlated with income. People are consuming more onions as their income increases.

Adjusted Price
Cruzeiros Per Kilo

$Y = 137.382 - 26.548X_1$

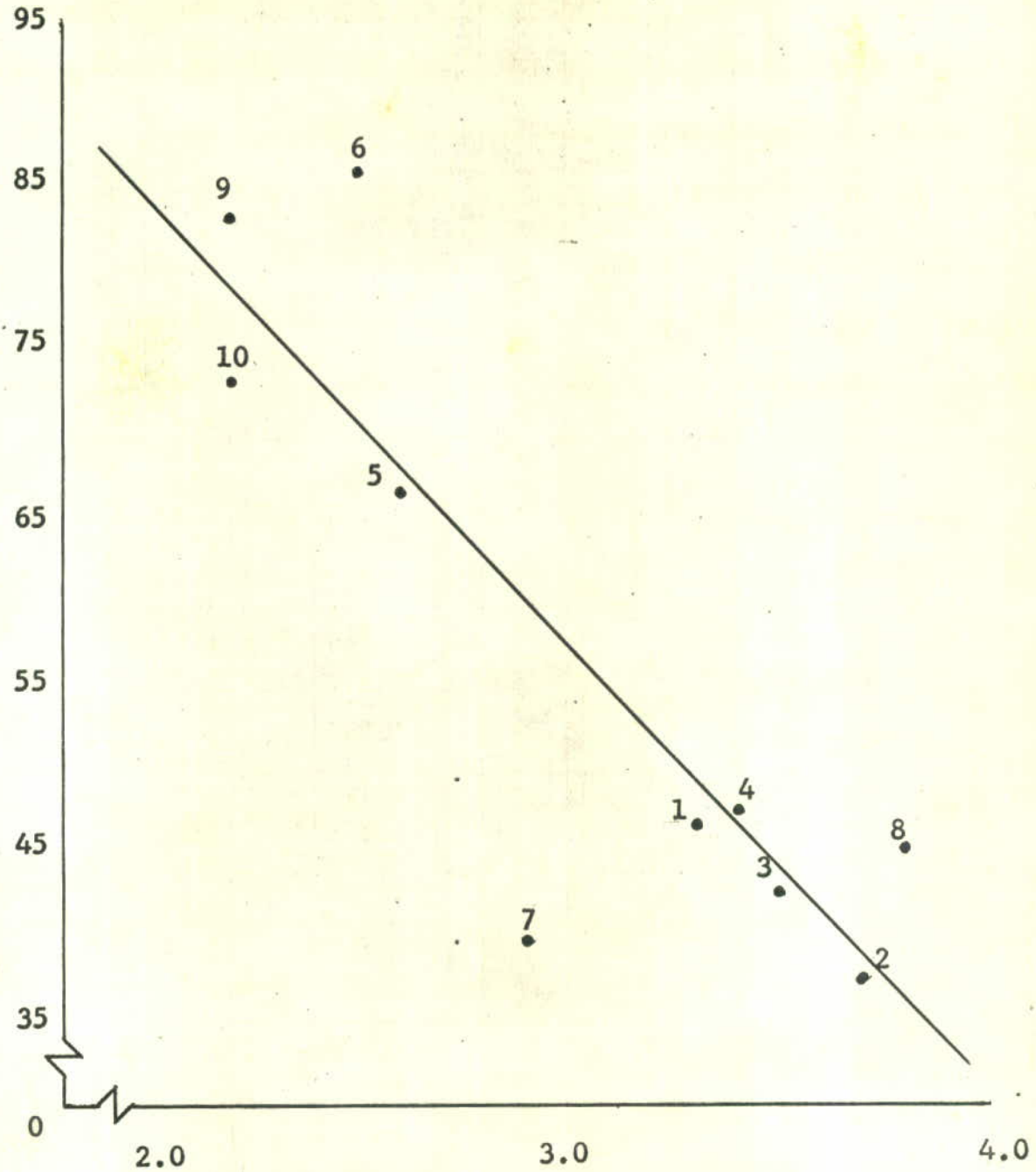

Figure No. 7. Onions: Relationship of the Yearly Quantity Consumed to the Adjusted Price, Sao Paulo, 1954-1963.

The coefficients of simple correlation for this analysis is:

	X_1	X_2	X_3	X_4	Y
X_1	1.000	-0.530	-0.612	-0.055	-0.058
X_2	-----	1.000	0.095	-0.507	-0.505
X_3	-----	-----	1.000	0.437	-0.139
X_4	-----	-----	-----	1.000	0.482
Y	-----	-----	-----	-----	1.000

It can be noted the small association between price of onions and quantity consumed. This may be due to the fact that considerable part of production coming from small gardens is not computed in the total production series.

In this analysis, consumption per capita of onions, deflated price of beans and rice as well as income explained 72.1 per unit of the variation in prices of onions. The coefficient of determination is significant at the level of 5 per cent.

As suggested by the values of intercorrelations, the quantity consumed of onions was the least important variables to explain varation in onions prices. The most important was deflated price of beans, followed by de-

flated price of rice and consumer's income.

The estimated prices computed from the demand equation are:

Table 7. Onions: Comparison of Actual Annual Observed Prices and Computed Annual Prices From the Demand Equation - 1954-1963. (Cruzeiros Per 15 Kilos, 1948-1952=100)

Year	Actual Farm Market Price	Computed Farm Market Price	Residuals
1954	58.80	61.60	-2.80
1955	49.30	50.80	-1.50
1956	33.50	35.10	-1.60
1957	47.90	47.20	0.70
1958	92.40	88.50	3.90
1959	72.20	57.50	14.70
1960	43.90	64.40	-20.50
1961	74.70	65.70	9.00
1962	43.70	39.70	4.00
1963	53.00	58.70	-5.70

Source: Equation VII and Appendix Table 24.

The direction of year to year movement of computed prices agrees with the direction of observed prices in all years but one.

The demand for onions at farm price level was found to be inelastic. On the average, a one per cent change in prices of onions was associated with 0.7 per cent change in the quantity consumed in the opposite direction. Price inelasticity is expected for perishable products and to the farm sector, this value means that for an increase or decrease in prices of onions, purchase will correspondingly decrease or increase less than proportionate. It follows that total revenue for onions farmers will increase only with a rise in the price of the product.

However, demand for onions was found to be income elastic. On the average, a one per cent increase in consumer's income was associated with 4.7 per cent increase in the quantity produced of onions in the same direction. Thus, increased incomes are enabling consumers to purchase more of onions to satisfy their needs.

FAT CATTLE

Sales of fat cattle is the largest single source of income of farmers in the State of Sao Paulo. In 1962, about 17.6 per cent of all cruzerios earned by farmers came from this source representing a total of $62.40 billion cruzeiros. Outstanding progress in production and value in beef in the last five years has meant that pork and hogs became more eclipsed than before.

Cattle are fed in the State on an extensive scale and production is middle grade beef or grass fattened beef. However, it is estimated that the quality of beef has been improving chiefly by means of increased feed lot operations and developments in beef breeding.

The State of Sao Paulo imports live animals generally feeder cattle and calves received from other neighbor States and it exports fresh or cured beef for processing as well as canned beef and variety meat such as tongue, livers, etc.

Unlike many agricultural commodities meat is exclusively a food item. Meat animals are produced primarily for their meat. Most of its consumption is by individual households, however, there is part of the pro-

duct consumed outside household for which neither a theoretical structure nor empirical data are available to make allowance for it.

It is estimated that demand for meat to go into stocks is small and net foreign trade is of the processed product and seldom very large. Thus in this analysis it is assumed that annual consumption is almost equal to total domestic production. The use of production alone as a measure of total meat supply is a convenient and necessary short cut in this analysis.

The economic assumption of the model is that the average price received by farmers for fat cattle is chiefly determined by the consumption per capita of fat cattle, by deflated price of other livestock competing goods and by the degree of urbanization. Real income per capita did not present significant statistical results in explaining prices of fat cattle and was dropped from the model.

The period covered in the study is 1954-1963. The computed demand equation for fat cattle at farm market level is:

$$Y = -42.379 - 2.825X_1 + 0.463X_2 + 72.257X_3 + 1.371X_4 \quad \text{(VIII)}$$

$$(-2.896)^{***}(2.583)^{***}(2.258)^{**} \quad (1.156)$$

$$R^2 = 0.897^{***} \qquad Sy = CR\$10.70$$

Where

Y = deflated price of fat cattle in cruzeiros per 15 kilos;

X_1 = consumption per capita of fat cattle in kilos per person;

X_2 = deflated price of hogs in cruzeiros per 15 kilos;

X_3 = deflated price of milk in cruzeiros per liter;

X_4 = degree of urbanization taken as percentage of people in urban areas.

The price-quantity relationship for fat cattle is shown on Figure 9.

The demand equation indicates that economic assumptionr were confirmed. Hogs, and milk are competing goods in consumption since all three are different sources of protein foods. It also indicates that as the degree of urbanization increases the price of fat cattle increases by the strength of demand for meat.

In order to ascertain the causal influences affecting prices of fat cattle in the period it is necessary to analyze intercorrelations among variables.

	X_1	X_2	X_3	X_4	Y
X_1	1.000	0.156	-0.460	-0.505	-0.776
X_2	-----	1.000	-0.567	-0.173	0.056
X_3	-----	-----	1.000	0.612	0.622
X_4	-----	-----	-----	1.000	0.715
Y	-----	-----	-----	-----	1.000

$Y = 245.580 - 2.825X_1$

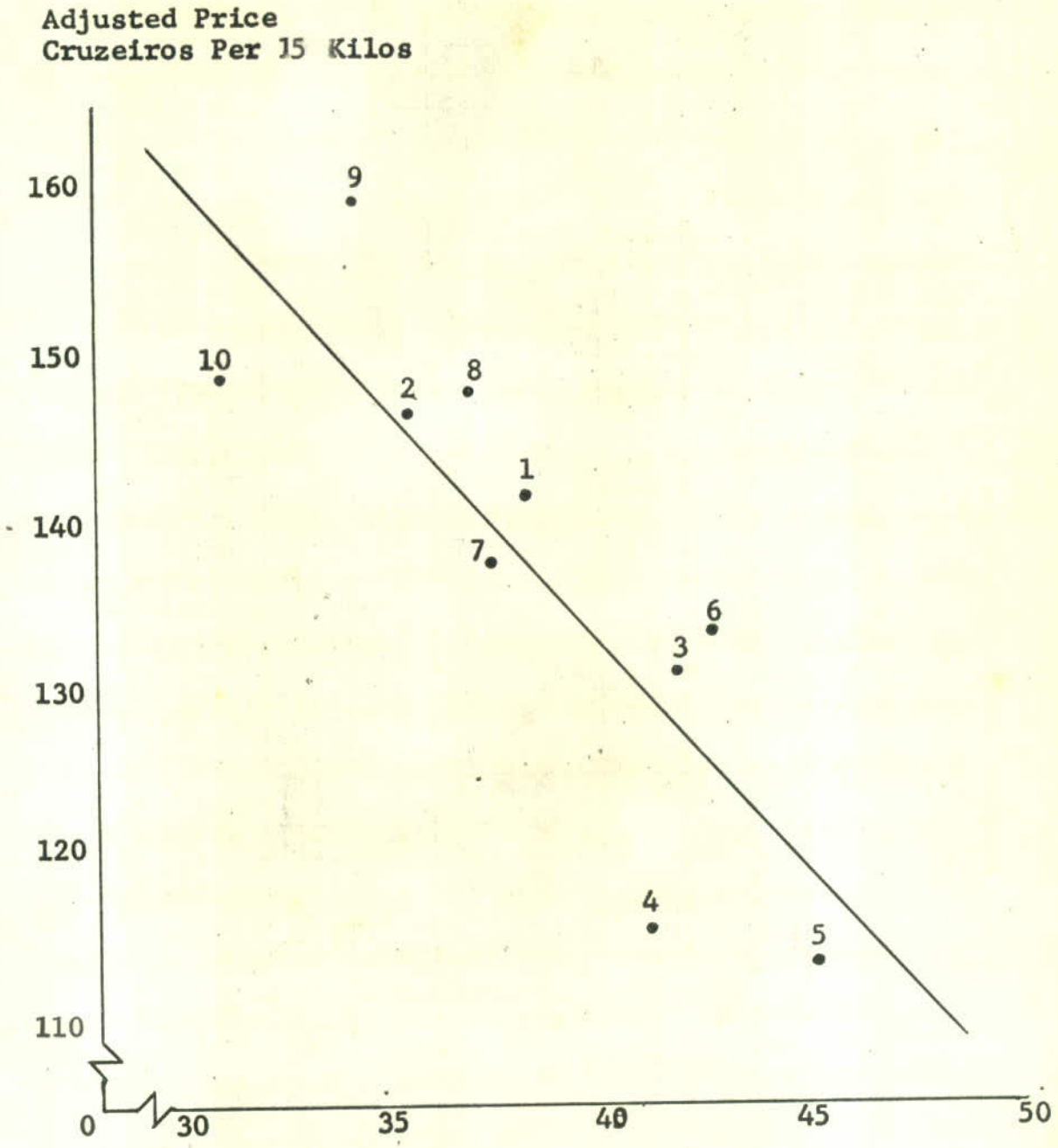

Figure 8. Fat Cattle: Relationship of the Yearly Quantity Consumed to the Adjusted Price, Sao Paulo, 1954-1963.

No serious intercorrelations were found among independent variables and it can be noted that the dependent variable is relatively highly associated with all independents factors but hogs. However this variable was left in the model because it worked very well when it was associated with other independent variables. The t test of the regression coefficient for hogs confirms it.

About 89.7 per cent of variation in prices of fat cattle was explained by variation in consumption of fat cattle, by deflated price of hogs and milk and by the degree of urbanization.

The most important variable in the model for explaining fat cattle price variation is consumption per capita, it was followed by deflated price of milk, deflated price of hogs and the least important is the degree of urbanization.

In order to evaluate the power of the model to predict fat cattle prices, the computed prices from the demand equation are compared with actual observed prices.

Table 8. Fat Cattle: Comparison of Actual Annual Prices and Annual Prices from Demand Equation, 1954-1963. (Cruzeiros per 15 Kilos 1948-52= 100)

Year	Observed Farm Market Prices	Estimated Farm Market Prices	Residuals
1954	114.00	110.20	3.80
1955	128.00	126.40	1.60
1956	117.00	113.20	3.80
1957	100.00	114.80	-14.80
1958	100.00	104.90	- 4.90
1959	110.00	102.50	7.50
1960	153.00	154.80	- 1.80
1961	162.00	156.90	5.10
1962	162.00	151.90	10.10
1963	149.00	159.50	-10.50

Source: Equation VIII and Appendix Table 25.

Despite the small size of standard error of estimate, CR$10.70, which gave relatively close estimate of the observed prices, the model was poor in estimate changes in the direction of the fat cattle prices. It can be noted that only three of the changes in direction of prices were predicted for the model.

The demand for fat cattle at farm market price level was found to be elastic. On the average, a one per cent change in the prices of fat cattle was positively associated with 1.3 per cent[52] change in quantity consumed. To cattle farmers this means that a decrease in the prices of cattle will be accompanied by an increase in sales more than proportionate and total revenue will increase. On the other hand, an increase in prices bring about a diminishing in sales less than proportionate and the total revenue associated will diminish.

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[52]Elasticity was computed at the mean of all variabels but urbanization. For this variable the figure used was the observation of the last year of the period.

HOGS

Hogs are a relatively important product for Sao Paulo farmers. Cash receipts to farmers from the sale of hogs in 1962 were $9.05 billion cruzeiros, which is about 2.5 per cent of the total.

Production of hogs is scattered throughout the State but its volume is closely related to supply of feed concentrates principally corn. This relation is often been expressed as hog-corn price ratio. Production increases following a period when hog prices are high relative to corn prices and it decreases following a low hog-corn ratio.

Consumption of pork are relatively small compared with beef consumption. Consumers preferences and higher costs of hogs production are factors determining this difference of consumption in both products.

Hogs are chiefly utilized in the form of pork products and lard. It is estimated that the State of Sao Paulo is an importer of slaughtered hogs to be processed within the State and it exports the processed lard. No data are available to quantify this interstate trade.

In the analysis the total domestic production of hogs will be assumed to equate total domestic consumption and it is based in observations for the period 1954-1963. Different economic structure before this period prevents the inclusion of those data in an analysis to detect recent relationships.

The economic assumption of the model is that the deflated average price received by farmers for hogs is determined not only by the quantity consumed of hogs but by the price of competing livestock products and consumers income.

The derived demand equation based on those assumptions is:

$$Y = 43.422 - 25.551X_1 + 0.205X_2 + 18.162X_3 - 0.018X_4 \quad (IX)$$

$$(-3.399)^{***}(0.858) \quad (2.661)^{**} (0.556)$$

$$R^2 = 0.819^{***} \quad Sy = CR\$14.36$$

Where

Y = deflated price of hogs in cruzeiros per 15 kilos;

X_1 = consumption per capita of hogs in kilos per person;

X_2 = deflated price of fat cattle, in cruzeiros per 15 kilos;

X_3 = deflated price of eggs in cruzeiros per dozen;

X_4 = consumers real income in cruzeiros per capita.

The linear demand curve is shown on Figure 9.

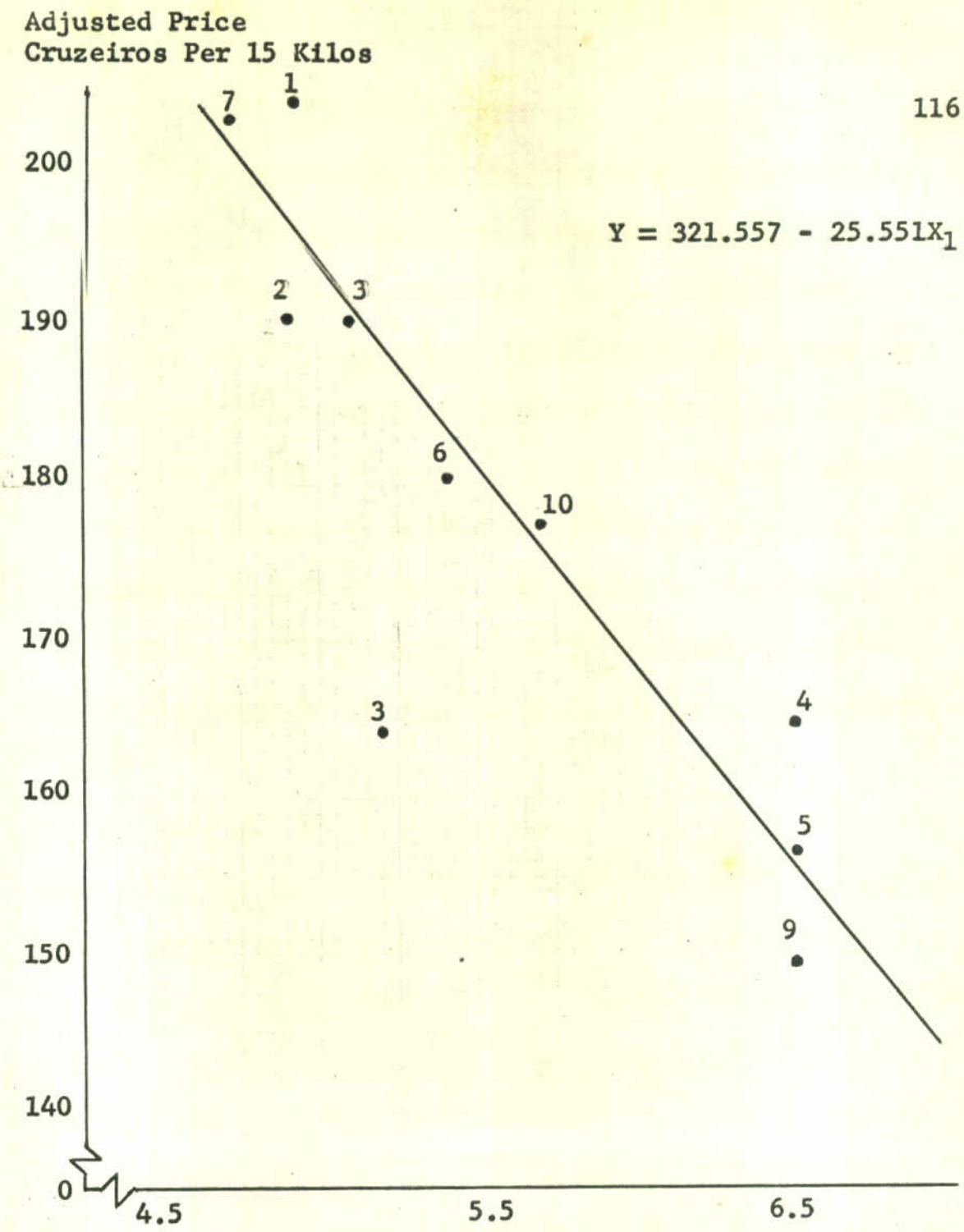

Figure 9. Hogs: Relationship of the Yearly Quarterly Consumed to the Adjusted Price, Sao Paulo, 1954-1963.

The equation shows that fat cattle and eggs are competitive products to hogs in consumption. Despite the t test indicate that the coefficient for income is not significantly different from zero it was left in the model to analyze its relationship to hog prices. The computed equation indicates that hog prices is inversely associated with income, this implies that as consumers increase their income they demand less quantity of pork.

The coefficient of simple correlation observed in the model is:

X_1	1.000	-0.239	-0.021	0.443	-0.736
X_2	-----	1.000	-0.470	-0.248	0.055
X_3	-----	-----	1.000	-0.198	0.513
X_4	-----	-----	-----	1.000	-0.369
Y	-----	-----	-----	-----	1.000

Price of hogs was relatively highly associated with consumption per capita of hogs.

In this analysis of the determinants of hogs prices, consumption per capita of hogs, deflated price of fat cattle, deflated price of eggs and real income per capita explained 81.9 per cent of total variation of hog

prices. The value of the R^2 was significant at the level of 5 per cent.

The Beta values indicated that the most important variable in the model explaining hogs prices was the consumption per capita of hogs, followed by deflated price of eggs, deflated price of fat cattle and the least important was real income per capita.

In order to indicate the power of the model to predict hog prices, estimated values from the demand equation are compared with actual observed values during the period.

Table 9. Hogs: Comparison of Actual Annual Prices and Annual Prices Estimated from Demand Equation, 1954-1963. (Cruzeiros per 15 Kilos 1948-52=100)

Year	Observed Farm Market Prices	Estimated Farm Market Price	Residuals
1954	185.00	177.00	8.00
1955	185.00	190.80	-5.80
1956	176.00	200.50	-24.50
1957	169.00	159.50	9.50
1958	169.00	167.80	1.20
1959	190.00	188.10	1.90
1960	238.00	223.70	14.30
1961	185.00	185.70	-0.70
1962	140.00	145.70	-5.70
1963	163.00	161.10	1.90

Source: Equation IX and Appendix Table 26.

The model gave reasonable results for predicting changes in the direction of the dependent variable. During the period, the model predicted correctly 7 of the year to year variations in direction of hog prices. The accuracy of forecast may be assumed to be relatively good since the standard error of estimate of CR$14.36 is not large.

The demand for hogs at farm price level was found to be price elastic. On the average, a one per cent change in price of hogs was associated with 1.3 per cent change in the quantity consumed in the opposite direction. To farmers this means that a decrease in hog prices will bring about an increase in the quantity taken more than proportionate and thus, the total revenue (price * quantity) associated with this sale will increase. Conversely, an increase in hog prices will bring a decrease in quantity consumed more than proportionate and the total revenue will decrease.

Income elasticity for hogs at farm level was found to be unitary. On the average a one per cent change in income was associated with 1.0 per cent change in quantity consumed, in the opposite direction. Thus, as consumer's income increases, quantity consumed of pork decreases in the same proportion.

SUGAR CANE

Sugar Cane is the most important agricultural raw material for the industry grown in the State of Sao Paulo. In 1962 about 35.8 billion cruzeiros were received by farmers for the sale of the commodity; which represented 9.2 per cent of the total. In total acreage it ranked fifth. This crop is grown in a intensive scale and production is localized in determined regions of the State, generally where are the best soil for agricultural exploitation.

Sugar Cane is grown to produce sugar and this is one of the most important sources of energy obtained from food. It has a wide use in human consumption.

The State of Sao Paulo is self sufficient in covering the raw material needs of the sugar mills. This analysis will deal with the average price received by farmers from the millers.

Differently from other commodities of this research, sugar cane is supposed to be the product which best fulfill the assumption that domestic production equals consumption. Net foreign trade is almost none and generally all crop is harvested.

The economic assumption of the sugar cane demand model is that the average price received by farmers is determined by consumption per capita of sugar cane and by degree of urbanization. There is no competitive product for sugar cane and income was left out of the model because it did not present significant statistical results. Like most agricultural commodities analyzed, the period which best fit the demand for sugar cane was the period 1954-1963.

The computed demand equation for sugar cane is:

$$Y = 149.292 - 0.102X_1 + 6.543X_2 \qquad (X)$$

$$(4.220)^{***} \quad (4.346)^{****}$$

$$R^2 = 0.743^{****} \qquad Sy = CR\$10.80$$

Where Y stands by deflated price of sugar cane in cruzerios per ton, X_1 stands by quantity of sugar cane consumed in kilos per person, and X_2 is degree of urbanization.

The linear demand curve fitted to the data for the period 1954-1963 is shown in Figure 10.

Both independent variables were highly significant in the model and they explained about 74.3 per cent of variation in sugar cane prices. Degree of urbanization was found to be more important in the model than per capita consumption of sugar cane to explain prices variation of the product.

$$Y = 313.299 - 0.1023X_1$$

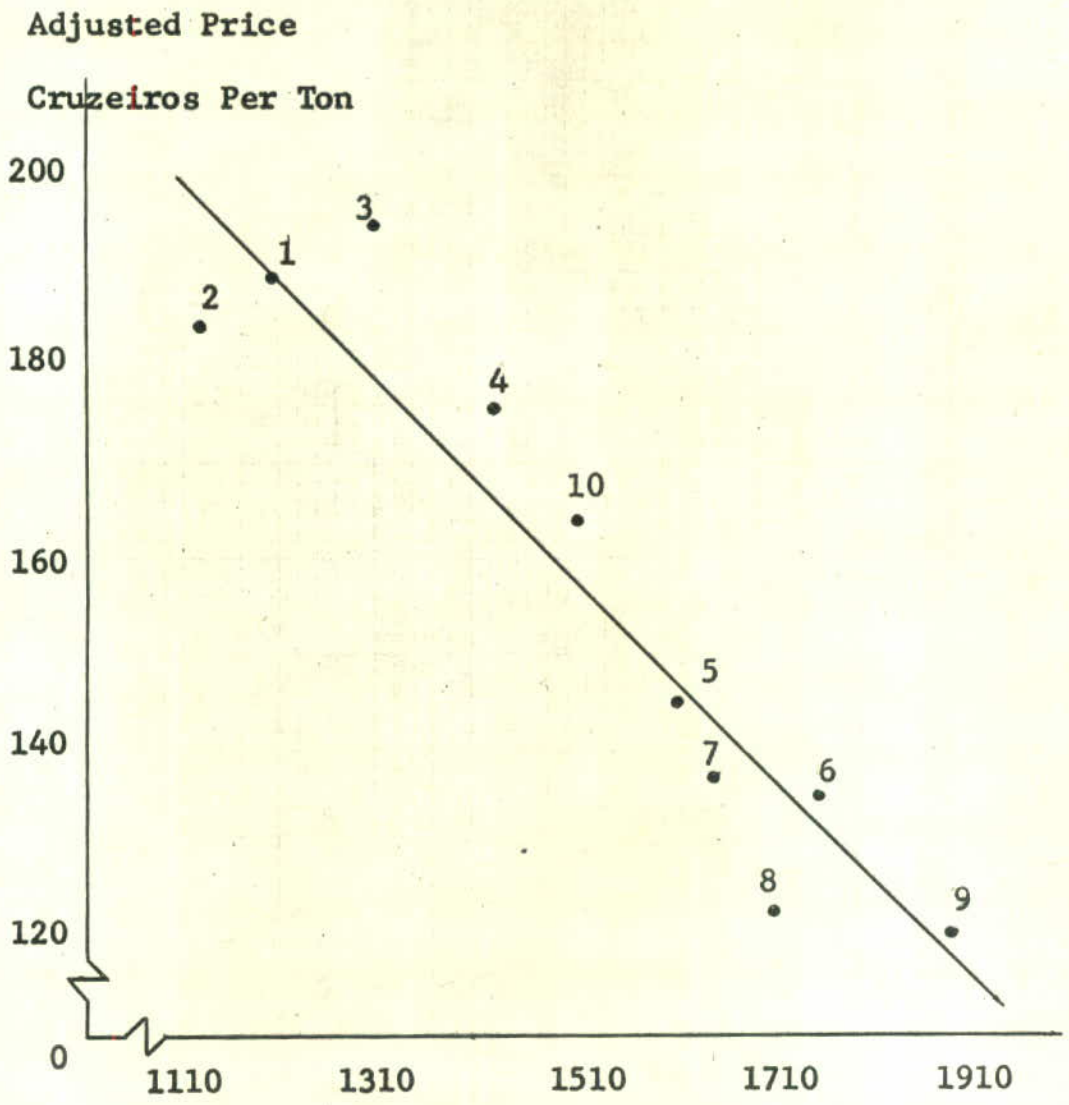

Figure 10. Sugar Cane: Relationship of the Yearly Quantity Consumed to the Adjusted Price, Sao Paulo, 1954-1963.

Despite the significance of the coefficients of regression of X_1 and X_2 both presented a relatively high intercorrelation.

	X_1	X_2	Y
X_1	1.000	0.813	-0.225
X_2	-----	1.000	0.300
Y	-----	-----	1.000

Table 10 shows the accuracy of the demand equation on to predict sugar cane prices and the directions of its movements.

Table 10. Sugar Cane: Comparison of Actual Annual Prices and Annual Prices Estimated from Demand Equation, 1954-1963. (Cruzeiros per ton, 1948-52=100)

Year	Observed Farm Market Price	Estimated Farm Market Price	Residuals
1954	111.00	111.80	- 0.80
1955	114.00	128.20	-14.20
1956	133.00	117.80	15.20
1957	123.00	113.50	9.50
1958	101.00	104.00	- 3.00
1959	100.00	97.50	2.50
1960	112.00	117.20	- 5.20
1961	107.00	121.20	-14.20
1962	116.00	112.30	3.70
1963	164.00	157.50	6.50

Source: Equation X and Appendix Table 27.

It can be noted that only three year to year variations in the computed prices were not the truely observed. Because of the small value of the standard error estimate, the computed prices are reasonable close to those actually observed.

Sugar cane prices at farm level was found to have a unitary elasticity. On the average a one per cent change in sugar cane prices was associated with one per cent change in consumption per capita in the opposite direction. To the farmers this means that both an increase or decrease in the prices of the product, the quantity taken was reduced and increased in the same proportion and the total revenue associated with the sales were the same.

The elasticity of urbanization was computed as an illustration. It was found that on the average, an increase of one per cent in urbanization is positively associated with a 2.9 per cent change in the quantity consumed. This is an interesting finding, it shows that the consumption of sugar cane is highly associated with the degree of urbanization.

PEANUTS

The value of peanuts production in 1962 was $14.00 billion cruzeiros which represented 4.0 per cent of total cash income of farmers for that year.

Peanuts is the raw material for the production of peanut oil which is the most important cooking oil consumed in the State. Together with cottonseed oil it represents about two-thirds of the total fats and oil consumption of households, restaurants, bakeries, and other users.

The State of Sao Paulo processes some peanuts produced in neighboring states and it generally exports the oil to those States. This is due to the fact that Sao Paulo owns the majority of peanut mills. Despite the estimation that this interstate trade is not important compared with the size of the domestic production, no data is available to prove it. For the purposes of this analysis of peanut prices, total production of the State will be assumed to equate consumption.

The economic assumptions of this model is that the price of peanuts are determined by thesize of peanut crops, by the per capita consumption of peanuts, by the per capita consumption of peanuts, by the per

capita consumption of cottonseed, by the deflated price of competing oils and by consumer's income.

The computed demand equation for the period 1954-1963 is:

$$Y = 110.220 - 0.791X_1 - 0.488X_2 + 0.290X_3 - 0.010X_4 \quad (XI)$$

$$(-3.536)^{***}(-1.733)^{**} \quad (4.648)^{***}(-1.093)$$

$$R^2 = 0.867^{***} \qquad Sy = \$4.69$$

Where:

Y = deflated price of peanuts in cruzeiros per bag of 25 kilos;
X_1 = quantity consumed of peanuts in kilos per person;
X_2 = quantity consumed of cottonseed in kilos per person;
X_3 = deflated price of gergelim;
X_4 = consumer's real income in cruzeiros per person.

Assumptions derived from economic theory were confirmed in the statistical analysis. Quantity of cottonseed (it was determined by assuming that an average of 61 per cent of cotton production is seed) was competitive with peanuts in consumption, the same was observed by gergelim oil. Consumer's income was negatively related with prices of peanuts. This means that as the income increases, people demand less of peanut oil, probably deriving consumption to other types of more expensive cooking oils.

Figure No. 11 shows the price-quantity relationship for peanuts.

$$Y = 77.877 - 0.791X_1$$

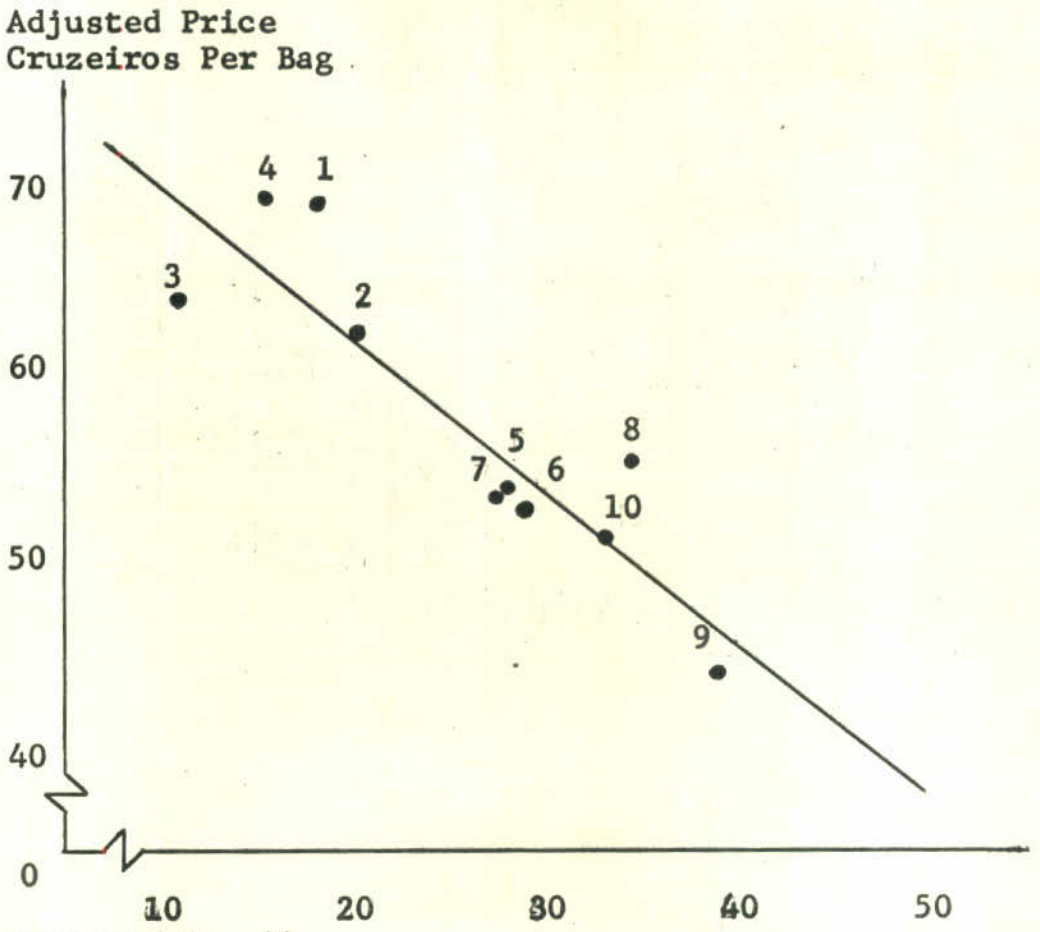

Figure: No. 11
Peanuts: Relationship of the Yearly Quantity Consumed to the Adjusted Price, Sao Paulo, 1954-1963.

However, the size of the coefficient for income is too small and the t test showed that it is not significant.

The coefficients of simple correlation for this analysis is:

	X_1	X_2	X_3	X_4	Y
X_1	1.000	-0.107	0.616	0.078	-0.116
X_2	-----	1.000	-0.130	-0.080	-0.321
X_3	-----	-----	1.000	-0.168	0.611
X_4	-----	-----	-----	1.000	-0.392
Y	-----	-----	-----	-----	1.000

Small association was found between price of peanuts and its quantity consumed.

In this analysis of the factors affecting prices of peanuts, quantity consumed of peanuts and cottonseed, deflated price of gergelim and consumers income explained 86.7 per cent of total variation in peanuts prices. Deflated price of gergelim was the most important variable to explain this variation, it was followed by consumption per capita of peanuts, consumption per capita of cottonseed and finally consumer's income.

Computed peanuts price and observed prices can be compared in the Table 11.

Table 11. Peanuts: Comparison of Actual Annual Prices and Annual Prices Estimated From Demand Equation, 1954-1963. (Cruzeiros per bag, 1948-52=100)

Year	Observed Farm Market Prices	Estimated Farm Market Prices	Residuals
1954	62.00	56.80	5.20
1955	45.00	44.70	0.30
1956	56.00	61.70	-5.70
1957	69.00	65.70	3.30
1958	49.00	50.70	-1.70
1959	48.00	49.10	-1.10
1960	74.00	75.90	-1.90
1961	65.00	60.20	4.80
1962	53.00	55.80	-2.80
1963	55.00	55.30	-0.30

Source: Equation XI and Appendix Table 28.

This model gave good results for predicting year to year changes in direction of peanuts prices. Only for the last year of the period the direction of movement of computed prices do not agree with observed changes in direction of peanuts prices.

The demand for peanuts at farm market level was found to be elastic. On the average a one per cent change in prices of peanuts was negatively associated with 2.8 per cent change in quantity consumed. On the other hand, demand for peanuts at farm level was found to be income inelastic. On the average a one per cent change in income was negatively associated with 4.2 per cent change in the quantity consumed. This means that an increase in income brought a decrease of consumption of peanuts. Since the income coefficient in the demand equation is not significant, this income elasticity needs to be confirmed by further research.

MANIOC

Manioc ranked 12 in the list of most important farm products of the State of Sao Paulo. In 1962, it was responsible for $12.0 billion cruzeiros or 3.4 per cent of total farmer's gross cash income.

Production of manioc is scattered throughout the State, localized according to the market for which it is grown. Manioc has many uses but chiefly it is used as raw material for the industry of starch, tapioca, manioc meal and other by products. A minor part of production is utilized for human consumption and in feed for livestock. Commercial farms produce for industrial use, farm and home gardens are responsible for feed and household consumption.

It is estimated that interstate trade in manioc is of a minor importance compared with the size of domestic production. However the State of Sao Paulo exports the processed product for foreign markets and internal markets. No data is available to quantify the latter but the former is of no importance according to the statistics of Rural Economics Division.[53]

[53] See R. A. Dias and C. C. Fraga, Op. cit. pp. 48-49.

Being a perishable commodity, consumption of manioc close represents production of the year. Since no interstate trade is assumed to affect the size of volume produced in this analysis, domestic production is taken as consumption of the State.

The definition of the demand for manioc should be done in its broad sense that is as the aggregate of all different markets for the product. The economic assumption is that the deflated price of manioc is determined by the quantity consumed of manioc, by the deflated prices of competing goods in the various outlets and by the degree of urbanization.[54]

The computed demand equation for the period of 1954-1963 is: $Y = 1{,}992.010$

$$- 2.747X_1 + 1.360X_2 + 2.715X_3 + 1.994X_4 + 28.655X_5 \quad \text{(XII)}$$

$$(-4.574)^{***}(3.176)^{***}(2.836)^{***}(2.426)^{**}(5.870)^{****}$$

$$R^2 = 0.953^{****} \qquad Sy = CR\$31.00$$

Where:

Y = deflated price of manioc in cruzeiros per ton;

X_1 = quantity consumed per capita, kilos per person;

X_2 = deflated price of rice in cruzeiros per bag of 60 kilos;

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[54]Consumer's income was dropped of the model because statistical analysis indicate that this variable was not significant to explain manioc prices.

X_3 = deflated price of potatoes in cruzeiros per bag of 60 kilos;

X_4 = deflated price of corn in cruzerios per bag of 60 kilos;

X_5 = degree of urbanization taken as percentage of population living in urban areas.

The linear demand curve fitted for the data of the years 1954-1963 is shown in Figure 12.

The statistical results indicates that rice, potatoes and corn are competing goods in consumption for manioc. They also indicate that degree of urbanization contribute to increase the quantity demanded of manioc.

Since this is a model with a large number of independent variables it is expected intercorrelations among those variables.

	X_1	X_2	X_3	X_4	X_5	Y
X_1	1.000	0.358	0.235	0.319	0.833	0.210
X_2	-----	1.000	0.721	0.367	0.129	0.576
X_3	-----	-----	1.000	-0.462	0.138	0.664
X_4	-----	-----	-----	1.000	0.227	-0.067
X_5	-----	-----	-----	-----	1.000	0.445
Y	-----	-----	-----	-----	-----	1.000

$$Y = 767.507 - .2747X_1$$

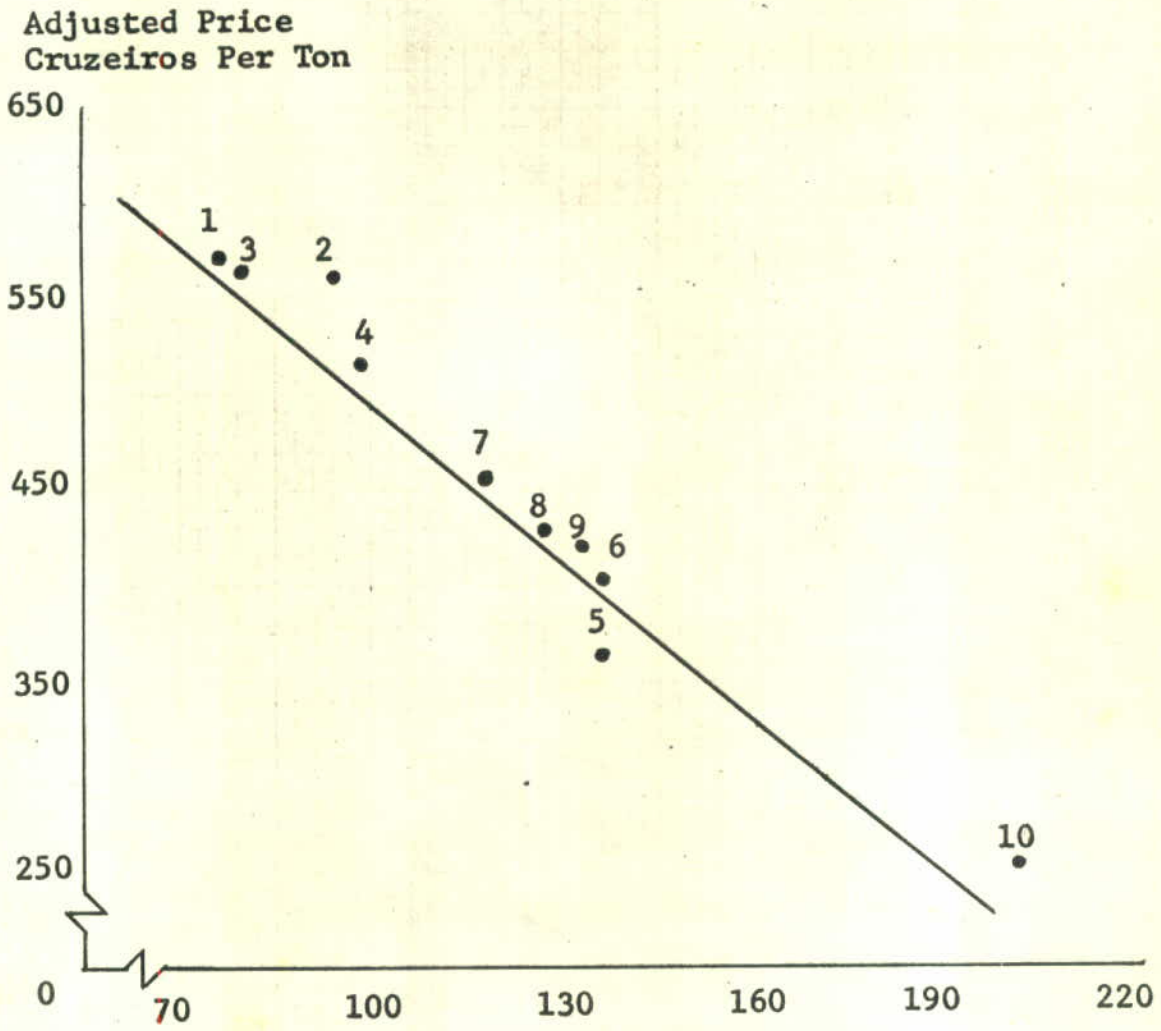

Figure 12. Manioc: Relationship of the Yearly Quantity Consumed to the Adjusted Price, Sao Paulo, 1954-1963.

High intercorrelations were observed for X_2 X_3 and X_1 X_5.

Consumption per capita of manioc, deflated prices of rice, potatoes and corn as well as degree of urbanization explained 95.3 per cent of total variation in prices of manioc. This was the largest coefficient of determination found in the analysis.

The computation of Beta values showed that the order of importance of the variables to explain variation in manioc prices was (1)X_5, (2)X_1, (3)X_2, (4)X_3, (5)X_4.

A comparison of estimated and observed values of manioc prices is shown on the next table.

Table 12. Manioc: Comparison of Actual Annual Prices and Annual Price Estimated from the Demand Equation, 1954-1963. (Cruzeiros per ton, 1948-52=100)

Year	Observed Farm Market Prices	Estimated Farm Market Prices	Residuals
1954	291.20	291.00	0.20
1955	234.70	201.70	33.00
1956	275.60	277.00	- 1.40
1957	275.90	272.10	3.80
1958	215.80	262.40	-46.60
1959	233.50	242.10	- 8.60
1960	198.30	204.20	- 5.90
1961	278.90	276.50	2.40
1962	533.70	531.90	1.80
1963	327.80	306.50	21.30

Source: Equation XII and Appendix Table 29.

Only twice the demand equation predicted wrong directions of year to year variations in observed manioc prices.

The demand for manioc at farm price level was found to be price inelastic. On the average a one per cent change in manioc price was inversely associated with 0.87 per cent in the quantity consumed. In terms of farmers total revenue this means that a program to increase manioc prices will increase their profits.

CASTOR BEANS

Castor beans is not one of the most important products grown in the State of Sao Paulo. Among the 24 agricultural commodities produced there, it ranked 17 as responsible for farmers total cash receipts with a value of $2.6 billion cruzeiros.

Differently from the minor importance of the value of its production, castor beans being a raw material for the industry of castor oil, is a product of unlimited importance. The major uses of castor oil is in the fabrication of synthetic fibers, jet planes combustibles and other important uses.

The State of Sao Paulo has the castor beans production localized in specialized areas of fertile type of soil and near the castor beans mills. Foreign markets are the largest consumers of castor oil, generally the exports of the product amounts to the major part of production.

It is estimated that the domestic production covers the necessity of industrial consumption. Since no empirical data is available to check it, this analysis has to assume that total production equals total consumption.

According to economic considerations of castor beans market behavior, it is assumed that the price received by farmers for this commodity is determined by quantity consumed of castor beans, by competing oils for industrial use and by the degree of urbanization. Index of business conditions was assumed to be an important variable to explain demand for the product but the statistical analysis showed that this is not true, consequently it was dropped from the model.

The computed demand equation for the period 1954-1963 is:

$$Y = 4.970 - 0.498X_1 + 0.017X_2 + 0.105X_3 \quad \text{(XIII)}$$

$$(2.939)^{***} \quad (1.263) \quad (2.569)^{***}$$

$$R^2 = 0.702^{***} \qquad Sy = \$0.31$$

Where

Y = deflated price of castor beans, in cruzeiros per kilos;

X_1 = consumption per capita of castor beans in kilos;

X_2 = deflated price of soybeans in cruzeiros per bag of 60 kilos;

X_3 = degree of urbanization.

The linear demand fitted for the data in the period is shown in Figure 13.

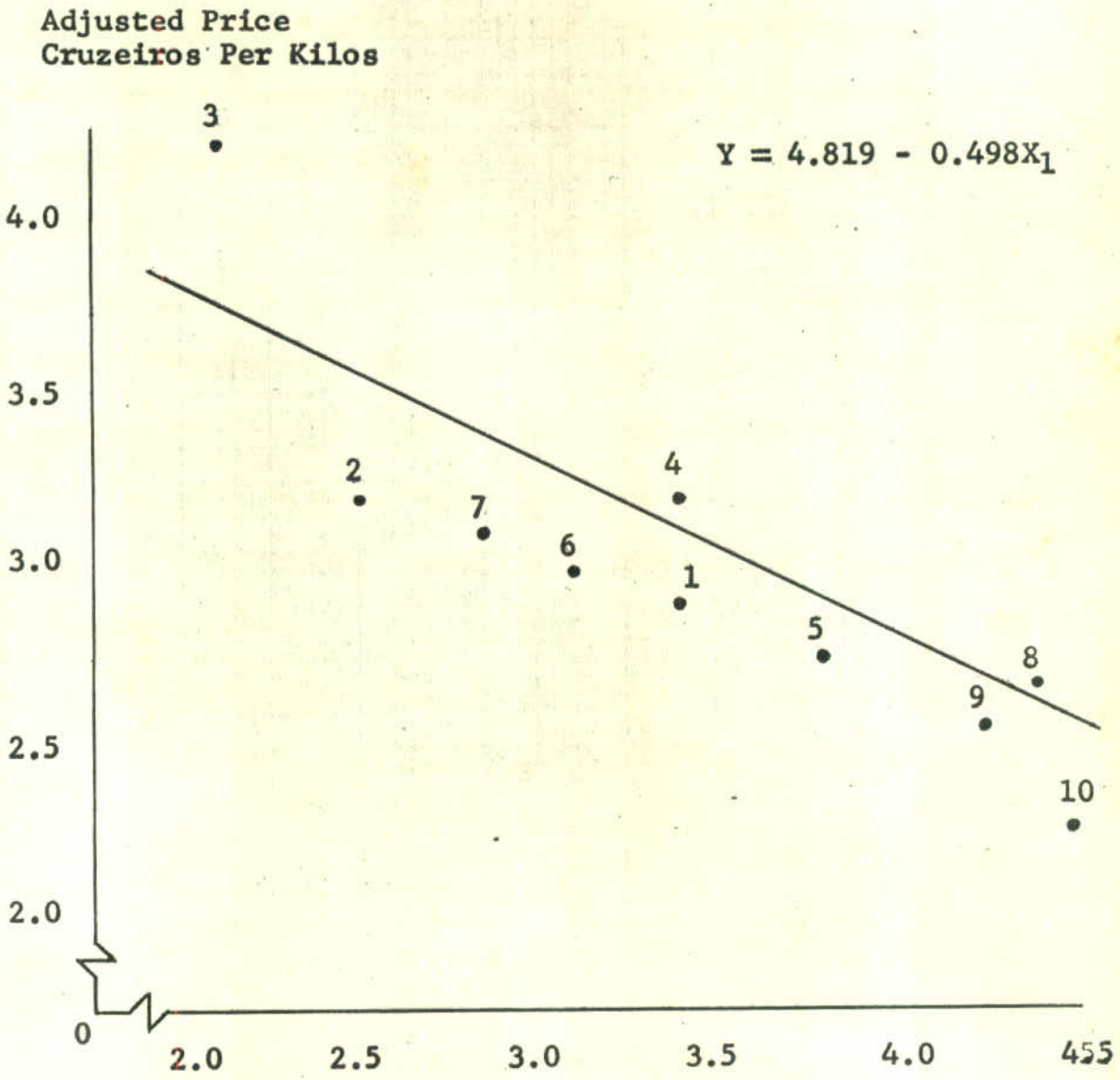

Figure 13. Castor Beans: Relationship of the Yearly Quantity Consumed to the Adjusted Price, Sao Paulo, 1954-1963.

The relations implied in the model are that soybeans compete with castor beans in industrial use and that degree of urbanization strengthens the demand for castor beans.

Likely in latter models, urbanization was relatively high correlated with the consumption per capita of the product.

	X_1	X_2	X_3	Y
X_1	1.000	0.458	0.724	-0.115
X_2	-----	1.000	0.606	0.481
X_3	-----	-----	1.000	0.454
Y	-----	-----	-----	1.000

70.2 per cent of the variation in the castor beans prices was explained by all three independent variables working together. Consumption per capita of castor beans was the most important variable in the model to explain this variation, followed by degree of urbanization and deflated price of soybeans.

The power of the demand equation in estimate castor beans prices can be analyzed in Table 13.

Table 13. Castor Beans: Comparison of Actual Annual Prices and Annual Prices Estimated from the Demand Equation, 1954-1963. (Cruzeiros per Kilos, 1948-52=100)

Year	Observed Farm Market Prices	Estimated Farm Market Prices	Residuals
1954	1.50	1.60	-0.10
1955	2.00	2.30	-0.30
1956	3.00	2.50	0.50
1957	2.40	2.20	0.20
1958	2.00	2.00	0.00
1959	2.20	2.40	-0.20
1960	3.00	3.20	-0.20
1961	2.50	2.40	0.10
1962	2.70	2.50	0.20
1963	2.30	2.50	-0.20

Source: Equation XIII and Appendix Table 30.

The computed equation failed only once to predict the right price movement from one year to the next. Therefore, the accuracy of estimation was good in this model. It also can be noted that since prices were relatively stable in the period the standard error of estimate had a small size.

Price elasticity of demand for castor beans at farm market level was found to have a value of 3.0 that is, it was elastic. Also elasticity of urbanization was 1.7.

CHAPTER VI

IMPLICATIONS OF THE STUDY

The immediate object of a statistical demand analysis is not only the measurement of relationship but also an explanation of the particular values obtained. The analyst should rationalize the numerical results on either a common sense or a theoretical basis. The statistical findings presented in the preceding chapter are summarized in Table 14.

Table 14. Selected Agricultural Products: The Summary of the Results of the Demand Analysis, Sao Paulo.

Products	Coeff. of Multiple Determination - R^2	Standard Error of Estimate	Elasticities	
			Price	Income
Corn	0.791	$ 8.20	$0.90	---
Rice	0.783	22.17	1.60	4.3
Potatoes	0.710	16.12	0.70	---
Beans	0.700	58.12	1.96	16.9
Tomatoes	0.612	7.38	3.60	---
Oranges	0.814	3.48	1.80	6.8
Onions	0.721	12.61	0.70	4.7
Fat Cattle	0.897	10.70	1.30	---
Hogs	0.819	14.36	1.30	1.0
Sugar Cane	0.743	10.80	1.00	---
Peanuts	0.867	4.69	2.80	-4.2
Manioc	0.953	31.02	0.87	---
Castor Beans	0.702	0.31	3.00	---

Source: Equation I to XIII.

The meaning of these results and their implications in the formulation of agricultural price policy should be explained under a framework of economic theory.

At first glance the high coefficients of price and income elasticities for all products are noted. These results show some deviation from most findings of previous work in demand analysis made in United States and Europe.

According to Foote,[55] "Demand for Most Farm Products, at least at the local market level, tends to be inelastic." According to Klein,[56] "the income elasticity of demand for food is less than unity, as should be in the case with necessities, in support of Engel's law about the decline in percentage spent as income rises."

The relevant factor that tends to make agricultural commodities have an inelastic demand is that they generally do not have close substitutes. However, even among agricultural commodities products show different elasticities values depending upon the type of substitutes they have

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[55] Foote, Op. cit. p. 81.

[56] Lawrence R. Klein, An Introduction to Econometrics (Prentice-Hall, Inc. 1962), p. 59.

Note on footnote 56. Engel's Law says that high-income groups spent more money per capita for food than low-income groups, but the high-income groups spent a smaller portion of their income for food than the low-income groups.

compared with others. Meats and other livestock products generally have relatively high coefficients of price and income elasticities because they have more a character of luxury goods than the majority of agricultural products.

One cannot give, of course, a precise definition of necessities or luxuries in terms of price or income elasticities of demand but the notion that products with income elasticity greater than one and less than one are in a general sense luxuries and necessities respectively seems a useful one.[57]

Assuming that, (1) the economic theory or a priori knowledge which guides the model is a true explanation of the subject under scrutinity, (2) all the proposed data are in the form called for by the model or economic theory and (3) that there is a suitable methodology for processing the model, there must be an explanation for the statistical findings of this study.

Elasticity is a proportional concept and the elasticity of a straight line curve on a chart with arithmetic scales, therefore, is not constant from point

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[57] A. W. Stonier and C. C. Hague, A Textbook of Economic Theory, (London: Longmans Green & Co., 1953) p.72.

to point along the line. The value of elasticity, which is independent of both price and quantity units, varies from point to point and always measures the rate of proportional decrease of quantity for proportional increases in prices from the price and quantity in question. The elasticity decreases as the price decreases and the quantity increases.[58]

Leftwich's[59] figure will be used as an illustration of elasticity of demand. See Figure 15, next page. In that figure, X is the commodity, $/X is the price of the commodity and X per UT is the quantity taken.

The three categories of elasticity with respect to its magnitude can be derived from the Figure 15. Point P_2 has elasticity equal to $\frac{M_2T}{OM_2}$ which obviously is less than one, thus inelastic, point P_1 has elasticity equal $\frac{M_1T}{OM_1}$ which is more than one, consequently is elastic; Point P being located at the middle of distance OT, has a unitary elasticity. Then, it can be derived the elasticity at different points of the curve. It is highest at the upper end and lowest at the lower end. It is higher than unit at the top, decreases to unit at the middle and

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[58] R. G. D. Allen, Mathematical Analysis for Economists, (London: MacMillan & Co., Ltd., 1938) pp. 252-260.

[59] Richard N. Leftwich, The Price System and Resource Allocation (Revised Ed., New York: Holt, Rinehart and Winston, 1960) pp. 34-45.

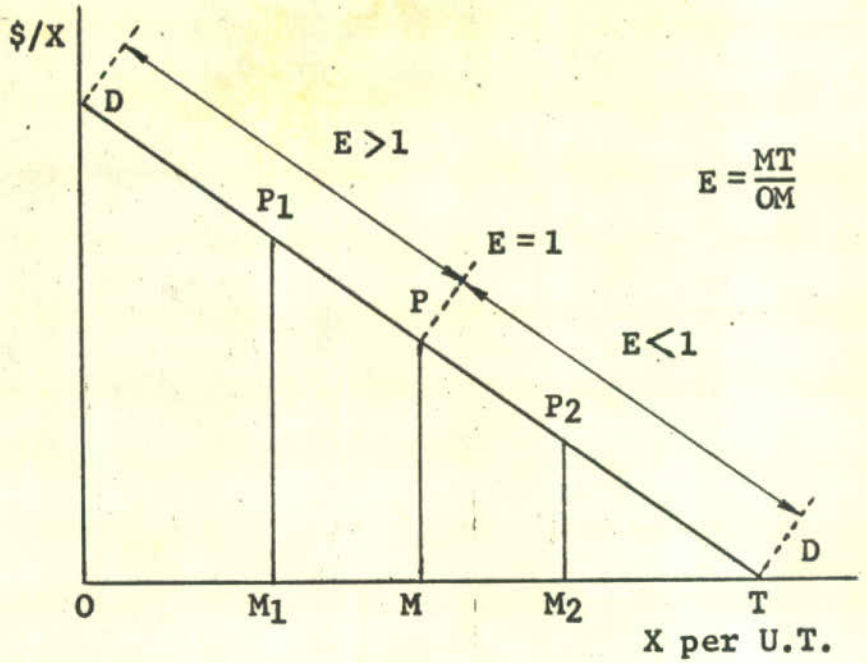

Figure No. 14
Demand Curve for Hipothetical Commodity X.

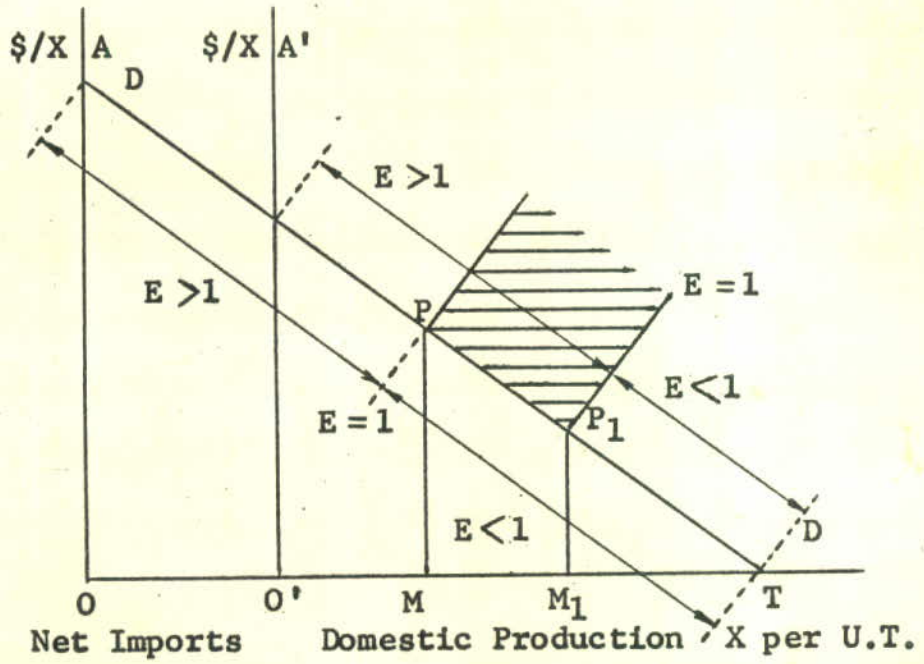

Figure No. 15
Geometrical Demonstration of Effect of Underestimated Consumption in Demand Elasticities.

gets less and less than unity from there on down.

But before applying those theoretical concepts to the results of this study it is necessary to stress the following points.

First, the State of Sao Paulo with 13 million people and its capitol city of 5 million and with the most important seaport of the country, is the economic center of a region which goes far beyond its state boundry limits. Agricultural Economists in their analysis, have been called this region as the "geographical economic region of Sao Paulo." By this they mean that a significant part of agricultural production of at least 4 adjacent states is canalized through the marketing system of Sao Paulo to this huge consumption center. The State, besides its domestic agricultural production,imports large part of other states' production, process it, store it, and sometimes reexport to this same region. Or, this production can be exported to foreign markets. Secondly, great part of domestic production came from, not only large commercial farms but from small farmers and gardens whose production is not included in official crop estimates. Thirdly, in this study, due to the nature of avail-

able data, the use of domestic production alone as a measure of total quantity available was convenient and necessary shortcut in the analysis. Consequently, these facts show that the assumption that domestic production equals the consumption of the State is not always valid. This assumption, in light of marketing channels, may mean that consumption was typically underestimated in the models. The effects of this underestimation can be judged as shown in Figure 15.

Using the same geometric aspects of Figure 14, it is possible to construct in another figure the new situation. See Figure 15 on page 146.

In the graph, domestic production or assumed quantity taken in this study, equals O'T. At point O' the price axis for the specified commodity was drawn. The distance OT represents the estimated true consumption that is domestic production plus net imports. At this point the same price axis was drawn. According to what was explained in the preceding Figure, point P limits the values of elasticities, that it is elastic at its left and inelastic at its right side. However, the price axis located at the value of domestic production shows that the elasticities in that segment of the

curve is delimitated by the point P_1. This means that assuming that domestic production equals consumption the elasticities along the line will change the position compared with the position of the curve if domestic production plus net imports would be used.

In this case, the shaded area between P and P_1 is the area where estimated point elasticity would be greater than 1 while true point elasticity would be less than 1 if consumption is larger than domestic production.[60] This discussion suggests that the coefficients of price elasticity in this hypothetical situation would be overestimated throughout its entire range. Since the statistical findings of this research showed that the coefficients of demand elasticity were particularly high, this should be the explanation for this particular situation.

While the empirical setting of these analyses suggest that elasticities may be overestimated, the economic setting also suggests that true elasticities may be higher in this economy than in Europe or the United States. In cases where the standard of living is high,

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[60] Using the formula of elasticity $\frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$, it can be noted that as the denominator increases the value of the relation (elasticity) should decrease.

the need for food may be satisfied at most all current levels of price or income. This implies inelastic demand for food items. When the standard of living is lower, this may not be the case. If the need for food in economies with lower real income is not met in conditions of high prices of food or low income, these items may be expected to have higher values of elasticity coefficients.

It is important to measure elasticity of demand for each crop. In a free market economy it is important to know how much and in which direction variations in the size of the crop affect farmer's income as well as prices. The difficulty with most agricultural products are that they are often relatively inelastic in demand and supply and changes in quantity sold or produced cause quite disproportionate changes in price with a consequent disruption of the flow of income. Consequently there is much political pressure for policy of stabilizing prices, especially by Government action.[61]

This shows how important the knowledge of distinction between a relatively elastic and relatively

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[61]Kenneth E. Boulding, Economic Analysis, (3rd. ed; New York: Harper & Brothers, 1955) Chapter 8.

inelastic demand can be. While the price policy formulators may base their decisions on many non-economic factors, the agricultural economist should be able at the very least, to predict consequences of policy decisions and alternatives. A knowledge of basic economic and market relationships of the commodities in question will greatly increase the economists accuracy and confidence.

CHAPTER VII

CONCLUSION

With the aid of price and domestic quantity produced over the period 1948-1963, comparatively static demand functions at farm market level were derived for corn, rice, potatoes, beans, tomatoes, oranges, onions, fat cattle, hogs, sugar cane, peanuts, manioc and castor beans.

Price elasticities were computed for all those products and income elasticities were computed for about half of them. In general the coefficients of price and income elasticities were higher than what would be expected for farm products.

Although empirical evidence for those high values exists in the analysis, it was shown that the obtained coefficients might be overestimated when domestic production was assumed to equal consumption of the State. On the other hand, under the peculiar conditions of low personal real income, the results of price and income elasticity might be a little bit higher than those

obtained under the conditions of a higher level of real income per person.

Any conclusion based on a quantitative finding of a price research should be examined with the understanding that errors can appear as cause of inaccuracy of data, methods or a priori knowledge of the behavior of economic variables. In this study probably the inaccuracy of data is the major source of error. However, the quantitative measurements of this study are probably the best possible approximation of demand relationships which can be obtained from existing data.

APPENDIX

Appendix Table 15 - Prices

General Index of Prices, Brazil, 1948-1963
1948-52 = 100

Year	Index[1]
1948	80
1949	86
1950	96
1951	112
1952	125
1953	144
1954	182
1955	213
1956	254
1957	290
1958	329
1959	454
1960	585
1961	803
1962	1218
1963	2105

Source: Getulio Vargas Foundation, Rio de Janeiro, Brazil.

(1) This index is a weighted average of wholesale prices, cost of living and civil construction.

Appendix Table 16 - Income

Yearly Total Income at Current Values, Total Real Income, Real Income Per Capita and Index of General Business Conditions, Sao Paulo, 1948-1963.

Year	Current Values of State's Total Income in Millions Cruzeiros (1)	Total Real Income Million Cruzeiros (2)	Total Real Income Per Capita In Cruzeiros	Index of General Business Conditions 1948-1952 = 100 (3)
1948	51,803.2	64,754.0	7,623	88.1
1949	60,032.0	69,804.6	7,925	94.9
1950	71,127.6	74,091.2	8,112	100.8
1951	87,035.2	77,710.0	8,214	105.7
1952	101,543.4	81,234.7	8,291	110.5
1953	122,162.5	84,835.0	8,360	115.4
1954	158,435.2	87,052.3	8,283	118.4
1955	194,380.5	91,258.4	8,384	124.1
1956	235,706.1	92,051.1	8,165	125.2
1957	278,976.6	96,198.8	8,232	130.8
1958	345,834.6	105,116.8	8,685	143.0
1959	457,887.8	100,856.3	8,046	137.2
1960	617,604.9	105,573.4	8,137	143.6
1961(4)	. . .	110,340.8	8,204	150.1
1962(4)	. . .	113,680.3	8,271	154.6
1963(4)	. . .	117,019.8	8,339	159.2

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

(1) Data from Getulio Vargas Foundation.

(2) Deflated by General Index of Prices.

(3) This index represents the total real income of the State computed for the base 1948-1952 = 100.

(4) Estimated from extrapolation of linear trend.

Appendix Table 17 - Population

Yearly Total Population, Urban Population, Rural Population and Degree of Urbanization, Sao Paulo, 1948-1963.

Year	Total Population (Thousands)	Urban Population (Thousands)	Rural Population (Thousands)	Percentage of Urban Population Over Total
1948	8,494	4,407	4,087	51.9
1949	8,808	4,670	4,138	53.0
1950	9,134	4,950	4,184	54.2
1951	9,460	5,232	4,228	55.3
1952	9,798	5,530	4,268	56.4
1953	10,148	5,846	4,302	57.6
1954	10,510	6,180	4,330	58.8
1955	10,885	6,535	4,350	60.0
1956	11,274	6,913	4,361	61.3
1957	11,686	7,315	4,371	62.6
1958	12,103	7,742	4,361	64.0
1959	12,535	8,197	4,338	65.4
1960	12,975	8,675	4,300	66.9
1961	13,438	9,191	4,247	68.3
1962	13,958	9,741	4,217	69.8
1963(1)	14,456	10,125	4,241	70.7

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo. Figures were estimated from raw data of the State Statistical Department.

(1) Observations for 1963 were extrapoleted by the linear trend.

Appendix Table 18 - Corn

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per 60 Kilos	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per 60 Kilos
1948	1,081.6	75.00	127.3	94.00
1949	1,025.3	78.00	116.4	91.00
1950	1,226.8	57.00	134.3	59.00
1951	1,075.5	77.00	113.7	69.00
1952	1,004.8	112.00	102.5	90.00
1953	991.6	134.00	97.7	93.00
1954	1,458.0	110.00	143.7	60.00
1955	1,080.0	212.00	99.2	99.00
1956	1,029.0	225.00	91.3	88.00
1957	1,338.0	223.00	114.5	77.00
1958	1,380.0	274.00	114.0	83.00
1959	1,332.0	408.00	106.3	90.00
1960	1,740.0	361.00	134.1	62.00
1961	1,764.0	720.00	131.3	90.00
1962	2,214.0	995.00	158.6	82.00
1963	2,688.0	1,190.00	185.9	56.00

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 19 - Rice

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per 60 Kilos	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per 60 Kilos
1948	646.9	145.00	76.15	181.20
1949	682.3	168.00	77.46	105.30
1950	901.0	111.00	98.64	115.60
1951	773.2	101.00	78.91	92.80
1952	534.3	205.00	54.53	164.00
1953	542.6	384.00	53.47	266.70
1954	558.0	379.00	54.97	208.20
1955	684.0	371.00	62.84	174.20
1956	448.8	499.00	39.81	196.40
1957	528.0	569.00	45.18	196.20
1958	540.0	707.00	44.62	214.90
1959	648.0	770.00	51.69	169.60
1960	660.0	845.00	50.87	144.40
1961	792.0	1,030.00	58.94	128.20
1962	612.0	2,910.00	43.84	238.90
1963	720.0	5,270.00	49.81	250.30

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 20 - Potatoes

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1952

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per 60 Kilos	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per 60 Kilos
1948	202.5	133.00	23.8	166.20
1949	253.3	91.00	28.8	105.80
1950	211.1	170.00	23.1	177.00
1951	240.1	144.00	25.4	128.60
1952	285.1	143.00	29.1	114.40
1953	285.7	244.00	28.1	169.40
1954	345.3	275.00	32.8	151.10
1955	348.3	233.00	32.0	109.40
1956	333.5	271.00	29.6	106.70
1957	352.6	342.00	30.2	117.90
1958	415.1	406.00	34.3	123.40
1959	380.1	540.00	30.3	118.90
1960	459.4	607.00	35.4	103.80
1961	436.7	903.00	32.5	112.40
1962	427.8	1,790.00	30.6	147.00
1963	426.0	2,880.00	29.5	136.80

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 21 - Beans

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per 60 Kilos	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per 60 Kilos
1948	157.3	214.00	18.5	267.50
1949	176.0	108.00	20.0	125.60
1950	124.9	117.00	13.7	101.00
1951	122.0	149.00	12.9	133.00
1952	102.4	205.00	10.4	164.00
1953	148.1	340.00	14.6	236.00
1954	121.0	215.00	11.5	118.10
1955	88.2	546.00	8.1	256.30
1956	102.1	703.00	9.1	276.80
1957	150.0	659.00	12.8	227.20
1958	150.0	447.00	12.4	135.90
1959	116.4	1,570.00	9.3	345.80
1960	195.6	1,840.00	15.1	314.50
1961	139.2	1,510.00	10.4	188.00
1962	116.4	5,190.00	8.3	426.10
1963	160.8	5,620.00	11.1	267.00

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 22 - Tomatoes

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per 28 Kilos	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per 28 Kilos
1948	90.5	60.00	10.6	75.00
1949	85.2	59.00	9.7	68.60
1950	120.0	73.00	13.1	76.00
1951	69.2	90.00	7.3	80.30
1952	86.8	91.00	8.8	72.80
1953	90.2	89.00	8.8	61.80
1954	160.9	120.00	15.3	65.90
1955	120.7	135.00	11.1	63.40
1956	116.4	151.00	10.3	59.40
1957	134.7	192.00	11.5	66.20
1958	173.0	205.00	14.3	45.10
1959	170.7	262.00	13.6	57.70
1960	235.8	320.00	18.2	54.70
1961	270.4	502.00	20.1	62.50
1962	224.0	946.00	16.0	77.70
1963	395.9	1,120.00	27.4	53.20

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 23 - Oranges

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per 40 Kilos	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per 40 Kilos
1948	146.8	14.00	17.3	17.50
1949	104.2	16.00	11.8	18.60
1950	138.7	22.00	15.2	22.90
1951	114.6	29.00	12.1	25.90
1952	98.5	46.00	10.0	36.80
1953	156.8	48.00	15.4	33.30
1954	198.7	53.00	18.9	29.10
1955	252.4	78.00	23.2	36.60
1956	314.1	82.00	27.9	32.20
1957	391.6	77.00	33.5	26.50
1958	501.0	91.00	41.4	27.60
1959	590.8	94.00	47.1	20.70
1960	721.9	98.00	55.6	16.70
1961	936.3	116.00	69.7	14.40
1962	960.0	249.00	68.9	20.40
1963	1,080.0	412.00	74.7	19.60

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 24 - Onions

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per 15 Kilos	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per 15 Kilos
1948	22.1	26.00	2.6	32.50
1949	28.4	43.00	3.2	50.00
1950	27.0	62.00	2.9	64.60
1951	22.9	51.00	2.4	45.50
1952	27.0	72.00	2.7	57.60
1953	34.3	58.00	3.4	40.30
1954	35.2	107.00	3.3	58.80
1955	40.1	105.00	3.7	49.30
1956	39.1	85.00	3.5	33.50
1957	39.9	139.00	3.4	47.90
1958	34.5	304.00	2.8	92.40
1959	31.2	328.00	2.5	72.20
1960	38.3	257.00	2.9	43.90
1961	51.2	600.00	3.8	74.70
1962	30.1	532.00	2.2	43.70
1963	32.3	1,115.00	2.2	53.00

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 25 - Fat Cattle

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per 15 Kilos	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per 15 Kilos
1948	370.0	80.00	43.6	100.00
1949	390.0	88.00	44.3	110.00
1950	390.0	95.00	42.7	99.00
1951	394.0	120.00	41.6	107.00
1952	380.0	153.00	38.8	122.00
1953	375.0	175.00	36.9	121.00
1954	400.0	207.00	38.1	114.00
1955	386.7	273.00	35.5	128.00
1956	472.0	297.00	41.9	117.00
1957	476.8	290.00	40.8	100.00
1958	545.0	328.00	45.0	100.00
1959	529.9	500.00	42.3	110.00
1960	486.9	894.00	37.5	153.00
1961	489.4	1,300.00	36.4	162.00
1962	476.0	1,980.00	34.1	162.00
1963	441.0	3,145.00	30.5	149.00

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 26 - Hogs

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per 15 Kilos	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per 15 Kilos
1948	49.5	150.00	5.8	187.00
1949	53.3	135.00	6.0	157.00
1950	58.0	165.00	6.3	171.00
1951	56.2	175.00	5.9	156.00
1952	50.7	200.00	5.2	160.00
1953	50.9	250.00	5.0	174.00
1954	51.7	336.00	4.9	185.00
1955	53.9	394.00	4.9	185.00
1956	59.0	446.00	5.2	176.00
1957	75.5	490.00	6.5	169.00
1958	78.5	557.00	6.5	169.00
1959	67.2	864.00	5.4	190.00
1960	61.3	1,390.00	4.7	238.00
1961	69.1	1,490.00	5.1	185.00
1962	91.4	1,710.00	6.5	140.00
1963	82.8	3,430.00	5.7	163.00

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 27 - Sugar Cane

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per ton	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per ton
1948	5,895.0	97.00	694.0	121.00
1949	5,189.0	119.00	702.6	138.00
1950	6,993.0	125.00	765.6	130.00
1951	8,436.0	128.00	891.7	114.00
1952	9,927.0	138.00	1,013.2	110.00
1953	10,865.0	145.00	1,070.6	101.00
1954	12,686.0	203.00	1,207.0	111.00
1955	12,230.0	242.00	1,123.6	114.00
1956	14,751.0	339.00	1,308.4	133.00
1957	16,750.0	356.00	1,433.3	123.00
1958	19,562.0	332.00	1,616.3	101.00
1959	22,174.0	454.00	1,769.0	100.00
1960	21,704.0	656.00	1,672.7	112.00
1961	23,152.0	860.00	1,722.9	107.00
1962	26,600.0	1,410.00	1,905.7	116.00
1963	22,000.0	3,450.00	1,521.8	164.00

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 28 - Peanuts

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per 25 Kilos	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per 25 Kilos
1948	194.9	51.00	22.9	64.00
1949	142.5	49.00	16.2	57.00
1950	130.9	60.00	14.3	62.00
1951	194.1	62.00	20.5	55.00
1952	131.6	61.00	13.4	49.00
1953	125.9	84.00	12.4	58.00
1954	190.8	113.00	18.1	62.00
1955	222.7	96.00	20.4	45.00
1956	121.6	142.00	10.8	56.00
1957	179.4	200.00	15.3	69.00
1958	338.8	161.00	28.0	49.00
1959	363.5	219.00	29.0	48.00
1960	362.5	436.00	27.9	74.00
1961	465.0	519.00	34,6	65.00
1962	545.0	642.00	39.0	53.00
1963	480.0	1,055.00	33.2	55.00

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 29 - Manioc

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per ton	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per ton
1948	530.0	127.00	62.4	158.70
1949	407.0	159.00	46.2	184.90
1950	754.0	280.00	82.5	291.70
1951	666.0	330.00	70.4	294.60
1952	647.0	410.00	66.0	328.00
1953	690.0	660.00	68.0	458.30
1954	823.0	530.00	78.3	291.20
1955	1,019.0	500.00	93.6	234.70
1956	903.0	700.00	80.1	275.60
1957	1,150.0	800.00	98.4	275.90
1958	1,641.0	710.00	135.6	215.80
1959	1,703.0	1,060.00	135.8	233.50
1960	1,525.0	1,160.00	117.5	198.30
1961	1,701.0	2,240.00	126.6	278.90
1962	1,850.0	6,500.00	132.5	533.70
1963	2,900.0	6,900.00	200.6	327.80

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

Appendix Table 30 - Castor Beans

Yearly Production, Current Average Prices Received by Farmers, Production Per Capita and Adjusted Average Price Received by Farmers, Sao Paulo, 1948-1963

Year	Production 1,000 tons	Current Average Prices Received by Farmers CR$ per Kilos	Production per Capita, Kilos	Average Price, Adjusted by General Index of Prices, 1948-1952 = 100 CR$ per Kilos
1948	78.4	1.70	9.2	2.10
1949	46.5	1,20	5.3	1.40
1950	46.0	2.60	5.0	2.70
1951	29.7	3.70	3.1	3.30
1952	49.4	2.80	5.0	2.20
1953	47.1	2.60	4.6	1.80
1954	36.2	2.80	3.4	1.50
1955	27.6	4.20	2.5	2.00
1956	23.7	7.60	2.1	3.00
1957	39.3	6.90	3.4	2.40
1958	45.7	6.70	3.8	2.00
1959	39.5	9.90	3.1	2.20
1960	36.0	17.40	2.8	3.00
1961	59.7	20.20	4.4	2.50
1962	67.2	32.90	4.8	2.70
1963	65.0	48.20	4.5	2.30

Source: Rural Economics Division of Secretary of Agriculture, Sao Paulo.

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