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An income analysis of the demand for food in the Lima metropolitan area

Carlos Amat y León Ch.
Iowa State University

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by

Carlos Amat y Leon

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INTRODUCTION

It has been our intention to analyze, in the first place, the implications of the particular Peruvian characteristics of its population income and income distribution on the aggregate demand for consumption goods. We have explained those relationships in the light of the formation of the demand concept in a sociological context. This in our opinion is necessary because each culture of "social matrix" requires a different set of given goods and services in order to function normally.

In Part II we focus our analysis on the consumption function and average income elasticities in the Lima metropolitan area.

PART I. DEFINITION AND UNIQUE CHARACTERISTICS OF THE PERUVIAN CASE

CHAPTER I. THEORY OF THE CONCEPT OF DEMAND

The structure of demand portrays the decisions of individuals, members of social groups, as to the magnitude, nature, and composition of goods consumed as measured by the distribution of the consumer's budget. The latter is, in the final instance, the expression of consumer preferences, their level of income, and the structure of prices of competitive and complementary products.

The observed demand consequently represents the behavior of consumers at a given time and place, in relation to the levels of income achieved by different social groups and the price structure of these goods. Consumers are located in different cultural frameworks. The value system of beliefs, desires, perceptions and interests through which objectives are established leads through everyday happenings to an institutionalized "social game".[1]

The normal functioning of such a game requires the stable supply of a package of goods and services different for each cultural structure.

Consumption is part of social action. Consequently the economic system must be so designed as to generate the flow of goods and services demanded by a given culture.

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[1]The term "social game" is used in this paper as synonymous with the anthropological concept of culture.

CHAPTER II. DEVELOPMENT OF THE DEMAND DIFFERENTIATION IN THE PERUVIAN CASE

The heterogeneity of the social framework in Peru makes it necessary to decompose virtually all types of analysis. A mere sociological analysis is not enough to establish explicit numerical relationships between the principal variables explaining the behavior of the Peruvian as a consumer. The veracity and precision of the estimates for the demand of a product at a given moment will be in direct relation to the veracity and relevance of the values assumed for each explanatory variable and the connecting values of the parameters.

Analysis of the consumer behavior of the average Peruvian by using national aggregates conceals the drastic differences among the social conditions within the country. Inferred "facts" relative to the national average would be questionable. What principally defines Peru is the heterogeneity of its geographical and cultural characteristics. The country is clearly divided into three regions, each with its own climatic characteristics, different resource potentials and different levels of physical and economic productivity. All this influences the flow of goods to be produced and conditions consumption habits in relation to food, housing, clothing, transport, power, and other needs.

Geographically Peru is located between 0°01' and 18°21'

latitudes in the tropical region. The Andes Mountains run from North to South and split into various chains creating numerous rivers and valleys. The bulk of population and economic production in the Sierra is found in these valleys. The mountains are barren or covered with natural pastures. The temperature varies considerably between seasons and during the day. Thus, during the winter the temperature ranges between a maximum of 20 degrees C. and a minimum of 5 degrees C. The wet season is from September to May and becomes more intense during the summer months. The altitude varies between 2,000 and 5,000 meters above sea level. Some of the snow capped peaks are over 6,500 meters high. The area located at 3,500 meters above sea level is called the Puna, and is suitable only for livestock farming. Living conditions are disadvantageous for human beings.

One branch of the Andean Mountains runs parallel to and only a few kilometers from the coast of the Pacific Ocean. Vast deserts are divided by steeply sloped river basins, draining the Andean mountain mass. It is in such coastal valleys that agriculture thrives most profitably.

This coastal strip climbs to 1,500 meters. The climate is relatively uniform. Daytime summer temperatures average 25 degrees C. There is no rain during the winter season, but fog is common, due to the Humboldt current. This is a cold current which flows along the entire coast. It produces

a very rich ocean biology. By exploiting only one of the many fish species, the "anchoveta", Peru has become in the last decade foremost in fishery production in the world.

The jungle in the eastern region of Peru covers about 59.3% of Peruvian territory, with average temperatures of 29 degrees C. and heavy rainfall throughout the year. The population along the rivers is mainly dedicated to growing rice, black beans, and yucca.

The Incas specified the altitude in terms of temperature variations, defining three zones: the yunga, the quechua, and colla, corresponding to the warmer, temperature, and colder zones respectively. There was a differentiation of crops. The division of work was adjusted to the living calendar of the communities as determined by the biological sequence of agricultural and livestock activities. The agricultural units within this subsistence economy cultivated land in each of the three zones. This required regular seasonal migrations. Such mental and social structures still persist in the traditions of the Sierra population. Food is grown locally; among these, potatoes, corn, and quinua. Clothing is woven from alpaca and llama wool. The utensils are made of clay and metals.

With the Spanish Conquest of the Incas, a Western culture was imposed upon the native Indian culture. The Spaniards absorbed the political and military machinery, monopolizing

for themselves the benefits of the resources which generated wealth such as land, crops, cattle, and mines; they imposed their cultural values (religion, language, customs, etc.). Social prestige came to be based on "Spanish" traditions.

The new agricultural and mining centers were oriented towards the needs of the Metropolis (Spain). A process of economic and institutional capitalization began along the coast, changing the center of economic gravity from the inter-Andean valleys, where the Inca's socio-economic life had centered, to the coastal valleys.

The development of export crops along the coast stimulated the formation of new urban centers which supplied the social, commercial, financial, political and administrative services required for the development of the economic life of the coast. Work differed between two markets; on the one hand, unskilled labor on the plantations, and artesan labor in urban areas. On the other hand, the political, military, and administrative machinery remained in the hands of those of recent Spanish descent.

The cultural aspirations of this group were brought from Spain. Its perpetuation led to increasing imports from Spain. The establishment of production and commerce using European technology further augmented such imports. In this manner, Metropolitan Spain used its colonies as market outlets for domestic production. Similarly, Spanish gentry

assured the permanent ascendancy of Crown and Church. This marked social stratification continues until today, and explains much of the heterogeneous social behavior of the Peruvian inhabitant.

CHAPTER III. STRUCTURE OF FOOD CONSUMPTION

The relevant consumer unit and correlated units of measurement differ between products. For food products and clothing it is sufficiently appropriate to refer to per capita consumption. On the other hand per family consumption is more appropriate for those products which are used collectively.

An expenditure unit, according to Katone (1), is composed of all related persons living under the same roof, who pool their income for payment of their most important expenditures. Therefore, the amount demanded of one of these goods considered basic for the low income social group will depend directly on the number of consumer units. The intensity of their consumption will be dependent on the nature of the item, as well as on the type of social context in which these items are used. Population, therefore, undoubtedly constitutes one of the most important factors in the explanation of the evolution of the total consumed amount of these goods.

The average levels of per capita consumption, the variety and quality of the products which make up the consumer food basket and the distribution of expenditure of the family budgets show a marked inequality between the urban and the rural consumer. In the urban zone there is a great variety of products of different qualities. In the rural zone, on

the other hand, home consumption which is based on food produced in the region is predominant. Consumer habits are closely linked to production. This leads general to a rather monotonous simple staple diet in the rural areas. The diversification of food production is limited, particularly in the Sierra and the jungle region. This is aggravated by the virtually nonexistent interprovincial markets in rural areas, the relatively high price of imported food, dispersion of the population, as well as the very low per capita income of this population.

Indices of Per Capita Consumption of the Principal Groups of Food Products

A first approximation was made of the per capita consumption levels of food groups by regions and for urban and rural areas. This information shows the level of gross per capita human consumption in relation to average national per capita consumption.

The family expenditure surveys of the Direccion Nacional de Estadistica y Censos (2), the nutrition surveys of the Ministry of Public Health (3), the Arequipa and Cuzco Survey (4), and the Food Balance Sheet, 1964, published by CONESTCAR (5) were used in establishing these quantitative analysis. With these figures, typical consumption profiles were set up for each region and area. We classified the

surveys in the following manner:

1. Coast

   Urban: Lima, Chiclayo

   Rural: Tumbes, Tacna

2. Sierra

   Urban: Huancayo, Cuzco, Arequipa

   Rural: Puno, Vicos, Cuzco

3. Jungle

   Urban: Iquitos

   Rural: Yurimaguas

The average national per capita consumption was obtained from the 1964 Balance Sheet. This was taken as a base, which, compared with estimated per capita consumption for each region made it possible to calculate the respective indices of each product.

The urban diet contains foods with a high protein, vitamin, and mineral content. In the rural areas, on the other hand, the consumption of tubers, cereals, and dried beans dominate, indicating an acute protein deficiency.

The Coast is better fed than the other regions, both qualitatively and quantitatively. It has the highest consumption level for cereals, oils, fats, and dairy products. In the jungle there is a high rate of consumption of fruit, mainly bananas. This product is included in a great variety of staple dishes and takes the place the potato holds in the

Table 1. Indices of the per capita consumption by groups of products and according to three natural regions and urban and rural zones in relation to the average national level of consumption (quantitative indices in relation to the national average: 100)

Products	Coast			Sierra			Jungle			Republic		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Cereals	118	99	114	100	100	100	58	39	45	109	92	100
Roots & Tubers	47	44	46	100	162	145	15	116	86	61	137	100
Dried Beans	62	92	69	110	85	92	128	341	277	80	118	100
Fruits	91	43	81	-	99	28	291	705	580	105	95	100
Vegetables	112	54	99	276	54	113	63	12	27	155	49	100
Oils & Fats	190	117	174	141	21	55	40	34	36	167	39	100
Dairy Products	146	79	131	226	6	68	9	73	54	162	26	100
Meats	136	87	125	154	37	70	142	167	158	142	61	100

Sierra, and that of rice in the Coast.

The percentage distribution of consumption, by regions and zones, of the same groups of food products is shown in Table 2. It is based on the average population distribution during the period 1960-64, adjusted for the different per capita consumption levels in Table 2.

The amount consumed is the average consumption during the years 1960-64. This basis uses the CONESTCAR (5) production. We assumed that in the short run the relationship between domestic apparent consumption and the gross human consumption would be constant between 1962 and 1964.

Two-thirds of the market for vegetables, oils, dairy products and cereals is in the urban areas, indicating that these are typically consumed in urban areas. The Coast accounts for more than 50% of the market in oil, dairy products and meat. The Sierra, on the other hand, represents nearly two-thirds of the market in tubers and roots, and over half is in cereals, dried beans and vegetables.

Structure of the Average Urban Consumers Expenditure

The family budget surveys of six cities (2) determined the expenditure profiles for each city.

The average urban consumer, in 1965, distributed his expenditure in the following manner:

Table 2. The percentile distribution of national human consumption of food products by regions and expressed in total consumer percentage (Peru, 1964)

Food Groups	Coast			Sierra			Jungle			Peru		
	U[a] %	R[b] %	T[c] %	U[a] %	R[b] %	T[c] %	U[a] %	R[b] %	T[c] %	U[a] %	R[b] %	T[c] %
Cereals	36.5	8.5	45.0	14.2	36.8	51.0	1.6	2.4	4.0	52.3	47.7	100.0
Tubers and oots	14.6	3.8	18.4	14.3	59.4	73.7	.4	7.5	7.7	27.3	70.7	100.0
Dried Beans & Pulses	19.2	7.7	27.1	15.7	31.5	47.2	3.6	22.1	25.7	38.7	61.3	100.0
Fresh Fruits	28.2	3.7	31.7	14.2	-	14.2	8.1	45.8	53.9	50.5	47.5	100.0
Fresh Vegetables	34.7	4.6	39.3	38.2	19.9	58.1	1.8	.8	2.6	74.7	25.3	100.0
Oils and Fats	58.7	10.1	68.8	20.0	7.7	27.7	1.1	2.2	3.3	80.8	20.0	100.0
Dairy Products & Milk	47.3	7.6	56.9	35.1	2.6	37.7	.3	5.1	5.4	84.7	15.3	100.0
Meats & Derivatives	42.2	7.5	49.7	22.0	13.6	35.6	4.0	10.7	14.7	68.2	31.8	100.0

[a] U = urban.

[b] R = rural.

[c] T = total.

Food	=	55%
Housing	=	20%
Clothing	=	13%
Miscellaneous	=	12%

The price elasticity of the demand for food is inelastic. Due to an unstable supply of food in urban markets the consumer at times, trying to maintain previous consumption standards, must spend more than 50% of his income on food.

Food expenditure is a very important component in the urban consumer's welfare. This additional expense is financed by reducing the consumption of other goods and services. Laborers and white collar workers will be obliged to bargain for higher wages. The latter usually do not increase in proportion to the increase in prices.

Not all food products are equally significant. Considering the total expenditure on food as 100, we obtain the percentage allocated on each sub-group of food products as follows:

Meats and sausages	26.3%
Cereals	18.3%
Milk and dairy products	12.4%
Fresh vegetables	7.1%
Fats and oils	6.9%
Fresh fruit	5.0%
Tubers and roots	4.6%

Sugar, salt, and spices	4.4%
Nonalcoholic beverages	4.0%
Fish	3.8%
Food and beverages away from home	
Miscellaneous	0.4%
	100.0%

The meat groups (mainly beef), cereals (wheat and rice), milk and dairy products, fats and oils, amount to 63.9% of expenditure on food. A one percent increase in their price will have a stronger effect on the cost of living, than would a similar percentage increase in the prices of other products. The country has not succeeded in producing sufficient quantities of meat, milk, fats, and oils. Increasing amounts of foreign currency have to be spent on imports of these products so as to maintain the prices at reduced levels. A devaluation causes a considerable increase in the cost of living and constitutes a drastic cut in the real income of the consumer. Economic policy in favor of the real income of the urban consumer must pay great attention to this group of products.

Available data indicate that the proportion of expenditures spent on food in rural areas is above 70%. The remainder is spent on locally manufactured goods and some imported items from the Lima Metropolitan area.

Table 3. Structure of the urban and rural population by age groups, 1960-1980[a]

	Rural		Urban	
	1960	1980	1960	1980
0-14	46.4	47.7	42.5	40.4
15-64	49.5	48.9	54.3	56.5
65 and more	4.1	3.4	3.2	3.1
	100.0	100.0	100.0	100.0

[a]Source: (7).

CHAPTER IV. POPULATION

Certain products are used only by males; others only by females. Also, products may be used principally by given age groups. The geographic location of a human group will also affect consumption habits. This is of considerable importance in Peru. On the other hand, the consumption of goods in an urban area is based on cultural patterns manifested in a vast assortment of social activities. Preferences will be influenced by modern or Western culture. The large Metropoli of the American and European continents are powerful centers of influence which spread their way of life by means of the mass communication media.

The urban area concentrates the industrial, utilities, commercial, and public sectors.

The rural population, however, is under the influence of the agricultural activities. Customs are molded by tradition, due to physical and cultural isolation. Business activity is limited. The lack of communication, the high cost of transport and the dispersal of the population all increase the price of those products produced in urban areas and those produced in neighboring areas. This together with the low per capita income creates only a small market for urban products in rural areas. Rural people are obliged to consume those products available in their environment, cer-

tainly so in the Sierra and jungle regions.

These regions have been neglected for centuries in terms of public investment in physical and institutional infrastructures. This caused them to remain outside of the economic development of the rest of the country. Recently, however, there has been a relative increase in the public expenditures directed to these regions through community development programs, agrarian reform and road construction.

Table 3 presents the composition of the Peruvian population by ages, and by urban and rural areas. The projection assumes that fertility decreases, reducing the net rate of growth from 44.1 per thousand per year in 1960, to 38.1 per thousand per year in 1980.

The decrease is related to a growing urban population, with higher educational levels and increased participation of women in economic life, all of which decrease the size of the family.

The total population of Peru is projected to increase from 10,025,000 in 1960 to 18,527,000 persons in 1980, equivalent to an annual geometric rate of growth of 3.1%. In twenty years the population will have grown 85%. Both the birth rate and the mortality rate are projected to decrease, but the latter decreases more rapidly. The number of living newborn infants per female decreases from 3.1 in 1960-65 to 2.6 in 1975-80. The birth rate differs between urban areas

Table 4. Total population by regions (thousands)[a]

Region	1950	1960	1965	1970	1975	1980
Coast	2685	3950	4928	6127	6094	9430
Urban	1861	2963	3780	4797	6094	7695
Rural	824	987	1148	1330	1523	1735
Sierra	4694	5193	5615	6073	6522	6948
Urban	1267	1573	1771	2041	2296	2557
Rural	3427	3620	3824	4032	4226	4391
Jungle	590	882	1107	1386	1730	2149
Urban	140	241	232	430	567	746
Rural	450	641	784	956	1163	1403
Peru	7969	10025	11650	13586	15869	18527
Urban	3268	4754	5837	7199	8875	10895
Rural	4701	5871	5813	6387	6994	7632

[a]See Table 5.

and rural areas. In urban areas the change is from 2.85 to 2.08 per thousand, whereas in rural areas the decrease is from 3.54 to 3.10 per thousand. The size of rural families is larger than those found in urban areas.

In Peru the nuclear family and the family unit as used in the household expenditure surveys are not identical. The rapid urban migration causes established families to increase temporarily in size until such newly arrived relatives establish themselves independently. The urban upper and middle classes probably follow the pattern of developed countries. The number of family units tends to increase in proportion to the total population. These are the groups which demand a large variety of household goods and appliances. Numerically, however, they are a minority.

The age groups of 19 years or less represent about 45% of total population, indicating that the Peruvian population has a very large proportion of minors. In Table 3 we observe that in rural areas the proportion of the younger population increases from 46.4% in 1960 to 47.7% in 2980.

The nutritional requirements of each age group are different. the demand for food is influenced by these proportions. The age group from 0 to 4 years for example is the deciding factor in the estimates of the demand for milk.

Between 1960 and 1980 the population in the coast will increase by 4.5% annually, drastically changing the regional composition of population.

The Sierra decreases its share of 51.8% in 1960 to only 37.5% in 1980, due to the continued migration from the Sierra to the Coast, as to a lesser degree towards the jungle.

In 1960 the urban population accounted for 47.4%. In 1980 it will reach 58.8%, indicative of an important continued migration from the country to the city.

Urbanization and migration to the coast are transforming the traditional demand structure. It supposes an acceleration of modern patterns of living.

The peasant born in the Sierra, moving to the city must confront new values, new organizations, new behavior patterns, new goods, all of which he must learn to manage.

The social cost and the psychological trauma are large, but the promise of better economic conditions is sufficient incentive to face the challenge of city life.

Table 5. Summary of results of population projections under Hypothesis II[a]

Characteristics	1960	1960-65	1965-70	1970-75	1975-80
Growth rate in thousands	-	30.0	30.7	31.0	30.9
Birth rate in thousands	-	44.1	41.8		39.8
Mortality rate in thousands	-	14.1	11.1	8.8	7.2
Number of expected infant survivals per woman	-	3.1	2.9	2.7	2.6
Life expectancy at birth in years	-	54.0	58.0	62.0	65.0
Percentage of total population by age group: 0-14	44.6	45.0	45.0	44.2	43.4
15-59	50.0	50.1	50.8	51.5	
60-	5.4	5.0	4.9	5.0	5.1
Men per 100 women	101.0	101.2	101.3	101.5	101.6

[a]Source: (7).

Table 6. Percentile distribution of the total population[a]

Region	1950	1960	1965	1970	1975	1980
Coast	33.7	39.4	42.3	45.1	48.0	50.9
Urban	23.3	29.6	32.4	35.3	38.4	41.5
Rural	10.4	9.8	9.9	9.8	9.6	9.4
Sierra	58.9	51.8	48.2	44.7	41.1	37.5
Urban	15.9	15.7	15.4	15.0	14.5	13.8
Rural	43.0	36.1	32.8	29.7	26.6	23.7
Jungle	7.4	8.8	9.5	10.2	10.9	11.6
Urban	1.8	2.4	2.8	3.2	3.6	4.0
Rural	5.6	6.4	6.7	7.0	7.3	7.6
Peru	100.0	100.0	100.0	100.0	100.0	100.0
Urban	43.0	47.4	50.1	53.0	55.9	58.8
Rural	57.0	52.6	49.9	47.0	44.1	41.2

[a]The same as Table 5, (7).

CHAPTER V. INCOME

The concept to be used is that of disposable personal income after taxes, i.e., income available for spending or saving. A commonly used proxy concept is the gross national product per capita. In the long run, disposable personal income and the gross national product are closely correlated, although not from year to year, as shown by the Peruvian national income accounts.

There is no significant long term or cyclical tendency which could decrease the ratio between both concepts. Consequently, their average rates of growth during a period of years must be equal.

The characteristics and growth of income are in the final instance derivative to production, and the working of the labor markets, the distribution of ownership of capital, and other institutional factors.

Characteristics of the Operation of the Productive Structure of Peru

We divide our analysis between the foreign and the domestic markets. The domestic market in turn is seen in relation to urban and rural areas.

The Foreign Sector

Exports traditionally have been the driving force of the Peruvian economy. Exports in relation to the gross domestic income (G.D.I.) increased from 16.1% in 1950 to 20.1% in 1965. The rate of growth in exports surpasses that of G.D.I. in the past twenty years (8).

Table 7. The relationship between disposable personal income and gross national product

Period	Exports	I.G.I.
1950-1959	10.5%	7.1%
1959-1966	7.0%	5.3%
1956-1966	4.3%	4.0%

In the reduced form of the simple macro model of Otero (6) the export multiplier relative to G.D.I. equals 3.20. The private consumption multiplier equals 1.7. Ing. Otero explains that the export multipliers may have an upward bias because of the formulation of the model. But historically the evolution of the foreign sector and the GNP of the country have been parallel.

In 1966 mining accounted for 46.3% of the value of exports, fishing products 25.9%, sugar and cotton 17.1%. The production process of these concerns requires productive services from the rest of the economy. But the capital

intensive technology with which they operate implies the use of qualified manpower, and a large amount of products, acquired through the trade and financial networks located in Lima.

Exports increase the capacity to import capital goods, intermediate inputs and raw materials necessary for producing and consumer goods use to increase the supply of food such as: beef, wheat, dairy products, and fats. Such imports make it possible to maintain stable prices for relatively long periods of time.

Tax revenue is also related to the behavior of the foreign sector. Public expenditure and investment represented 25.7% of G.D.I. in 1965, as compared to only 13.6% in 1950. Customs and tariff revenue formed 40% of the total government revenue in 1965. Indirectly much of the sales taxes are also related since the profit tax paid by enterprises in the import and export sector are of great importance. Peruvian exports are diversified. Mining and fish meal products, which were relatively insignificant in the fifties, are now the most important products exported. The importance of agricultural exports is decreasing. The future evolution of agricultural exports depends on the growth of world markets. Due to low price and income elasticities their future is not promising. Prices are expected to grow but slowly in coming years. The increase in the value of

exports will depend mainly on the expansion in copper production. New mining investment could begin production as soon as 1975 if agreements with the Peruvian government are signed this year.

The growth of the economy is restricted on account of the Balance of Payments. Servicing of the public debt alone amounts of US $1,195 million in the period 1970-1980. Approximately 66.7% of this amount will have to be paid between 1970-1974, a period in which no additional exports will be forthcoming. The government will be able to refinance most of the public debt, creating import debits for investments designed to reactivate the economy.

The availability of foreign loans is another possibility of complementing the government's investment capacity. The International Development Bank has granted a US $100 million loan for the agricultural sector which, added to the US $140 million of available credit previously granted amounts to an approximate total of US $240 million to be used during the coming three years. The challenge thus posed is in the administrative ability of the government to carry out projects which are relevant to development.

Table 8. Projections of the balance of payments and the impact of new investments in the period 1970-1980 (millions of US dollars)[a]

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Balance of payments surplus of deficit	-50	-54	-56	-41	-43	-16	-107	-96	80	73	70
Public debt service	-178	-184	-166	-160	-109	-82	-73	-69	-58	-58	-56
New investments	163	-202	-256	-253	-162	-53	-25	-19	-	8	12
Imports for new investments	97	122	143	138	93	32	14	11	-	6	9
Exports from new investments	-	-	5	74	131	353	481	482	492	493	494

[a]Source: Basic information, Ministerio de Economía y Finanzas, Lima, 1969 (7).

The Domestic Sector

Official statistics are not available in terms of a domestic and foreign sector. Only mining is exclusively located in the export sector. For purposes of this study we must carefully qualify our statements bearing these characteristics in mind. Similarly we will not enter into a theoretical or empirical discussion of the two sectors. The composition of the labor force and the gross domestic product of Peru and its evolution during the period 1952-1966 is clearly defined in Tables 13 and 14, where the capacity of each sector is generate work and income is depicted.

Table 9. Distribution of manpower

Year	Agriculture	Industry	Mining	Others	National
1950	58.9	13.0	2.2	25.9	100
1961	52.8	13.5	2.2	31.5	100
1965	50.5	13.8	2.2	33.5	100

Development of the rural areas is directly related to agricultural production. The urban economy has a more complex structure, with the industrial sector playing a decisive role.

Agriculture employs more people than all other sectors

combined. Nevertheless, it generates only 15% of gross national product. Its rate of growth is well below the national national average. The sectoral differences in manpower and GNP are reflected in labor productivity. The agricultural sector indicates very low productivity levels and offers the least prospects for future improvement.

Agricultural gross product per rural inhabitant in 1950 equalled 2,345 Soles and in 1967, 2,718 Soles, both in constant 1963 prices, indicating the slow increase in rural income and its falling behind in relation to incomes earned in urban areas. In 1967 rural per capita income was one-fifth of that corresponding to the nonagricultural sectors. The income differential explains the migration towards the urban centers.

The crucial problem in the rural area is the marginality of 40% of the population, much of its found in the Sierra. These people work farms no larger than two or three hectares. They have no access to credit, insurance, technical assistance, transportation, or communication.

The drastic difference in the social and economic structures existing in the regions under study are a fact. The varied pace of development of each is basically explained by the development of the agricultural sector; i.e., the rate of growth in GNP generated in rural areas is closely related to the rate of growth in agricultural production. The latter

Table 10. Evolution and productivity levels

Year	Agricultural	Industry	Mining	Commerce	Others	National
1952	23.6	16.2	4.6	17.2	38.4	100
1962	18.4	18.9	6.4	17.3	39.0	100
1966	16.2	19.9	7.1	17.3	39.5	100
1971	13.7	21.3	8.0	17.4	39.6	100
Total growth project 1966-67	3.2	7.0	2.8	5.3	-	5.3
Index of average per capita renumeration 1961	42.	146.	271.	183.	-	100 (S/16981.00)
Average productivity of work in thousands of Soles per work (1963 in Soles)						
1950	7.3	20.5	35.7	-	35.9	17.1
1961	9.1	32.5	74.0	-	41.1	23.8
1965	9.8	38.1	71.1	-	44.4	26.7

differs between regions. Using this criterion, the GNP in rural areas of the Sierra has remained virtually the same, while the GNP of rural areas located along the coast or in the jungle has increased at a rate above four percent annually.

Confronting these estimates with the projected growth rate in rural population by regions we obtain a first estimate of projected per capita increase in GNP in rural areas. We also have an independent estimate of projected GNP in the urban coastal area. We used a judgement estimate of GNP development in urban areas in the Sierra and the jungle. Subsequently minor adjustments were necessary to make individual estimates consistent with the projected national growth rate.

Table 11. Average annual GNP/capita rate[a]

	Coast %	Sierra %	Jungle %	Peru %
Total	3.5	0.9	2.2	2.1
Urban	3.9	1.8	2.7	3.2
Rural	2.0	0.5	2.0	1.0

[a]Source: (7).

Table 11 is only a first hypothesis, indicative of the different rates of development between regions.

CHAPTER VI. THE DISTRIBUTION OF PERSONAL INCOME

In Peru there are extreme differences in the incomes of those participating in the economic process. It is the logical result of an economy which is marked by heterogeneity in all aspects.

Brady (9) analyzed the distribution of personal income for Peru in 1963. With the reservations regarding the quality and the availability of information required for this type of research, Brady obtained two estimates. We will use the second estimate, since it includes all the economically active population.

The average income per worker equals S/ . 17,500 Soles annually, but 85% of those employed earned less than this. The average annual income of this group is 5,500 Soles, i.e., one-third of the overall average. Meanwhile, the upper group which covers 14.62% of the population earns an average income of S/ . 87,862.00. That is, five times more than the national average. In view of this range of observed incomes the national average level of income has little relevance.

Undoubtedly the behavior of the consumer earning S/ . 5,500 per year differs considerably from that of a consumer earning 87,862 Soles annually. The distribution of his expenditures and the respective income elasticities will

Table 12. Distribution of total personal income in Peru (estimate "B"), in millions of Soles, 1963

	Bank of Income (Soles 1963)	Amount of Income	Percentage		No. of Workers	Percentage	
		Absolute	Abs.	Acum.	Absolute	Abs.	Acum.
1	- 500	39.72	0.07	0.07	132,397	3.80	3.80
2	501 - 1,000	38.88	0.06	0.13	52,962	1.52	5.32
3	1,001 - 1,500	174.40	0.29	0.42	124,572	3.58	8.90
4	1,501 - 2,000	511.12	0.84	1.26	329,561	9.46	18.36
5	2,001 - 2,500	-			-		
6	2,501 - 3,000	644.66	1.06	2.32	227,563	6.53	24.89
7	3,001 - 3,500	475.78	0.80	3.12	127,539	3.95	28.84
8	3,501 - 4,000	501.68	0.82	3.94	126,316	3.62	32.46
9	4,001 - 4,500	693.86	1.14	5.08	161,507	4.63	37.09
10	4,501 - 5,000	1,503.42	2.47	7.55	332,448	9.54	46.63
11	5,001 - 6,000	1,780.49	2.92	10.47	343,900	9.30	55.93
12	6,001 - 7,000	1,291.95	2.12	12.59	202,544	5.81	61.74
13	7,001 - 8,000	2,343.56	3.84	16.43	311,185	8.95	70.67
14	8,001 - 9,000	835.49	1.37	17.80	99,495	2.85	73.52
15	9,001 - 10,000	371.64	0.61	18.41	38,290	1.10	74.62
16	10,001 - 12,000	2,319.31	3.80	22.21	210,294	6.03	80.65
17	12,001 - 14,000	-			-		
18	14,001 - 16,000	154.69	0.25	22.46	10,820	0.31	80.96
19	16,001 - 18,000	2,509.65	4.11	26.57	154,070	4.42	85.38
20	18,001 - 20,000	-			-		
21	20,001 - 30,000	6,545.06	10.73	37.30	240,890	6.91	92.29
22	30,001 - 40,000	1,006.83	1.65	38.95	29,800	0.85	93.14
23	40,001 - 50,000	193.20	0.32	39.27	4,600	0.13	93.27
24	50,001 - 60,000	7,822.65	12.83	52.10	139,958	4.02	97.29
25	60,001 - 70,000	4,401.31	7.22	59.32	64,700	1.86	99.15
26	70,001 -100,000	-			-		
27	100,001 -150,000	516.00	0.85	60.17	4,300	0.12	99.27
28	150,001 -200,000	2,960.60	4.86	65.03	16,900	0.48	99.75
29	200,001 +	21,335.38	34.97	100.00	8,760	0.25	100.00
Total		60,971.33	100.00		3,485,398	100.00	

Table 13. Aggregate and per capita income and occupational distribution according to the man active manpower in Peru in 1963[a]

Occupational Group	Aggregate Income: 1,000	%	No. of Persons	%	Per Capita Income	Rate
Remunerations						
A. Direct Income						
Employees	3473,347.4	5.5	382,900	11.0	9071	52%
Laborers	6343,314.1	10.0	1094,800	31.4	5794	33%
Domestics	1526,701.2	2.5	195,100	5.6	7825	45%
Workers	1432,310.4	2.4	317,600	9.1	4510	26%
Unspecified nonworking	877,224.4	1.5	82,400	2.3	10646	61%
B. Independent Income						
Employees	4401,312.0	7.0	64,700	1.8	68026	392%
Professionals & Technicians	2708,613.6	4.5	15,400	.4	175884	1014%
Businessmen	516,000.0	.8	4,300	.2	120000	692%
Office Personnel	252,000.0	.4	1,500	.1	168000	969%
Salesmen	4749,360.0	.8	179,900	5.2	26400	152%
Farmers, Drovers, Fishermen	12006,627.3	20.0	861,100	24.7	13943	80%
Miners	42,814.2	.1	800	-	53518	309%
Transports Drivers	1006,830.0	1.7	29,800	.9	33786	195%
Artisans in Tex., Construction & Mechanics	1071,360.0	1.8	198,400	5.7	5400	31%
Other Arts & Works	84,250.0	45.0	15,600	.4	5400	31%
Other Lab., & Workers	193,200.0	.3	4,600	.2	42000	242%
Work of Personal Service	681,000.0	1.1	22,700	.6	30000	173%
Unspecified	113,400.0	.2	6,300	.2	18000	104%
Reciv. Prep/Inc.	19488,467.6	32.0	7,500	.2	2598000	1499%
National Income at Factor Cost	60402,626.0	100.0	3485,400	100.0	17330	100%

[a]Source: (9).

be different. In order to study the demand, we must use income stratification.

The high income group demands a greater variety of quality goods. The small number of buyers and the volume sales do not justify domestic production. Nonetheless, because the pruchasing power is concentrated in this consumer group, their consumption habits determine the type and quality of economically viable domestic manufacture of finished goods.

Low income groups demand mostly basic food and services as discussed in chapter IV. They have a limited expenditure for the purchase of industrial goods. They cannot be selective as to the variety and quality of these goods.

Consumers have various sources of income. The possible sources of income are:

1. Personal services rendered on a contractual basis.
2. Rents.
3. Payments, pensions, life insurance, etc.
4. Profits.

It is the distribution of labor and capital factor earnings within the existing institutional framework which explain the distribution of income.

Brady's study indicates that 0.2% of the active population receive all of their income from property, an amount equivalent to 32% of total income.

It is likely that this figure is an overestimate, since the author, in order to construct this table, had to suppose that the principal categories of occupation were mutually exclusive. The superimposition of two or more categories could not be estimated. Table 25 using an ILPES study estimates the group of businessmen at 1.6% of the active population. Regardless of possible errors the conclusion remains valid that no less than 90% of consumers receive their income from personal contractual services rendered. The labor market is then basic to the consumer goods market.

The Labor Market

There are considerable differences in the income levels of workers. In fact, there are several labor markets. The labor markets are differentiated by type of occupation, and by economic sectors and by job qualification. The group of semi- or unqualified workers forms the largest market, but with the lowest rate of growth. Professionals, technicians, and qualified workers are a minority group, but with a high rate of growth. The considerable investment of the public sector in education will upgrade the future distribution of job qualification levels.

As early as 1975 we project a larger participation of professionals, technicians, and qualified workers. Nevertheless, such changes represent only a minor modification in

Table 14. Types of occupation and their evolution during the period 1965-1975[a]

Occupation	1965	%	1975	%	Rate
Professionals and technicians	161,000	4	304,000	6	8%
Owners and administrators	970,000	26	1317,000	26	36%
Office workers and salesmen	428,000	11	648,000	13	51%
Qualified workers	135,000	3	269,000	6	99%
Semi- or unqualified workers	1819,000	49	2355,000	46	29%
Others	142,000	4	172,000	3	21%
TOTAL	3655,000	100	5065,000	100	38%

[a]Source: (10).

the income distribution since the participation of the higher income groups may increase more than proportionately. Consequently, the income distribution as such will not change, particularly because of a continued, massive participation of the unqualified labor force.

In Table 15 we regroup the occupational categories as used by Brady according to the classification used by the National Employment Service (9).

Table 15. Occupational categories

Occupational Group	Number of Workers	Rate of Income[a]
Professionals and technicians	3%	520
Qualified workers	2%	192
Office workers and salesmen	18%	83
Farmers and administrators	25%	80
Semi- and unqualified workers	52%	67

[a]100=S/17,500.

The occupational groups in Table 15 were aggregated as follows:

1. Professionals and technicians: All those persons classified as: employers, professionals, and technicians, businessmen, administrators and office personnel. Their average income level is five times the national average.

2. Qualified workers: Drivers, domestic workers, and other workers. Their income is nearly double the national average.

3. Office workers and salesmen: Includes the group of employees and salesmen. It is obvious that they are professionals working as employees, but they do not influence the level of income of the group because they are numerically

Table 16. Rate of average per capita renumeration by category of occupation (Job) in 1961[a]

Sector (1)	Associate Worker		3/2	Self-Employed	National
	Workers (2)	Employees (3)	(4)	(5)	Total (6)
Agriculture	102	389	268	127	100=S/7,080
Fishing	73	-	-	36	100=S/40,149
Mining	35	196	161	25	100=S/46,032
Industry	61	105	44	18	100=S/24,839
Construction	62	191	129	103	100= 25,293
Power	50	176	126	-	100= 45,404
Commerce	70	192	122	31	100=S/31,119
Banking Insurance	28	46	18	-	100=114,121
Communications	60	78	18	-	100=S/31,705
Transport	52	78	26	49	100=S/30,024
Miscellaneous	87	246	159	84	100=S/5,594
Public Administration	42	115	73	-	100=S/25,936
Education	35	100	65	-	100=S/36,430
Health	34	120			100=S/31,396
	54	202	148	67	100=S/16,981

[a]Source: (10).

few. Their income level is 17% below the national average.[1]

4. Farmers and administrators: This includes only the group of independent farmers. The businessmen and administrators are not taken into account because their income opportunities correspond more to the group of professionals. Besides, they only account for 0.2%.

5. Semi- and unqualified workers: This includes the domestic servants, unpaid family help, textile workers, construction and mechanics. Their income level is below the national average by 67%.

Persons with better qualifications and education are most likely to achieve higher income levels. Table 17 shows that 87% of the professional and technical group has at least secondary education, and 54% have higher education. Ninety-five per cent of unqualified workers did not have secondary education. Only 65% finished grade school, and 30% received no formal education at all. One way to better the distribution of income is to accelerate education in the low income groups so as to give them skills and qualifications which would increase their productivity. In Peru there is a great polarization of income because of the discriminatory nature of the educational system. The income of professionals and

[1]Brady worked with the provincial census data published by the INP in 1965. The published data for employees and workers refer to a six-month earning period (9). Brady's study does not allow for this very substantial error.

Table 17. Manpower by occupation according to educational levels (1967)[a]

Occupations	Level of Education			
	No Instruction	Elementary	Secondary	University
Professionals and Technicians	-	11	35	54
Farmers and administrators	38	50	10	2
Office workers and salesmen	7	46	45	2
Qualified workers	2	74	23	1
Semi- and unqualified workers	30	65	5	-

[a]Source: (10).

technicians is notoriously different from others, due to the scarcity of their number in relation to the market demand. The institutional framework within which they work gives them greater power to negotiate special prerogatives in working conditions and income levels. On the other hand 75% of the workers compete in markets where supply exceeds available job opportunities. An educational policy designed to update workers' skills should necessarily be complementary with the modernization and broadening of the business structure.

The difference in the income levels between workers and employees is shown in aggregate terms by the fact that employees have almost double the income of workers, but this

relationship varies between sectors.

In certain sectors the difference between workers and employees is small, as in all social and economic services (health, education, transport, communications, banking, government and industry). This is a special case. In these sectors employees are predominant among job holders.

The functional distribution of income is according to wages, profits, rents, and interests. Table 19 compares the former of these (excluding management income) with the total of profits, rents, and interests for the years 1961 and 1965.

It appears that the wage share during a period of great economic prosperity declined, with property owners keeping most of the benefits of economic growth. Per capita income of this group must have increased very much.

The production initiative and the capacity to invest are concentrated in this group, deciding the technology and shape of economic growth.

The distribution of income can also be differentiated by sectors. The sector with the highest average income is the financial sector. Workers in this sector earn almost seven fold the national average. Earnings in the energy, mining, and fishing sectors are almost triple the national average. The sectors mentioned cover a limited number of the active population. Commerce, transport, communications, education and public health also pay their employees above

average earnings. Manufacturing and construction are above the national average. Agricultural workers enjoy less than one-half the national average earnings level. In order to achieve a better income distribution, workers must be transferred from agriculture to the more productive activities in the urban areas. A successful transfer presupposes the creation of employment opportunities.

The period 1961-1966 was not marked by drastic changes in the distribution of sector income. It is important to know to what extent the projected sectoral growth pattern between 1966-1971 will contribute to substantial changes in the distribution of sector income. Gross National Income was projected to grow at a rate of 5% annually. Individual sectors may grow at that same rate, or at a lesser rate as is true for the agricultural sector, or at a higher rate as is true for the manufacturing sector.

A rapid growth rate does not necessarily translate itself into increased per capita earnings of the labor force. This depends on the supply of and demand for employment in each sector. Generally the rate of growth of those willing to work at current wage levels exceeds demand at that wage level, except in group I. But this class of workers is very small relative to the total labor force. Employment is critical in the urban areas, where groups III and IV constitute 92% of the urban labor force.

Table 18. The functional distribution of income[a]

Income Shares	1961		1965	
	Population	Income	Population	Income
	%	%	%	%
Salary Earners				
Permanent workers	39.7	20.7	37.1	17.3
Part time workers	23.1	5.6	23.5	4.0
Employees	10.4	21.1	11.1	20.0
Unpaid family help	9.9	1.9	9.5	1.7
Profits, Rents, Interests				
Self-employed (small farmers)	17.0	8.6	17.1	7.7
Businessmen, renters, capitalists	1.7	42.1	1.6	49.3
Total of population employed	100.0	100.0	100.0	100.0

[a]Source: (11).

Table 19. Rate of average per capita remuneration by sectors in 1961 (Soles)[a]

Sector	Associated Workers		Self-Employed Workers	National Total
	Workers	Employees		
Agriculture	79	80	79	42
Fishing	318	-	128	236
Mining	176	203	104	271
Industry	164	76	40	146
Construction	170	141	229	149
Power	246	234	-	267
Commerce	235	175	88	183
Banking-Insurance	351	155	-	672
Communications	207	72	-	188
Transport	170	69	131	177
Miscellaneous	53	40	41	33
Public Administration	119	87	-	153
Education	137	106	-	215
Health	114	110	-	185
Total	100= S/9,266	100= S/34,312	100= S/11,361	100= S/16,981

[a]Source: (11).

Table 20. Sectorial stratification of income indices, the percentage and the rates of growth of demand-supply of the active population

Strata		Income Indices in 1961	Percentage of Active Population		Average Date of Annual Growth 1966-71		
			1961	1966	Inb.	Pob. A Demand	Pob. A. Supply
I	Banking & Insurance	672	0.6%	0.7%	6.7%	5.2%	5.0%
II	Mining, Power, Fisheries	296	2.8%	3.1%	3.7%	0.9%	3.4%
III	Commerce, Transport, Communications & Services	189	21.8%	23.2%	5.4%	2.8%	4.3%
IV	Industry, Construction, Government	150	22.2%	23.9%	6.7%	3.0%	4.3%
V	Agriculture & Others	44	52.1%	49.0%	3.2%	1.0%	1.8%

PART II. AN ECONOMETRIC ANALYSIS OF THE CONSUMPTION FUNCTIONS AND AVERAGE INCOME ELASTICITIES IN THE LIMA METROPOLITAN AREA

CHAPTER VII. THE CONSUMPTION FUNCTION

In mathematical terms this relation can be expressed as follows:

$$c = f(y)$$

The definitions of the consumption and income variable depend on the situation studied.

Mathematical functions of the above type are called "Engel" curves. Ernest Engel (1821-1896) was a German economist and first established the relation between income and food expenditures.

We must choose among several possibilities that mathematical function which best represents the type of relationship studied.

This structural equation contains one endogenous variable related to an independent explanatory variable.

Two methods have been used to estimate Engel curves, one using time series and the other household expenditure surveys.

A time series is a sequence of monthly or annual information of an economic quantity or other quantifiable concept. For example, disposable income is a time series generated through a system of National Income Accounts. Time series in economics frequently refer to aggregate concepts. For example the concept of a price of a product nevertheless must refer to the weighted average of a series of trans-

actions at a given point in a given year. Because of this, aggregates of income and expenditure may conceal the true relationships between the expenditure and income. Furthermore, unwanted influences, such as trends and cycles, usually cannot be separated easily from other explanatory variables.

Thus, Houthakker (12) indicates that the analysis of time series, if it is to be useful in Engel curve analysis, must observe the following:

1. Constancy of the income distribution during the period analyzed.
2. Constancy of the structure of relative prices.
3. No change in consumer habits and preferences.
4. No spatial reallocation of income.
5. Constant quality of the goods offered.
6. The constancy of the assortment offered.

None of the above assumptions will likely be true for a time series covering more than a decade. In order to isolate the income variable we must use a multivariate analysis, allowing for systematic and measurable changes in above shift variables. Normally economic time series, and particularly so in Peru, are not long enough or reliable enough to permit above type of analysis of variance.

Family budgets are obtained by taking a sample of representative families in a given community. Information

on the composition and size of their family, type of occupation, income earned and detailed expenditure data are obtained.

Through appropriate stratification of consumption and income variables, all types of Engel curves can be obtained, even very complex ones not contemplated in time series analysis.

Similar surveys in various areas and regions of the country and within different social strata will generate the information necessary to precisely define demand characteristics for each one of these categories and to establish their similarities or differences. Systematic budget studies in different years generate the data necessary to observe structural changes in consumption as time passes.

A number of difficulties occur in this type of analysis. First, the sample must be representative, but the characteristics defining the sample are not known beforehand. Individual consumer's characteristics are assumed to be normally distributed so that their influence on the average of group behavior be negligible. Secondly, the behavior of different income strata is not qualitatively different. Thirdly, an increase aggregate income is assumed to be distributed proportionally among the families represented by the sample. Fourthly, the price of a given product is assumed to be the same for all the families sampled.

For our analysis we disposed of the original data of the household expenditure surveys undertaken by the Direccion Nacional de Estadistica y Censos in six Peruvian cities (13).

CHAPTER VIII. THE CALCULATION OF THE ENGEL FUNCTIONS AND THE INCOME EXPENDITURE ELASTICITIES FOR PERU

Family Budget Surveys

The Direccion Nacional de Estadistica y Censos conducted a household expenditure survey, in 1965, in six cities of the Republic.

The initial results were published in a special issue of the monthly bulletin "The new index of Consumer Prices for the Metropolitan Lima Callao Area" (13). Mr. H. J. Kumin (Regional Statistician of the International Labor Office) and Engineers Jorge Villaran and Carlos Brain directed the survey.

The objective of the survey was to update the base weights of the Lima-Callao cost of living index.

The survey obtained information on family expenditure and its composition, the size of family, the number of employed members and their contributed income to share family expenditures. The towns surveyed were Metropolitan Lima-Callao, Chiclayo, Arequipa, Cuzco, Huancayo, and Iquitos. The survey period was one year (April 1964-March 1965). The size of the sample was 800 families in Lima and 400 families in each of the remaining five cities.

In Metropolitan Lima - Callao a city map was used to eliminate nonresidential areas and high income residential

areas. The remaining areas were divided into individual blocks. These were numbered, and from them a random sample of 23 blocks was selected, containing 3,500 families. Some 359 families did not qualify for further analysis. Of the remaining families a random sample of 800 families were taken as participants in the household expenditure survey.

All those persons who usually live together and whose main meals were cooked in one kitchen were defined as a family or household. Only families with two or more members and having at least some earned income were considered eligible. Each week 16 families were selected at random Work began on Saturday since it was estimated that 50% of the week's purchases were made on that day. The interviews were held every evening. A very detailed questionnaire was used to obtain information on the expenses incurred, food, housing, clothing, and miscellaneous. Savings, pension and sickness plans, gifts, loans, or repayments thereof were not considered.

The families were stratified later according to their annual average per capita income expenditure using the following formula:

$$\frac{\text{annual family income + annual family expenditure}}{2 \times (\text{Number of members of family})}$$

Seventy-five per cent of the questionnaires balanced expenditure and income within a range of a 10% difference.

The remaining 15% balanced out within a range of 20%, indicating the accuracy of the survey.

The "Barriadas" were not included in the sample because of practical difficulties. No up-to-date plans of these areas specifying blocks and streets were available, creating difficulties in identifying the sample universe. Interviewers were reluctant to work in these areas.

The barriadas are formed by recent and no so recent migrants from the provinces. A recent census indicates that the population living in the barriadas 40% of the population living in the Lima Metropolitan area. If the behavior of this type of transient consumer is not observed, we cannot speak of a representative sample. Nevertheless, despite this obvious reservation, the sample of 800 families did cover those migrants who settled within established residential areas. Ninety per cent of these families had an average annual per capita income between 2,000 Soles to 12,000 Soles.

The income range covered in the Lima survey of 2,000 Soles to 20,000 Soles average per capita income per year contains about 90% of the income earning population. Probably even a little more. The average annual gross per capita income equalled 9,000 Soles, which corresponds with Brady's estimates.

The survey did not attempt to analyze the consumption

pattern of the high income strata since the objective was to obtain a representative structure of weights for workers and employees, in order to systematically register the changes in the living standard of the community.

The composition of expenditures has not varied much between 1934, 1960 and 1966. This would indicate that the relative price structure of substantially large expenditure groups has changed little. The percentage spent on food has not decreased much in the last 30 years. This item should have decreased with significant increases in income.

However, the way in which the system of weights was established in 1934 and 1960 do not give us sufficient basis to make definite conclusions.

Analysis of Four "Engel" Functions

The results of the Lima survey were processed and tabulated according to 20 income intervals of one thousand Soles each.

We adopted functions commonly used in this type of study on such functions which, from the theoretical point of view, were preferable. Out intention was to see which of these functions best reflected consumer behavior under Peruvian circumstances. This also gave us an opportunity to compare our findings with the results obtained in other countries.

We limited ourselves to relating the change in the per capita expenditure on a given item to per capita income. Experience indicates that the linear, logarithmical, semi-logarithmic and inverse logarithmic functions are likely to be most representative to underlying expenditure-income relationships. Each of the above curves contains two parameters which must be estimated statistically.

One common method is that of the method of least squares. This method makes a number of implicit assumptions with respect to the distribution characteristics of the dependent variable (i.e., in above curves the variable Y) and the independent variable (i.e., in above curves the variable X). The observed variations in Y are explained by a systematic relationship between Y and the independent variable X, and a residual part which cannot be explained. This residual part, or "error" must have certain properties if the method of least squares is to be applicable.

Each Engel curve represents a particular transformation of the original observation. Consequently the properties of the random error must also refer to their transformed form. It is easy to understand that if the random errors are normally distributed, it is highly unlikely that such errors in their transformed form will be log normally distributed, and vice versa. Yet this unknown property of the unexplained residual should guide the particular Engel curve adopted. In

Table 21. Statistical analysis of 1934/46, 1960, 1966 indices[a]

Groups and Sub-Groups	Weights			
	1934-1936 Base	1960 Base Workers	Empls.	1966 Base
General Total	100.00	100.00	100.00	100.00
Food & Beverages	55.00	55.61	47.04	51.80
Housing & Furniture	18.00	18.00	21.31	21.00
Clothing	12.00	10.07	12.32	12.30
Miscellaneous	15.00	15.81	19.33	14.90

[a]Source: (13).

practice one usually forgets about the initial statistical considerations, and simply chooses the relationship that best explains the variations in the dependent variable. This criterion of best fit is measured by the coefficient of determination (R2).

Elasticities vary with the income level. It allows for the possibility that consumers begin to spend on a particular product only above a certain income level, or else that consumers spend a minimum amount independent of income.

The use of the semi-logarithmic form is recommended by Prais and Houthakker (14) in order to detect possible saturation levels. Under Peruvian circumstances and the income

Table 22. Algebraic forms and elasticity formulas of four Engel curves

Type of Engel Curve	Algebraic Form	Point elasticity E for given values of Y and X
1. linear	$Y = a + bx$	$E = b.(x/y)$
2. semi-logarithmic	$Y = a + b \log x$	$E = b.(1/y)$
3. inverse logarithmic	$\log Y = a + b\ 1/x$	$E = b.(1/x)$
4. double logarithmic	$\log Y = a + b \log x$	$E = b$

range studied, this type of curve did not yield satisfactory results. The inverse logarithmic curve allows for a saturation level and a possible switch of a given product between being initially classified as a luxury good at low levels and subsequently becoming a necessity at higher income levels.

Engel in his historic analysis used a double logarithmic form. This form has the useful property that a one percentage change in income will always cause a one percentage change in expenditure of a given product. This curve cannot have a positive or a negative intercept, it allows for no saturation level, it has a constant income elasticity independent of the level of income. It is surprising that a curve with so many prior drawbacks nevertheless was best adapted to represent the typical Engel curve under Peruvian circumstances.

By using an IBM computer it was possible to make four regressions for each of the groups of products using the classic method of minimum squares.

The regression results of each group of products were tabulated so as to compare the behavior of the different function using statistical indicators. The most relevant is the coefficient of determination (R^2). The standard error ($S_{y.x}$) and the ratio were also computed.

We also considered the additivity property of the functions involved. First with respect to the additivity of expenditure. Second, with respect to the additivity of elasticities, in the sense that the weighted elasticities of subgroups must tend to be equal to the directly estimated value of the elasticity of all subgroups combined.

The expenditures of the four expenditure groups, food, housing, clothing, and miscellaneous are not independent. The sum of the four weighted elasticities according to their corresponding expenditure proportions must be equal to unity, i.e.:

$$\Sigma \, W_i \cdot E_i = 1$$

In order to select one of these functions based on objective criteria, we have tried to clarify them in the light of their behavior during these tests.

The first test was to compare the coefficient of

determination of each of the functions. The double logarithmic functions scored highest in comparison with the other functions. The inverse logarithmic function was next in terms of the above criterion.

The linear Engel curve possessed the additivity property almost to perfection. The double logarithmic curve scored second in this test. The inverse logarithmic curve showed too drastic changes in the composition of expenditure as a result of variations in income. This resulted in a considerable overestimation of expenditure at lower income levels and underestimation at higher levels. The inflexion point generally corresponds to a very low income level which suggests that the double logarithmic curve might be more appropriate. The range of observed variation in income did not allow us to establish the upper asymptote of the inverse logarithmic expenditure curve.

We must therefore choose between the linear and the double logarithmic functions. We used a third test, in which the group elasticity was estimated through the weighted elasticities of the components.

Thus, with a scale of 10 to 1, we scored each function on each of the tests used, assigning the value of 10 to the best, and lesser values to the others in relative order of merit.

Function	R^2	Additivity	Elasticity	Total
Straight line	6	10	6	22
Logarithmic	10	8	10	28
Inverse logarithm	9	6	8	23

We also have to establish the difference in importance of each of the tests. Each was assigned a weight which was used against the scores above. Additivity was given a weight of .50, the other tests were given a weight of .25 each.

Function	R^2 x 25	Additivity x 50	Elasticity x 25	Total
Straight line	150	500	150	800
Logarithmic	250	400	250	900
Inverse logarithm	225	300	200	725

Therefore, we selected the double logarithmic function as generally representative of consumer behavior in the Lima area because it was the one that obtained the highest qualification.

Table 23. A comparative table of coefficients as related to the Engel curve for elasticity groups of food products

Products	Straight line R^2	Logarithmic R^2	Semi-Logarithmic R^2	Inverse R^2
Total expenditure on food	.91	.97	.90	.90
Cereals and derivatives	.79	.90	.86	.89
Meat & sausages	.83	.94	.89	.92
Fish & seafood	.68	.89	.57	.76
Fats & oils	.78	.89	.90	.95
Milk & dairy products & eggs	.89	.93	.95	.97
Fresh vegetables	.88	.96	.86	.89
Tubers & roots	.60	.77	.69	.78
Fruits	.91	.96	.79	.94
Dried beans & derived products	.38	.53	.48	.67
Canned fruits & vegetables	.37	.73	.35	.67
Sugar, salt & spices	.60	.75	.63	.68
Nonalcoholic beverages	.70	.77	.67	.58
Meal away from home	.43	.35	.34	.33

Table 24. Additivity test of expenditures

Income Level in Soles	Engel Curves	Expenditure in Soles				
		Food	Housing	Clothing	Miscellaneous	Total
1,000	Linear	1320	98	50	263	909
	Logarithmic	751	147	84	89	1071
	Inverse	140	22	7	7	176
3,000	Linear	2040	441	268	184	2933
	Logarithmic	1797	590	314	158	2857
	Inverse	2011	731	376	438	3556
6,000	Linear	3120	1249	746	854	5969
	Logarithmic	3115	1274	719	857	5965
	Inverse	3919	1765	1016	1237	7937
9,000	Linear	4199	2057	1225	1524	9005
	Logarithmic	4298	1998	1167	1429	8892
	Inverse	4895	2367	1415	1748	10425
12,000	Linear	5279	2865	1703	2194	12041
	Logarithmic	5401	2749	1646	2054	11850
	Inverse	5470	2742	1670	2078	11960
15,000	Linear	6358	3679	2181	2864	15076
	Logarithmic	6448	3522	2149	2721	14840
	Inverse	5848	2994	1845	2306	12973
18,000	Linear	7438	4481	2659	3534	18112
	Logarithmic	7453	4312	2672	2424	16861
	Inverse	6114	3175	1971	2471	13731

Table 25. Test of the sum of the weighted partial elasticities within the food groups

Products	Weights %	Expenditure weight x point elasticity: Income level: S/9,000		
		Linear	Double logarithmic	Inverse logarithmic
Cereals & derivatives	17.60	7.21	7.39	4.04
Meats & sausages	26.31	17.10	23.41	13.29
Fish & seafood	3.89	4.08	3.46	1.86
Fats & oils	6.97	4.32	5.29	3.19
Milk, eggs & derivatives	12.34	9.62	12.34	4.00
Fresh vegetables & tubercles	7.18	5.81	6.03	3.28
Fresh fruits	5.30	6.94	8.05	4.62
Dried beans	2.84	0.96	1.22	0.78
Canned fruits & vegetables	0.35	0.45	0.54	0.29
Sugar, salt & spices	4.41	2.29	2.16	1.19
Nonalcoholic beverages	4.15	3.07	2.90	1.42
Alcoholic beverages	1.89	3.25	1.49	0.62
Food away from home	2.26	3.48	2.27	1.58
Sub-total	100.00	70.81	78.75	40.02
Direct elasticity estimate of all food		0.77	0.79	0.43
Indirect elasticity estimate of all food		0.70	0.78	0.40

Table 26. Test of the sum of the weighted partial elasticities of the major expenditure groups

		Straight line	Logarithmic	Inverse logarithmic
Food	$\bar{E}$ Calculated food	0.78	0.79	0.36
	Weighted food E	0.64	0.79	0.35
Housing	$\bar{E}$ Calculated housing E	1.15	1.10	0.45
	Weighted housing E	1.16	1.10	0.54
Clothing	$\bar{E}$ Calculated clothing	1.14	1.19	0.54
	Weighted clothing E	1.88	1.20	1.62
Miscellaneous	$\bar{E}$ Calculated miscellaneous	1.32	1.26	0.56
	Weighted miscellaneous	1.27	1.19	0.38
Total Expenditure Elasticities:				
Estimate		0.96	0.97	0.43
Directly Calculated		1.00	0.98	0.44

CHAPTER IX. ELASTICITY COEFFICIENTS AS RELATED TO EXPENDITURE LEVELS

We used the double logarithmic Engel curve to represent the behavior of the consumer in relation to variations of his income.

The parameters and their standard errors for each of the food sub-groups are given in Table 26, as are the corresponding expenditure elasticities.

Distribution of Expenditures by Income Levels

The composition of expenditures of the average consumer can easily be computed if his average income is known. For Lima this average was 6,547 Soles per capita per year in 1965. By computing the composition at various levels of income we obtain Tables 27 and 28.

At a level of 3,000 Soles per capita annually food represents 63% of total expenditure. This explains why a small increase in the price of food has a large impact on the real income of low income consumers.

When consumers increase their income, the proportion of expenditure spent on food decreases rapidly. Consumers with higher incomes will allocate a greater proportion of their expenditures on nonfood products, thereby expanding the domestic market for industrial goods.

Table 27. Variations in the composition of expenditures of the four major groups of consumer goods by income level

Income Level	Food %	Housing %	Clothing %	Miscellaneous %
S/ 3,000	62.8	20.6	11.0	5.6
S/ 6,000	52.0	4.4	12.1	14.4
S/ 9,000	48.3	22.5	13.1	16.1
S/ 12,000	45.6	23.2	13.9	17.6
S/ 15,000	43.4	23.7	14.5	18.3
S/ 17,000	42.3	24.0	14.8	18.9

At high income levels the miscellaneous group becomes more important than clothing, whereas housing, expenditure reflects only a minor tendency to increase its participation in expenditure.

Food sub-groups vary much in behavior. Cereals, at lower income levels are the most important item in the food budget. With increasing incomes cereals are substituted, meat accounts for a surprisingly large percentage of total expenditure at all income levels, with a tendency to increase with increasing incomes. The increase in milk consumption is very sensitive to increased income, and becomes very important in the budget of consumers with incomes of over 18,000 Soles per year. The expenditure on fresh

Table 28. Elasticities of food subgroups as indicated by logarithmic Engel functions[a]

Food Group	A	B	R^2	Rates	Standard Error	Income Expenditure Elasticity	Expenditure Weight
Total Food	.49	.79	.97	27.8	.03	.79	100
Cereals	1.13	.42	.90	12.5	.04	.42	17.6
Meats & sausages	.48	.89	.94	16.9	.07	.89	26.3
Fish & seafood	1.29	.89	.89	12.1	.09	.89	3.9
Fats & oils	.58	.76	.89	12.3	.08	.76	6.9
Milk & derivatives	1.26	1.00	.93	15.5	.08	1.00	12.3
Fresh vegetables	.82	.84	.96	22.0	.05	.84	7.2
Tubers & roots	.31	.48	.77	7.6	.08	.48	4.5
Fruits	3.65	1.52	.96	20.2	.10	1.52	5.3
Dried beans	.30	.43	.53	4.4	.13	.43	2.8
Canned fruits & vegetables	5.08	1.57	.73	6.9	.29	1.57	.4
Sugar, salt & spices	.28	.49	.75	7.3	.09	.49	4.4
Alcoholic beverages	1.34	.79	.79	2.5	.40	.79	1.9
Food away from home	2.05	1.01	.35	2.9	.37	1.01	2.3

[a]The general function estimated was log of expenditure = intercept (A) plus (B) logarithm of level of income.

Table 29. Variations in composition of expenditure and the main food subgroups by income levels

Income Level	Cereals	Meats	Fish	Fats & Oils	Milk & Derivatives	Vegetables	Tubers & roots	Fruits
3000	23.3	23.0	3.7	6.6	9.2	6.9	4.9	2.5
6000	18.1	24.6	4.0	6.5	10.6	7.2	4.0	4.2
9000	15.6	25.7	4.2	6.4	11.5	7.3	3.6	5.7
12000	14.6	26.7	4.3	6.4	12.2	7.4	3.3	8.1
15000	12.9	27.0	4.4	6.3	12.8	7.5	3.1	8.2
17000	12.3	27.3	4.5	6.3	13.2	7.5	3.0	9.0

fruit also increases very rapidly when income increases.

Other subgroups, such as fish, fats, vegetables, and tubers maintain more or less stables participation. For nutritional purposes above tendencies are of importance since they show that the per capita income is a powerful instrument in changing the composition of the diet in terms of calories and proteins.

As income increases the proportion of food of animal origin, rich in proteins and relatively expensive, and vegetable food rich in minerals and vitamins such as fresh fruit, increase rapidly in importance. It is interesting to observe that the consumption of fish and seafood increases but little with increased family income. Seafood is very rich in proteins and of potential abundance in Peru.

Traditional agricultural policy in the last two decades has tried to control the price of meat, milk and cereals. One of the roles of the foreign sector has been to finance this consumer strategy favoring the urban consumer. Those who had to bear the burden of lower prices were the meat, milk and rice producers. The agricultural sector thus subsidized the urban consumers' real income by accepting lower prices for their products than would have been paid if imports of beef, milk, wheat and rice had been prohibited in order to protect and promote national production.

The Soles thus freed in the family budget are partially

spent on nonagricultural goods. The market for such products is broadened.

The current agrarian reform program aims to increase rural incomes. This could create a market for expanded agricultural production and possible increased prices.

Both are necessary to provide a long run basis to solve the problem of rural poverty. A policy of income distribution in favor of low income people requires a change in traditional price policies. Urban groups might have to pay increased prices for products produced by the rural sector. Soles so distributed will be used in the purchase of essential goods. It is rather arbitrary, of course, to judge that the consumption of food products by low income consumers are more important than the decrease in consumption of a non-food product for a high income consumer.

The Practical Use of the Income Elasticity Concept

The use of this parameter has many advantages:

a) It is simple and precise.

b) It has no dimensions, making it possible to compare the consumer attitudes to products under different conditions, occupations, between areas, etc.

c) It facilitates the intertemporal comparison which shows the rate of change in this coefficient.

d) It facilitates international comparison obviating currency differences and compatibilization of the concept of purchasing power.

e) No adjustments need to be made in order to avoid the distortions caused by inflation.

f) The income elasticity is a handy criterion in classifying products as necessities, luxuries, or inferior goods.

The elasticity used in this study is the expenditure elasticity. This elasticity is smaller than the income elasticity, since the first part is a component of the second.

Secondly, our dependent variable measures expenditure, not quantity. These three variables are functions of income:

$$G(Y) = Q(Y) \cdot p(Y)$$

High income consumers pay higher prices for a given product obtaining higher quality or perhaps more agreeable service, or hygienic conditions, etc., which in themselves do not improve the quality of the products. The income expenditure elasticity according to Wold and Jureen (15) equals:

$$E_G = E_q + \frac{E_p}{1 + E_p}$$

Products that vary much in quality can be expected to have a large quality elasticity, staple foods tend to be homogenous, and the income-quantity elasticities will be nearly the same.

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