THE FUTURE GROWTH OF WORLD DEMAND FOR AGRICULTURE IMPORTS AND THE IMPLICATIONS FOR UNITED STATES EXPORTS

by 6408

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PREFACE

The intent of this thesis is to determine the nature of demand for agricultural imports by various nations of the world. By determining this, some insight is hoped to be obtained upon where and in what quantity the United States will be exporting agriculture goods in the future.

This study is closely related to the field of economic development since one of the primary factors to be considered in determining import demand is economic growth. The author's interest in this study developed from his interest in economic development and United States agriculture.

This study has drawn upon United Nations sources as a basis for its data and has analyzed the data by means of a computerized regression and correlation analysis study. Publications by the Food and Agriculture Organization of the United Nations were particularly relevant for information desired by this study. Several major authors who have done work in this area have been cited in this thesis. They include Lester Brown, Arthur Mackie, John Mellor, and Robert Stevens.

The author wishes to express his appreciation for the guidance of Dr. John Sjo, his committee chairman and the assistance of Dr. Orlan Buller for aid in the area of data analysis and Dr. Orlin Scoville for assistance in the area of international agriculture development. The author also wishes to thank his wife, Carol, for her assistance in preparing and typing this thesis.

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CHAPTER I

INTRODUCTION

Increases in demand for food and other agricultural goods produced in the United States can occur in three basic ways. One source of increased demand is through increased domestic food consumption demands, a second source is increased industrial demand for agricultural products, and the third source of demand increase is increased demand for United States exports of agricultural goods.

Most people of the United States are presently consuming nearly all of the food they desire to. This is evidenced by the fact that per capita food consumption has grown at an average rate of less than .5 percent per year for the last fifteen years.[1] In addition to the slow growth of per capita consumption, the number of consumers has not been increasing rapidly since population growth has averaged only about 1.5 percent per year since World War II.[2] These two factors have caused domestic food consumption demand to increase at slow rates. Much of the growth in food consumption demand that has occurred

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[1]United States Department of Agriculture, Agriculture Statistics, 1969 (Washington, D.C.: Government Printing Office, 1969), p. 579.

[2]Statistical Office of the United Nations, Statistical Yearbook, 1968 (New York: United Nations Publishing Service, 1969), pp. 550-53.

has been due to shifts in consumption from cheaper staple-type foods to more expensive types of food.

Growth in demand for agricultural goods to use in industrial processes and the production of new synthetics has not been rapid in the recent past. Much publicity and hope has been directed toward efforts to develop new processes and products which make use of agriculture goods. However to date, these efforts have not had much success.

The farmer has had to rely on the export market in the recent past to provide much of the substantial growth in demand for agriculture goods. This market has been expanding at an average rate of 6.2 percent for the last fifteen years.[3] It also appears from this study, that the export market will hold the best promise of these three markets for future increases in demand for agricultural goods.

The increases of demand for agricultural products by countries of the world will be an important factor to the United States farmer. The farmer presently relies upon the export market to sell about one-sixth of the cash value of his production.[4] For many crops, such as wheat and cotton, the export market is an even more important market.

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[3]United States Department of Agriculture, Agriculture Statistics, 1969, p. 590.

[4]Authur B. Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, U.S.D.A. Economic Research Service, Foreign Agriculture Report No. 24 (Washington, D.C.: Government Printing Office, 1967), p. i.

Not only are agricultural exports important to the United States farmer, they are also important to the United States balance of payments situation. Agricultural exports comprise about one-fifth of the United States total exports.[5] In recent years when the balance of payments problem has been rather critical, agricultural trade has shown continual, strong positive balances. This has helped to prevent even larger deficits than have occurred.

To many countries of the world, particularly developing nations, agricultural trade is essential to their economy and the welfare of their people. Many developing nations produce large amounts of agricultural goods and export a major portion of them. Their export markets in many cases consist largely of agricultural goods and provide a major part of their economy's income.

Many of these same developing nations which export large amounts of agriculture cash crops and raw materials need to import large amounts of food goods. The need for food imports generally arises because of rapid population growth rates. This study has found that unless income growth occurs with population growth, little increase in imports will occur because of a lack of "purchasing power." Population growth usually must be slowed in order to allow progress in per capita income growth and the creation of "purchasing power".

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[5]United States Department of Agriculture, Agriculture Statistics, 1969, p. 590.

The strong demand of developing nations for food and their inability to purchase it, has often caused developed nations to provide food on concessional terms. The question arises whether this is harmful or helpful to current and long-run cash export markets. This is one of the questions people concerned with the United States agriculture export market ask. Other important questions to ask may be which countries will offer the best markets in the future; what will be the effect of population control programs on the demand for food; what effect does economic growth have on the demand for food imports; what is the effect of increases in a country's agricultural production upon its demand for imports of agricultural goods; and at what rate will demand for agricultural imports grow? It is these questions and others like them with which this study will concern itself.

CHAPTER II

A REVIEW OF THE NATURE OF THE WORLD'S FOOD PROBLEM AND DEMAND CHARACTERISTICS FOR FOOD AND AGRICULTURE GOODS

> Agriculture's performance of its basic task of supplying food for the expanding population has come under more anxious scrutiny during the past decade than ever before. The implications of the accelerating population growth in developing countries and of the unsatisfactory nutritional levels of the bulk of their populations are now widely realized.[6]

"The prevention of malnutrition throughout the world through the provision of adequate diets for a rapidly expanding population is a task of staggering proportions."[7] The complexity and dimension of the world's food problem may be larger than any problem the world faces today. The world food problem is closely related to, and sometimes a cause of other major problems of the world today such as war, pollution, racial and social unrest, nuclear threats, etc. Among these problems, the largest killer and cause of social and economic unrest is probably malnutrition. Malnutrition is a staggering problem today, but all indicators indicate that it will become an even bigger problem in the future if steps are not taken to check the spread of hunger.

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[6]Food and Agriculture Organization of the United Nations, The State of Food and Agriculture, 1965 (Rome, Italy, 1965), p. 5.

[7]President's Science Advisory Committee, A Report of the Panel of the World Food Problem, Volume II, The World Food Problem (Washington, D.C.: Government Printing Office, 1967), p. 5.

"The most urgent needs in less developed countries are an increase of calories and good quality proteins."[8]

> Nutrition has a vital role in the health of adults as well as children and profoundly influences socioeconomic and cultural development. Malnutrition leads to deterioration of physical fitness and mental efficiency, to emotional and personality disturbances, and to reduction in the capacity to perform work.[9]

All the education, economic aid, technological advice, and equipment the developed world can provide, will not cause significant increases in economic efficiency if it is received by an undernourished, tired, and unmotivated people.

Evidence shows that on a global or world-wide basis enough food is currently produced to adequately feed all the people of the world. A study by the U.S.D.A. implies

> that the world will probably continue to have excess production capacity by 1980. Any problems of food shortages would arise out of the distribution of productive capacity or of the commodities among countries. The production capacity of developed countries will grow regardless of growth in LDC's.[10]

This study and others like it point out that "the world's increasingly serious nutritional problem arises from the uneven distribution of the food supply among countries, within countries, and among families with different levels of income."[11] Knowing this, it can be seen that it is important to

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[8]President's Science Advisory Committee, The World Food Problem, p. 5.

[9]Ibid.

[10]Martin E. Abel and Anthony S. Rojko, World Trade Situation, Prospects for World Grain Production, Consumption, and Trade, U.S.D.A. Foreign Agriculture Economic Report No. 35 (Washington, D.C.: Government Printing Office, 1967), p. iv.

[11]President's Science Advisory Committee, The World Food Problem, p. 11.

improve markets, internal and external, improve trade, and assure the opportunity for all to share in earning available income. It is clear that the need for trade, and the determinants of the level of trade are important factors involved in the food distribution problem between countries.

Trade of the proper goods and in adequate volume could do much to alleviate today and tomorrow's world food problem. However, in the long run, it appears quite certain that any solution of the food problem must involve population control and increased food production within developing countries and malnutrition areas. However growth of trade can play a major role too, along with other efforts, in alleviating the world food problem.

The Determinants of Trade

Trade of food and agriculture products is not based on need alone, malnutrition and large population concentrations do create a need for food, but, unless this need is backed in income with which to create purchasing power, very little trade will occur. Without income, need for food cannot be "effective or real demand" in terms of actual trade. The lack of "effective demand" in low income countries lies behind the fact that "prosperous nations trade much more than less-prosperous or low-income nations."[12] It is also for this reason, that the United States' largest agriculture export markets at the present and in

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[12]Authur B. Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, p. 5.

the past have been other developed countries. However, because of the rapid population growth and malnutrition in developing countries, these countries may provide the potentially largest market. The developing countries lack of income growth is the key to their lack of "effective demand" growth.

Economic growth or income growth "in low-income countries is clearly associated with substantial rises in demand for food."[13] It follows, "that one of the best allies of U.S. farmers have in their quest for overseas markets is economic development."[14]

Economic development creates jobs and purchasing power which gives more people the means to buy more and better food. "Growth in world markets for U.S. agriculture products have been and will continue to be related to economic growth in other countries."[15]

Before considering the specific causes of growth in demand for domestic or internal demand for food, it is necessary to determine why growth in domestic demand for food and agriculture goods often becomes growth in demand for imports of food and agricultural goods. Increases in domestic demand become increases in import demand for two basic reasons. "First, the

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[13]John W. Mellor, The Economics of Agricultural Development (New York: Cornell University Press, 1966), p. 57.

[14]Growth Abroad Spells Bigger Farm Markets," Foreign Agriculture, July 8, 1968, p. 8.

[15]Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, p. iii.

growth in demand is often more rapid than increases in production."[16] This is generally the case in low income countries where population growth is increasing rapidly but production per capita is increasing only slowly. "Secondly, the full range of items desired cannot be economically produced in sufficient quantity or quality locally."[17] This is the case often created by economic growth. As countries' income levels increase, the desire for "luxury foods" such as certain drinks, fruits, meats, etc. increases. Also, people begin to realize the need for balanced diets and demand foods to meet diet requirements. Many of these foods cannot be produced in the country because of their climate, soils, etc.

Income growth is one of the primary causes of increases in domestic and import demand for food and agriculture goods. Increases in income allow people to purchase food and goods to satisfy their basic caloric, shelter, and clothing needs. When rises in income are rapid, the resulting increase in demand cannot be filled by domestic production and result in the creation of external demand. Also, as has been discussed, economic growth creates demand for a wider variety of goods. One of the primary causes for the broadening of demand is the rise in educational levels which generally accompanies economic growth. Better educated people are more aware of nutritional requirements and foods available in other countries. Hence,

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[16]Quentin M. West, "Developing Countries and U.S. Agriculture," War on Hunger, May, 1970, p. 16.

[17]Ibid.

they demand a larger variety of food and agricultural goods, many of which must be imported.

It has long been recognized that increases in income causes a "selected" change in demand for food.

> Population expansion by itself normally provides for a symmetrical expansion of demand for agricultural commodities in the sense that the demand for each agricultural commodity will expand by the same percentage as all others. Expansion of income per capita, however, results in an asymmetrical expansion of demand. While demand for some commodities will rise very rapidly, demand for others will rise slowly, or even decline. In general the foods which provide the bulk of calories and carbohydrates, such as the starchy staples, will have lower income elasticities than those which provide proteins.[18]

Indirectly economic growth causes increased demands for imports of food and agriculture goods in other ways also. It improves the market system which increases trade. It also creates urbanization and industrialization. A "major source of increases in demand for food is the movement of people from rural to urban areas."[19]

> Most people living in rural areas of developing economies produce at least some food for their own use. When a family moves to town, and thus becomes dependent on commercial supplies, the land they formerly used for subsistence may produce less or its produce may be used to supplement diets of people who stay in the area. In either case the addition to commercial demand for food is not matched by an increase in commercial supply.[20]

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[18]Mellor, The Economics of Agriculture Development, p. 65.

[19]Mordecai Ezekiel and Marguerite C. Burk, Food and Nutrition in Developing Economies, ec. by Herman H. Southworth and Bruce Johnston (Ithaca, New York: Cornell University Press, 1967), p. 344.

[20]Ezekiel and Burk, Food and Nutrition in Developing Economies, p. 344.

Hence, the excess demand often results in increases in imports of food. With urbanization, also comes industrialization. Industrialization in many cases creates increased demand for agricultural raw materials. Some of these materials must also be imported and used in the manufacturing process.

A second major factor in causing increased demand for food and agricultural goods is population growth. "The population explosion in the developing countries is undoubtedly the most important single factor dominating the world food situation during the whole of the postwar period."[21] This was the conclusion of the Food and Agriculture Organization, (FAO).

There is disagreement concerning whether the growth of income or population is the most important factor in determining increases in demand for food. However, it appears universally agreed that "the two main factors influencing demand are the growth of population and income."[22]

The FAO, in its study of the relative importance of income and population growth in determining demand for food has summarized its finding in Table 2.1 presented on the next page. The table makes various assumptions about growth of gross domestic product and populations. It uses two population growth rates. The high growth rate is based upon a continuation of past growth rates while the lower growth rate anticipates the

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[21]Food and Agriculture Organization of the United Nations, The State of Food and Agriculture, 1965, p. 5.

[22]Food and Agriculture Organization of the United Nations, Agriculture Commodities - Projections for 1975 and 1985, Vol. I. (Rome, Italy, 1967), p. iii.

TABLE 2.2

A PROJECTION OF THE RELATIVE IMPORTANCE OF POPULATION GROWTH AND INCOME IN DETERMINING RATES OF GROWTH IN DEMAND FOR FOOD, FOR VARIOUS REGIONS, 1957-1959, 1969-1971.

Average annual rates of growth		Asia & Far East[1]	Near East & Africa[2]	Latin America[3]	Japan	Mediterranean Europe	EEC	Other Western Europe	North America
Population		2.3	2.5	2.7	0.7	1.0	0.7	0.4	1.8
Projected increase in demand for all food expressed in terms of farm value:									
Per capita	Low	1.0	1.0	1.0	2.2	1.6	1.4	0.5	0.16
	High	1.9	1.6	1.3	2.5	2.1	1.7	0.6	0.35
Total	Low	3.4	3.5	3.7	2.9	2.6	2.1	0.9	1.9
	High	4.3	4.1	4.1	3.3	3.1	2.4	1.1	2.1
Ratio between the income and the population effects on the total demand expressed in terms of farm value:									
	Low	0.4	0.4	0.3	3.3	1.8	2.1	1.0	0.1
	High	0.8	0.6	0.5	3.9	2.4	2.6	1.4	0.2

[1]Excluding Japan
[2]Excluding South Africa
[3]Excluding Argentina and Uruguay
Source: Mellor, The Economics of Agriculture Development, p. 58.

adoption of effective population control measures. Gross Domestic Product (GDP) was also assumed to grow at two different rates. The low rate of growth of GDP is somewhat slower than past growth rates while the high rate was "set in the light of the rates of growth being sought under the national development plans of many developing countries."[23]

The figures in the lower half of Table 2.1 indicate the percentage of total change in demand for food attributed to population increases under the various assumptions indicated. Based on the results of their study, which are summarized in Table 2.1, the FAO concluded the following:

> The future trend in world demand for food as a whole will be determined mainly by the increase in the number of consumers. Population growth is likely to be more important than income growth. In developing countries, this is a result of the rapid rate of population increase, while in most developed countries where per capita incomes will rise somewhat faster, the income level is already high enough to permit an adequate food intake.[24]

In looking at the table, it can be seen that there are cases where population growth accounts for less than 50 percent of the growth in demand and therefore is not the dominate factor. Notable examples are Japan and Western Europe. These examples tend to indicate that where per capita income growth is rapid and population growth has been checked, income is a larger factor than population. This is the case Mellor refers to when he states that "indeed at certain stages of development the

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[23]Food and Agriculture Organization of the United Nations, Agriculture Commodities - Projections for 1975 and 1985, Vol. I. p. 6.

[24]Ibid., p. 32.

income effect on demand for food may be more important than the population effect."[25] Mellor presents a table very similar to Table 2.1, which is from another FAO commodity projection study, to support his statement. In this table, which is Table 2.2 on the following page, a ratio greater than one indicates that income has a larger effect upon demands for food than does population. In addition to showing total rates of increase in food demand, the table also shows the rate of per capita increase in demand for food. It is interesting to note that the areas in which total demand is increasing the most rapid, such as Asia, Africa, and Latin America, are not the areas where per capita demand is increasing the fastest. Per capita demand increased more rapidly where population growth was slow and income growth high.[26] This relation occurs in areas such as Japan and Europe.

Another relation which Table 2.2 appears to present, is that the rate of per capita demand growth is at its highest rate where income is the dominate factor. In areas where population growth is the dominate factor, total demand growth rates are at their peak.

Other factors besides income and population affect demand for food and agriculture goods also. These factors, however, are not usually as important as income and population

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[25]Mellor, The Economics of Agriculture Development, p. 57.

[26]Rates of income growth for various countries can be found in Table A.2 of the Appendix.

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and do not generally affect total demand on a broad scale, but rather cause certain products to have changes in demand. Such factors are tastes, prices, advertising, climate, transportation, etc. A great number of factors also affect the level of trade of food and agricultural goods. "Some of these are general and preferential tariffs, quantitative restrictions, international liquidity, bilateral arrangements, exchange restrictions, consumption habits, comparative costs, colonial or sovereignty status, income, population, and basic resource endowments."[27] As has been stated, income and population growth are felt to be generally the most important factors. However in individual cases any one of the factors listed could be very important. Mackie states that he believes it is safe to assume that international demand is determined much in the same way as domestic demand. "In spite of all these individual country conditions affecting trade, it is assumed that if a general increase in effective demand for agriculture and other products is not met domestically, it will spill over national boundaries and increase the total demand for imports."[28]

Yet to be mentioned, is perhaps the third most important factor affecting demand for imports of food and agriculture goods. That factor is internal production of food and agriculture goods. If developing countries were able to produce

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[27]Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, pp. 9-10.

[28]Ibid., p. 29.

goods as rapidly as demand increased for them, one of the two basic reasons previously quoted for growth of import demand would be eliminated. The fact is, however, that production in developing countries has not kept pace with increases in demand.

Table 2.3 on the following page indicates the trends in food and agricultural production of various regions which have been grouped as developed and developing.

Developing regions have been able to increase total production just as rapidly as developed regions. However, they have not been able to keep pace on a per capita basis due to their rapid population growth. Therefore in developing nations demand created by population growth alone has just barely been met with little additional production increases left to meet other increases in demand caused by income growth and other factors. That is, per capita food levels are only being held at past levels and not increasing.

Figures have been given previously in Tables 2.1 and 2.2 on the rates of increase in total demand for food. Projections of the rates of growth of total demand for agriculture products and food are compared to projections of rates of increases in production or supply in Table 2.4 on page 19. The projections in Table 2.4 are also shown graphically in Figure 2.1 on page 20. The figure shows that developed countries, as in the past, will have no problem keeping pace with demand increases. However developing nations in general will not be able to meet increases in demand unless high production trends exist and low

TABLE 2.3
INDICES OF WORLD[1] AND REGIONAL AGRICULTURAL PRODUCTION

	1948-52 average	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969[2]	Change 1968 to 1969	Annual rate of growth 1956-58 to 1966-68
	1952-56 average = 100													Percent	
Total production															
ALL AGRICULTURAL PRODUCTS															
Western Europe	84	109	112	118	118	126	127	129	130	133	142	145	146	—	2.8
Eastern Europe and U.S.S.R.	82	128	130	132	135	138	133	145	148	165	167	174	169	— 3	3.5
North America	93	106	107	109	109	112	119	117	119	120	124	126	124	— 1	1.9
Oceania	89	118	119	122	125	133	137	141	135	152	143	166	163	— 2	3.6
Other developed countries[3]	81	117	119	121	125	133	135	139	139	144	166	166	168	+ 1	3.4
ALL DEVELOPED COUNTRIES	87	114	116	119	120	124	126	130	131	138	143	147	146	— 1	2.7
Latin America	87	117	118	120	127	130	132	135	142	139	147	146	149	+ 2	2.6
Far East[1,4]	87	111	117	121	126	128	131	135	133	135	141	148	154	+ 4	2.6
Near East[5]	82	118	122	123	123	135	138	141	143	147	153	158	162	+ 2	3.0
Africa[6]	88	110	113	121	115	124	128	131	134	133	137	141	142	+ 1	2.5
ALL DEVELOPING COUNTRIES	87	114	117	121	124	129	132	135	137	137	143	148	152	+ 3	2.7
World[1]	87	114	116	120	121	126	128	131	133	138	143	147	148	—	2.7
FOOD PRODUCTS ONLY															
Western Europe	84	109	112	119	118	126	128	129	130	134	143	146	147	—	2.9
Eastern Europe and U.S.S.R.	83	129	131	133	137	140	134	146	149	167	168	176	171	— 3	3.5
North America	92	109	109	111	110	114	121	119	122	127	132	133	131	— 1	2.2
Oceania	92	118	115	121	124	135	138	144	136	159	145	174	167	— 4	4.2
Other developed countries[3]	81	117	120	123	127	137	138	141	141	147	172	171	174	+ 2	3.7
ALL DEVELOPED COUNTRIES	87	115	117	120	121	126	128	131	133	142	147	152	150	— 1	2.9
Latin America	87	116	114	117	123	125	131	136	140	141	150	151	152	+ 1	2.8
Far East[1,4]	87	112	118	122	127	128	132	136	133	135	141	149	154	+ 4	2.6
Near East[5]	82	118	121	122	123	133	136	137	139	144	150	155	157	+ 2	2.7
Africa[6]	89	108	111	117	113	120	124	126	128	127	131	136	135	—	2.2
ALL DEVELOPING COUNTRIES	87	113	116	120	123	127	131	134	135	136	143	148	151	+ 2	2.6
World[1]	87	114	117	120	122	126	129	132	134	140	145	150	150	—	2.8
Per caput production															
ALL AGRICULTURAL PRODUCTS															
Western Europe	87	105	107	113	111	117	118	118	118	120	127	129	128	—	1.9
Eastern Europe and U.S.S.R.	87	121	121	120	122	123	117	126	127	141	141	145	140	— 4	2.2
North America	100	98	98	98	96	97	102	99	99	99	101	101	99	— 2	0.3
Oceania	99	107	106	107	107	111	112	113	106	117	108	123	119	— 3	1.4
Other developed countries[3]	86	111	111	112	115	121	121	122	121	124	142	139	139	—	2.1
ALL DEVELOPED COUNTRIES	92	108	108	110	109	112	113	114	114	119	122	125	122	— 2	1.5
Latin America	97	105	102	101	104	104	103	102	104	99	102	99	97	— 1	— 0.3
Far East[1,4]	94	102	104	106	107	106	106	106	103	101	103	105	107	+ 1	0.1
Near East[5]	91	106	107	106	103	109	109	109	108	107	109	110	109	— 1	0.3
Africa[6]	96	100	101	105	97	102	103	103	103	100	100	101	99	— 2	—
ALL DEVELOPING COUNTRIES	94	103	104	105	105	106	106	106	104	102	104	104	104	—	0.1
World[1]	93	105	106	107	106	108	108	108	107	109	111	112	110	— 2	0.7
FOOD PRODUCTS ONLY															
Western Europe	87	106	108	113	112	118	118	118	118	120	127	130	130	—	1.9
Eastern Europe and U.S.S.R.	87	122	122	122	123	124	118	127	128	143	142	148	142	— 4	2.3
North America	99	101	100	100	98	99	104	101	102	104	107	107	105	— 2	0.7
Oceania	102	107	102	106	105	113	113	116	107	122	109	129	122	— 6	2.1
Other developed countries[3]	87	111	112	114	116	124	124	124	123	127	147	143	144	—	2.4
ALL DEVELOPED COUNTRIES	92	109	109	111	110	113	114	115	115	122	125	128	125	— 2	1.7
Latin America	97	104	100	99	101	100	102	103	102	101	104	101	99	— 2	— 0.1
Far East[1,4]	94	103	106	107	108	107	107	107	103	101	103	106	107	+ 1	0.1
Near East[5]	90	107	106	104	103	108	108	106	105	105	107	107	106	— 1	0.1
Africa[6]	97	98	99	102	95	99	100	99	98	96	96	97	94	— 3	— 0.3
ALL DEVELOPING COUNTRIES	94	103	103	104	104	105	105	105	103	101	103	104	104	— 1	—
World[1]	93	106	106	107	106	108	108	109	108	110	113	114	111	— 2	0.8

[1] Excluding Mainland China. – [2] Preliminary estimates. – [3] Japan, South Africa and Israel. – [4] Excluding Japan. – [5] Excluding Israel. – [6] Excluding South Africa.

Source: Food and Agriculture Organization of the United Nations, The State of Food and Agriculture, 1970 (Rome, Italy), p. 2.

TABLE 2.4

PAST AND PROJECTED GROWTH IN PRODUCTION AND DEMAND FOR FOOD AND AGRICULTURE PRODUCTS

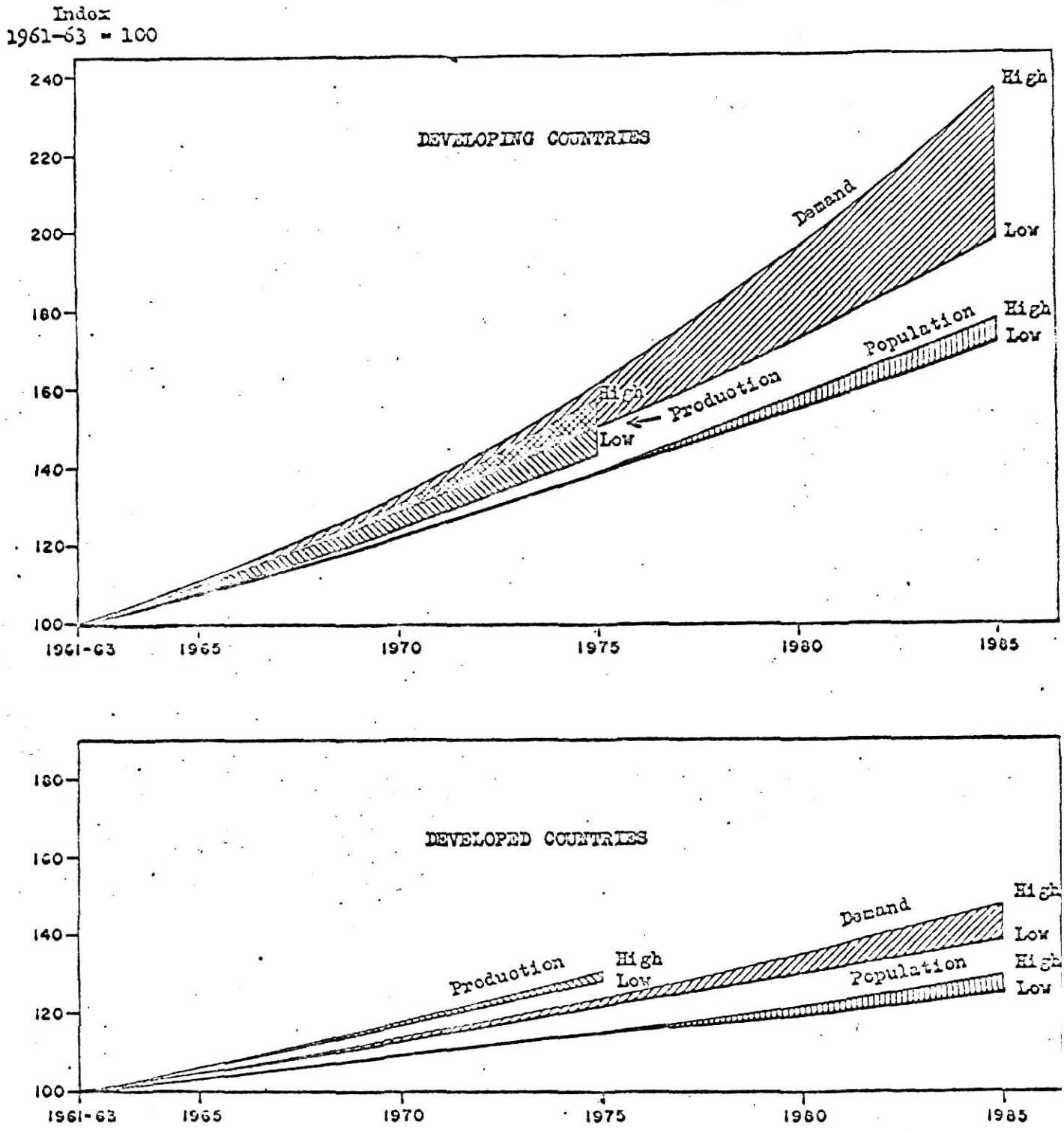
Areas	Production 1953-1063		Trends 1/ 1958-1963		Projected Production 1962-1975				Projected Demand			
	All Agric. Products	Food	All Agric. Products	Food	All Agric. Products		Food		All Agric. Products		Food	
					L	H	L	H	L	H	L	H
	Percent per year compound											
WORLD	2.8	2.8	2.6	2.6	2.3	2.7	2.3	2.7	2.3	2.7	2.3	2.7
1 - Developing countries	3.1	3.0	2.8	2.9	2.8	3.5	2.8	3.6	3.2	3.9	3.2	3.7
Latin America	3.1	3.0	2.3	2.5	2.8	3.4	3.0	3.6	3.1	3.8	3.2	3.5
Africa	2.8	2.5	3.2	2.9	2.9	3.6	2.8	3.5	2.9	3.6	2.9	3.4
Near East	3.4	3.2	3.0	2.5	2.3	3.6	2.3	3.6	3.5	4.3	3.4	4.0
Asia and Far East	3.0	3.0	3.0	3.0	2.7	3.5	2.8	3.5	3.2	4.0	3.2	3.9
India	2.7	2.6	2.6	2.5	2.8	3.7	2.9	3.8	3.3	4.1	3.3	3.8
2 - Developed countries	2.3	2.4	2.8	2.7	1.9	2.1	2.0	2.1	1.6	1.8	1.7	1.9
North America	1.7	1.8	2.3	2.0	1.7	1.8	1.9	2.0	1.5	1.5	1.6	1.6
EEC	2.3	2.3	3.1	3.2	1.8	2.0	1.8	2.0	1.4	1.7	1.4	1.7
Northern Europe	2.3	2.3	3.3	3.4	1.6	1.8	1.6	1.8	0.8	1.1	0.9	1.1
Southern Europe	3.9	3.8	3.1	2.9	2.3	2.7	2.3	2.7	2.6	3.3	2.4	3.0
Japan	3.4	3.6	2.2	2.3	2.5	2.7	2.5	2.6	2.8	3.5	2.8	3.3
Oceania	3.5	3.5	3.9	4.8	2.0	2.4	2.2	2.5	1.9	2.1	1.9	1.9
South Africa	3.2	3.6	3.3	3.9	2.8	3.2	3.0	3.4	3.0	3.7	3.1	3.6
3 - Centrally planned countries	...	...	...	...	2.4	2.8	2.4	2.8	2.6	2.8	2.5	2.8
U.S.S.R. and eastern Europe	4.2	4.2	2.0	2.1	2.2	2.6	2.1	2.5	2.1	2.3	2.1	2.3
Asian centrally planned countries	...	...	...	...	2.7	3.0	2.7	3.0	3.0	2.9	3.4	2.9

L = Low income assumption

H = High income assumption

1/ Computed from the three years average of the beginning and the end of the period shown.

Source: Food and Agriculture Organization of the United Nations, Agriculture Commodities - Projections for 1975 and 1985, Vol. I. p. 48.



Source: Food and Agriculture Organization of the United Nations, Agriculture Commodities - Projections for 1975 and 1985, Vol. I., p. 53.

Figure 2.1--Projected Growth of Population, Demand and Production

demand trends occur. It seems quite likely that demand will exceed supply in most developing countries and hence cause the need for imports of food and agricultural goods.

Another relation mentioned previously is also indicated in Table 2.4. In the world as a whole, production will be able to keep pace with demand until 1975. The problem of obtaining supply and demand balance until 1975 will not be one of production but one of trade.

The projections of increases in production were made by the FAO. The low income production rates are generally the same or slightly lower than those of the past while the high rates are substantially higher than past rates in the developing countries.

The projections are based on the following general reasoning.

> During the next ten years, the increase in cultivated acreage in developing countries is expected to be less than it was during the 1950's. Thus, the projections of food output, which show increases from 1962 to 1975 of 2.8 percent per year on the low income assumption and 3.6 percent per year on the high assumption, imply a faster increase in yields than between 1953-1955 and 1962-1963. Such an acceleration is not physically impossible; over the same period the increases of yields in western Europe was three times as fast as in developing countries taken together. The high production assumption presupposes an increase in the means of production available to and applied effectively to agriculture, particularly as regards fertilizers and irrigation. It presupposes the putting into operation of a series of auxiliary services allowing a sufficient number of cultivators to adopt a more advanced technology, an improved system of marketing, and a wide range of institutional changes.[29]

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[29]Food and Agriculture Organization of the United Nations, Agriculture Commodities - Projections for 1975 and 1985, Vol. I. pp. 50-51.

To this point, only the relation of rates of increase in demand and supply in the past and future have been considered. It has been seen that developing countries are and will have difficulty in keeping pace with expanding demand. However, the current levels of per capita production are not at levels sufficient to meet current population demands. So not only are the developing countries presently well behind in the race to feed their people, they are also having trouble just holding the pace when they need to be increasing their pace to win this race.

Nearly all of Africa, Asia, and Central America have caloric shortages as shown by Figure 2.2 on the following page. Table 2.5 below, shows the minimum daily nutritional requirements for various regions and their actual average level.

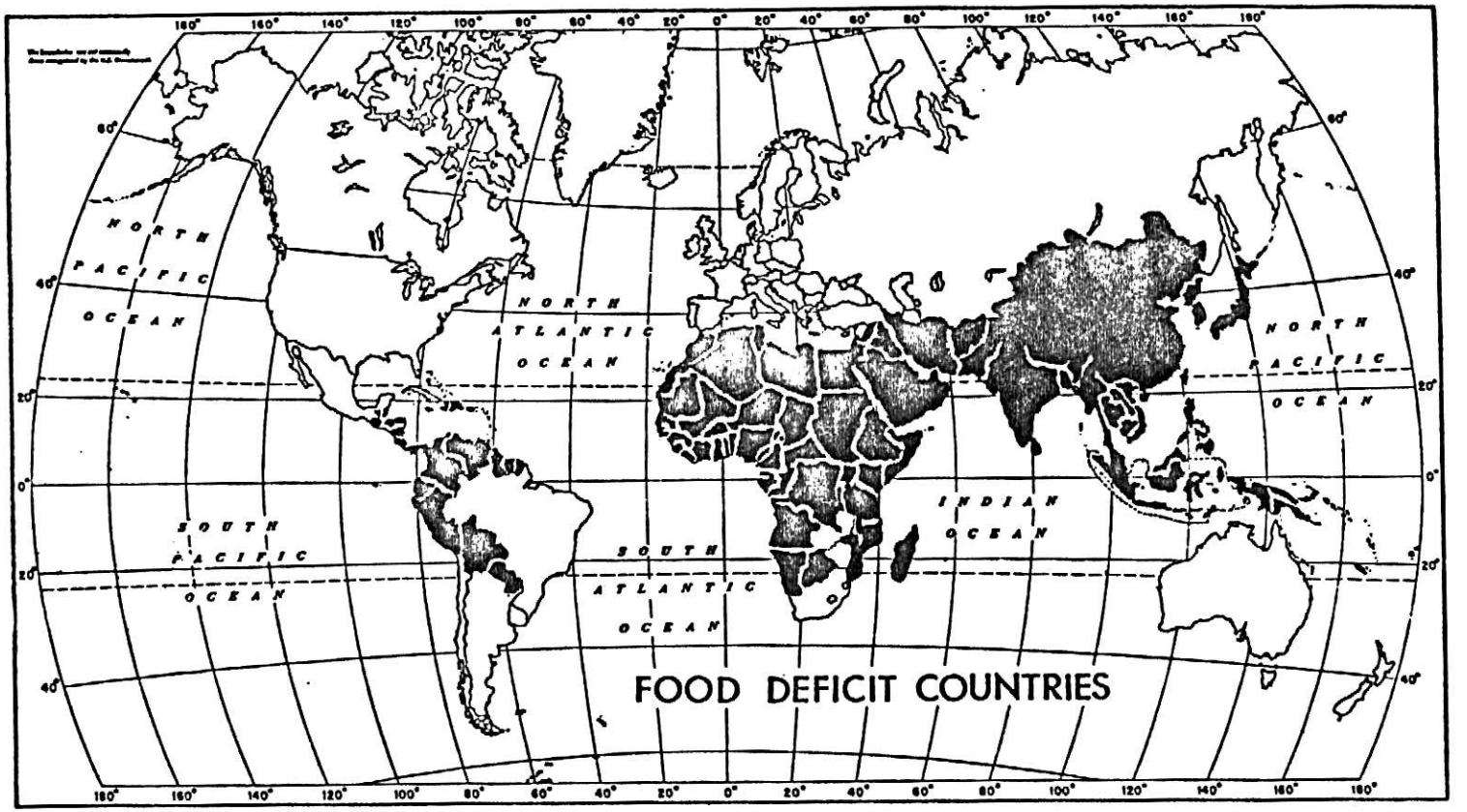
TABLE 2.5

CALORIC REQUIREMENTS AND EXISTING LEVELS BY REGION

Region	Required	Actual	Region	Required	Actual
Canada	2,710	3,080	Other Eastern Europe	2,635	2,925
United States	2,640	3,220	Soviet Union	2,710	2,985
Latin America	2,500	2,640	Western Asia	2,400	2,365
Mediterranean Europe	2,430	2,660	Africa	2,375	2,454
Other Western Europe	2,635	3,040	Far East	2,300	2,100
			Mainland China	2,300	2,200
			Oceania	2,650	3,210

Sources: Lester R. Brown, Man Land and Food, Foreign Agriculture Economic Report No. 11 (Washington, D.C.: U.S. Government Printing Office, 1963). p. 36.

Economic Research Service, The World Food Budget, 1962 and 1966, Foreign Agriculture Economic Report No. 4 (Washington, D.C.: Government Printing Office, 1961). p. 18.



Source: Lester R. Brown, Man, Land, and Food, Foreign Agriculture Report No. 11 (Washington D.C.: Government Printing Office, 1963). p. 37.

Figure 2.2--Food deficit countries

Individual country caloric levels are given in the Appendix in Table A.1. In many cases where regions as a whole have adequate diets certain countries do not. Many countries which do not have caloric deficits have areas of deficiency among various classes of people and deficiencies in certain diet requirements such as lack of proteins, fats, and various vitamins.

It becomes clear that the need for food is exceeding the supply of food in many developing countries. Furthermore, supply has not been increasing to meet this need. Therefore there is a large need for imports of food. However in many cases lack of income has prevented this need from becoming "effective demand" because of the lack of "purchasing power." This has caused problems within countries and internationally. Excess demand has caused food prices to rise rapidly in countries. This has led to inflation in developing countries since food purchases are a major expense of the people. The inability of low income countries to purchase food, coupled with the uneven distribution of food in the world is a source of international tension.

To alleviate these problems, concessional trade of food has been undertaken by developed nations to diet deficient or developing nations in general. Imports on cash and concessional basis have not been distinguished in the analysis which follows in this paper and are often not distinguished in import figures of other studies. Some argue that demand will continue to grow in developing countries, but it will be primarily for concessional

imports and not for commercial or cash trade. However, study by the Economic Research Service has shown this is not true. As economic growth continues, countries which were concessional importers become commercial importers. The Economic Research Service has studied U.S. concessional exports which constitute about 5 percent of world food trade and concluded,

> based on past trends, Division Economists are now able to project what's likely to happen to our exports in years ahead. And results show that the very nations we are now aiding today are apt to be cash customers in the future.[30]

In summary, the demand for imports arises for two basic reasons. First, internal supplies do not meet internal demand and secondly, the variety of items demanded can't be produced within the country. Population and income growth are the primary factors affecting the demand for the quantity, quality, and variety of goods demanded. The relative importance of these two factors depends upon the rate and level at which each exist in a given country. It has been seen that historically developed countries are the largest importers of agriculture and food goods but developing countries may have a larger potential for future increases in imports. The major factor preventing developing countries from importing larger amounts of food is a lack of income. Demand is potentially large in developing countries because of the failure of production to meet needs and keep pace with increasing needs.

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[30]Economic Research Service, Foreign Development and Trade Report No. 333 (Washington, D.C.: Government Printing Office, 1966). p. 11.

In considering the affect of internal production upon demand for imports, it is important to remember that in developing economies increases in agriculture production are closely related to increases in income and per capita income. This occurs because of the importance of agriculture incomes in the country's national income. Therefore, while increases in production may appear to be helping increase supply to meet demand, such increases in production may be serving to further increase demand through the increased income effect. Hence it is not obvious that increases in internal production will decrease the demand for imports.

Elasticity of Food Consumption

The Department of Agriculture Economic Research Service has published a report entitled Elasticities of Food Consumption Associated with Changes in Income in Developing Countries which studies income elasticity relations extensively.[31] The study assumed that national food consumption increases with economic development and population growth and could be expressed by the equation d=p+gn where (d) is growth in food consumption, (p) the rate of population growth, (g) the rate of growth in per capita income, and (n) the elasticity of demand for food associated with income changes. This study attempts to determine (n).

It was felt by the Economic Research Service (ERS) that since "rapid economic growth of developing nations is a

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[31]Robert D. Stevens, Elasticity of Food Consumption Associated with Changes in Income in Developing Countries, Foreign Agriculture Economic Report No. 23 (Washington, D.C.: Government Printing Office, 1965).

universally recognized need, information on elasticities of food consumption are needed in order to plan for food needs as economic growth occurs."[32] Mellor has also indicated that "knowledge of income elasticities is exceedingly important in projecting increases in demand and in planning to meet increased demand."[33] Of the variables specified in the equation above, the least is known about (n) the income elasticity of demand for food.

Stevens, the author of the ERS publication noted above, determined that "estimates of income elasticities of food consumption depend upon the points in the production-marketing system at which the effect of changes in food consumption associated with change in income are measured."[34] Stevens found that when production and marketing were disregarded and changes in total consumption at all levels together were compared to changes in income the elasticities were as indicated in Table 2.6 according to the level of income at which changes in income occurred. As the table, which is on the following page, indicates the elasticity declines over the income range as income increases. The average or arc elasticity is .73.

> Elasticities of food at the retail level were found to be some .2 to .6 higher than income elasticity of total food consumption. The most likely range for the long-run income elasticity of food at the retail level appears to be from .8 to 1.2. This range of elasticities is much higher than those seen in many other studies and suggest a more rapid

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[32]Stevens, Elasticity of Food Consumption Associated with Changes in Income in Developing Countries, p. 1.

[33]Mellor, The Economics of Agriculture Development, p. 60.

[34]Stevens, Elasticity of Food Consumption Associated with Changes in Income in Developing Countries, p. iii.

rate of growth in demand for retail food during development than is generally indicated.[35]

TABLE 2.6

INCOME ELASTICITY OF TOTAL FOOD CONSUMPTION

Income Level Per Capita	Income Elasticity of Food Consumption
$ 50	.82
100	.79
200	.76
500	.69
1,000	.60
1,500	.53

Source: Stevens, Elasticity of Food Consumption Associated with Changes in Income in Developing Countries, p. 20.

Elasticities at the wholesale level were found to be approximately the same as those at the retail level or perhaps slightly lower. However, the elasticity of food consumed at the farm production level was found to be "about .1 to .2 less than income elasticity of total food consumption, thereby, placing the range of most likely elasticities for net total food consumption at the farm level in the range .4 to .6."[36]

This study is more concerned with income elasticities of demand for agriculture and food imports than those of domestic consumption. Knowledge of import demand elasticities is important in determining future demand for imports as economic growth occurs, just as knowledge of domestic consumption demand elasticities is important in determining domestic food consumption

[35]Stevens, Elasticity of Food Consumption Associated with Changes in Income in Developing Countries, p. iv.

[36]Ibid.

needs. Of the domestic or internal elasticities given above, one might expect the import elasticity with respect to income to be closest to that of wholesale demand income elasticity which is in a range of approximately .8 to 1.2.

Arthur B. Mackie has made a study of elasticities of imports with respect to income growth in a publication entitled Foreign Economic Growth and Market Potentials for U.S. Agriculture Products. He studied elasticities over the period 1938 to 1961. "The average elasticity of imports as measured by arc elasticity for all goods and services by the developed countries from all countries was estimated to be 1.24."[37] During this same period, the income elasticity of agriculture imports by developed countries from all other countries was found to be 1.06. For developing countries, the corresponding elasticities were found to be slightly higher. Total import income elasticity was 1.55 while agriculture import income elasticity was 1.39.[38]

These elasticities as well as elasticities of imports of United States goods only by other developed and developing countries are summarized in Table 2.7 on the following page. When considering the elasticities for total imports originating from all countries and the United States in particular, the

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[37]Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, p. 30.

[38]Total agriculture goods imported consist of approximately 60 percent food goods and 40 percent non-food items according to the average of those countries studied in the analysis of chapter IV of this study.

elasticities for U.S. goods are very similar to the world average (1.24 to 1.30 and 1.55 to 1.72). This implies that with income growth countries increase their total imports from the U.S. at about the same rate as from all other countries.

TABLE 2.7

1938 - 1956-61 TIME SERIES ELASTICITIES

Type and Origin of Imports	Elasticity Coefficients of Imports	
	Developed Countries	Developing Countries
Total Imports		
All Countries	1.24	1.55
United States	1.30	1.72
Ag. Imports		
All Countries	1.06	1.39
United States		
Total	1.37	2.06
Commercial	1.28	1.56

Source: Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, p. 30.

However, the elasticities of United States agricultural goods imported are significantly greater than the world average during this period. Mackie attributes this to two factors, "one reason is the importance of Canada in our export market."[39] Because of the close economic integration between Canada and the United States, we have tended to increase trade with each other more rapidly than other countries as our income grew. Another reason according to Mackie, maybe the "influence of the special U.S. export program on agricultural trade with less developed countries."[40]

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[39]Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, p. 45.

[40]Ibid.

This program appears to be working since the U.S. is expanding its commercial exports of agriculture to developed countries faster than other countries. (This is indicated by the U.S. elasticity of 1.56 as compared to the world average of 1.39).

Mackie also conducted two cross-section analyses as opposed to the time series analysis just reviewed. One cross-section analysis was for the period 1938 and the other for 1959-61. With these two analyses, Mackie attempted to determine if substantial change in elasticity relationships has occurred. He found "changes in the basic income and trade relationships between the two periods are rather small, ... changes in total imports from the United States by foreign countries also exhibited rather strong tendencies to remain stable over time."[41] A summary of these two cross-section analyses is presented in Table 2.8.

TABLE 2.8

CROSS-SECTION ELASTICITIES

Type and Origin of Imports	Estimates of Elasticity of Imports and Correlation Coefficients			
	1938	R^2	1959-61	R^2
Total Imports				
All Countries	.96	57	1.04	72
United States	.91	28	1.07	59
Ag. Imports				
All Countries	1.20	60	1.19	70
United States				
Total	1.04	33	.97	44
Commercial	1.04	33	1.32	54

Source: Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products. p. 38.

[41] Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, p. 37.

Mackie warns that the cross-section and time series elasticity values are not strictly comparable. "The results of the time series and cross-sectional analysis are not exactly comparable and only the order of magnitude and directions of change are important in making comparisons."[42]

Several other observations can be made about the cross-section analysis results. Mackie believes that the rise in correlation coefficient values from the 1938 period to the 1956-61 period, especially for the United States "indicates that income has become a much more important factor in world trade in recent years."[43] As can be seen, there are no substantial changes in elasticities except for a significant rise in United States commercial agriculture imports elasticity which rose from 1.04 to 1.32. This result, as previously mentioned, has been attributed to the United States trade with Canada and our aid programs such as P.L. 480. In connection with this elasticity change, Mackie does not mention the following observation. The rise in commercial elasticities coupled with the fall in total elasticities indicates that commercial imports from the United States have been increasing more rapidly with income growth than concessional imports. This lends evidence to the argument that past concessional importers are becoming cash importers. Japan is a notable example of a country that has made such a transition during the period these two cross-section analyses cover. An article in

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[42]Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, p. 40.

[43]Ibid.

"Foreign Agriculture"[44] contends that other countries are following this same pattern. It sights as examples: Israel, Taiwan, South Korea, Thailand, South Africa and others.

One inconsistency arises between the time series and cross-section analysis. This inconsistency is not in the level of elasticities since Mackie has considered them uncomparable. The inconsistency arises in the relation of agriculture import elasticities as compared to total import elasticities. In the time series analysis, total import elasticities are greater than agriculture import elasticities. However, the opposite is true in the cross-section analysis.

> The implication of the higher elasticities for world agriculture imports than all imports is that, with continued world economic growth and 1959-61 economic conditions, agricultural trade would expand faster than total trade. This implication is contrary, however, to historical patterns of trade expansion relationships over longer periods of time. That is, the demand for nonagriculture goods and services, and hence total trade, expands more rapidly with rising consumer incomes than it does for food and other agricultural products.[45]

Mackie goes on to say that "previous results on the elasticity of imports for developed and less-developed countries indicate an increasing propensity to import agriculture products as economic development proceeds in the less-developed countries but not in developed countries."[46] Developed countries propensity to import agriculture goods appears to decline with further economic growth. The same propensity or elasticity

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[44]Growth Abroad Spells Bigger Farm Markets", Foreign Agriculture, July 8, 1968, pp. 8-10.

[45]Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, p. 42.

[46]Ibid., p. 49.

relations have been found to exist for nonagricultural goods also. Thus economic growth in developing countries may be very conducive to increased imports while growth in developed nations may have only small effects upon imports.

Table 2.9 is presented in support of the elasticity or propensity relations according to economic development levels as just described. This table is the table referred to as Table 19 in the following quotation.

TABLE 2.9

COMPARISON OF ELASTICITIES OF IMPORTS FOR DEVELOPED AND LESS-DEVELOPED COUNTRIES, 1959-61

Type and Origin of Imports	Elasticity of Imports Classified by Region[1]	Classified by Income[2]
Developed Countries		
Total imports from:		
All Countries	.96	.62
United States, total	1.09	.53
U.S. Commercial	1.32	.68
Agriculture imports from:		
All Countries	.92	.52
United States, total	.69	.66
U.S. Commercial	1.42	.98
Less-developed Countries		
Total imports from:		
All Countries	1.53	1.40
United States, total	.80	1.65
U.S. Commercial	1.07	1.65
Agriculture imports from:		
All Countries	1.69	1.15
United States, total	.81	1.26
U.S. Commercial	2.10	3.29

Source: Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products. p. 51.

[1]Various regions were classified as developed or developing and elasticities obtained by classifying all countries in that region as developed or developing. The Eastern Trade Area is included.

[2]Countries were classified by income alone. Developed countries had per capita incomes greater than $300 and developing countries less than $300. The Eastern Trade Area is excluded.

The trade data presented in this study and shown in Table 19 generally support the conclusion that the import elasticity for agriculture products tends to decline in highly advanced nations but generally to increase very rapidly in the developing countries. In short, results of this study indicate total world imports increase faster than world income but that world agriculture imports increase as fast or slightly less than growth of income.[47]

However, the relation just referred to for the world does not hold for developing countries according to Mackie.

Agriculture trade will expand faster than total trade in less-developed countries. The higher growth in demand for agricultural than for nonagricultural products is related to the relatively high income elasticity of demand for food in low-income countries.[48]

Thus, estimates of trade potentials for any future period will vary with whatever economic conditions are assumed in the different countries. What is important, however, is that when economic growth does occur-- regardless of the rate-- some positive increase in trade is very likely to result. Thus, the United States has a definite and positive interest in continued foreign economic growth, and especially in less-developed countries since they have the highest import elasticity.[49]

Agriculture Trade Trends

Perhaps the quickest way to present an over-all picture of past trends of world agriculture trade is through the following table.

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[47]Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, p. 50.

[48]Ibid., p. 63.

[49]Ibid., p. 52.

TABLE 2.10

INDICES OF THE VALUE OF EXPORTS[1]
(1957-1959 = 100)

Types of Value	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Agricultural Exports	94	100	104	96	100	106	109	110	123	134	134
Total Value of World Trade	85	94	101	97	102	114	119	125	136	153	166

[1]Excluding Eastern Europe, U.S.S.R. and China (Mainland).

Source: Food and Agriculture Organization of the United Nations, The State of Food and Agriculture, 1968. p. 27.

It is readily apparent from Table 2.10 that total trade has been increasing more rapidly than agricultural trade. This is consistent with the belief that the elasticity of imports is higher for nonagricultural goods than for agricultural and food items.

Part of the reason for the lag of growth in trade in agriculture goods as indicated by Table 2.10, which is in terms of value, is the decline of agriculture prices or the worsening of the terms of trade. However, this is another topic and will not be discussed here.

Table 2.11 presents a more detailed description of agriculture import indices by region. Table 2.11 lends historical support to the indication that developing regions have been and will continue to increase imports more rapidly than developed regions. The discrepancy between the developing and developed countries rates of change would be even greater if Japan, which has only recently become developed, would not have been included in the developed regions section.

The trade of the United States plays an important role in world trends since we trade about one-sixth of the total world volume and are the largest agriculture exporter. Table 2.12 gives a summary of U.S. agriculture trade since 1954.

United States exports of agriculture goods have consistently been a very important part of our export earnings. As indicated in Table 2.12, they have composed about 20 percent of our total exports. Since the beginning of the 1960's, the

TABLE 2.11

INDICES OF THE VOLUME AND VALUE OF AGRICULTURAL IMPORTS BY REGION

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969[1]	Change 1968 to 1969
	1957-59 average = 100															Percent
Volume																
Western Europe	89	96	100	97	103	107	109	114	116	118	122	127	126	128	133	+ 4
Eastern Europe and U.S.S.R.	79	81	94	95	111	117	129	129	137	168	167	162	144	147	142	— 3
North America	92	95	95	97	108	101	106	115	113	104	107	112	113	123	115	— 7
Oceania	101	93	98	102	100	101	104	95	105	110	120	117	110	111	117	+ 5
TOTAL DEVELOPED REGIONS[2]	90	96	99	97	104	107	110	116	118	119	124	130	129	134	137	+ 2
Latin America	92	89	99	102	99	103	108	115	125	140	136	147	143	151	...	...
Far East[3]	71	89	103	98	98	121	117	117	133	143	145	158	172	166	162	— 2
Near East[4]	71	86	95	94	111	124	137	138	141	149	169	171	173	173	...	...
Africa[5]	85	96	100	95	105	119	131	128	112	116	131	136	148	142	...	...
TOTAL DEVELOPING REGIONS	79	89	100	98	102	116	120	122	129	138	144	154	161	159	...	...
World[6]	87	94	99	97	104	109	113	118	121	126	131	136	135	139	...	...
Value																
Western Europe	94	101	106	96	98	104	102	108	117	124	128	133	130	126	...	...
Eastern Europe and U.S.S.R.	83	85	99	94	107	115	122	121	136	175	166	160	140	138	...	...
North America	102	102	101	97	102	95	93	97	102	101	98	104	103	114	...	...
Oceania	114	97	101	99	100	100	97	88	101	111	114	111	102	101	...	...
TOTAL DEVELOPED REGIONS[2]	95	100	105	96	100	104	104	108	118	128	130	135	131	130	...	...
Latin America	101	91	103	102	96	101	101	111	123	143	137	146	146	145	...	...
Far East[3]	74	90	108	98	95	114	111	111	128	149	143	158	175	172	...	...
Near East[4]	77	87	104	92	104	114	125	124	138	160	165	169	161	158	...	...
Africa[5]	87	97	103	97	99	112	120	114	105	118	131	129	136	131	...	...
TOTAL DEVELOPING REGIONS	83	91	105	98	97	110	112	113	124	144	143	152	159	156	...	...
World[6]	93	98	105	96	99	105	105	109	119	131	132	138	135	134	...	...

[1] Preliminary. — [2] Including Israel, Japan and South Africa. — [3] Excluding Japan and Mainland China. — [4] Excluding Israel. — [5] Excluding South Africa. — [6] Excluding Mainland China and other Asian centrally planned countries.

Source: Food and Agriculture Organization of the United Nations, The State of Food and Agriculture, 1970 (Rome, Italy, 1970), p. 18.

TABLE 2.12

UNITED STATES AGRICULTURE TRADE
(Values Expressed in Millions)

Year	Total Value of Agriculture Exports	Exports Under Government Programs	Ag. Exports As a Percent of Total Exports	Total Value of Ag. Imports	Excess of Exports Over Imports
1954	2.9	.6	19	4.1	-1.2
1955	3.1	.8	21	3.8	- .7
1956	3.5	1.3	21	4.0	- .5
1957	4.7	1.9	23	3.8	.9
1958	4.0	1.2	21	3.9	.1
1959	3.7	1.2	21	4.0	- .3
1960	4.5	1.3	24	4.0	.5
1961	4.9	1.5	24	3.6	1.3
1962	5.1	1.5	24	3.8	1.3
1963	5.1	1.5	23	3.9	1.2
1964	6.1	1.5	25	4.1	2.0
1965	6.1	1.7	23	4.0	2.1
1966	6.7	1.6	23	4.5	2.2
1967	6.8	1.6	22	4.5	2.3
1968	6.3	1.5	20	4.7	1.6

Source: United States Department of Agriculture, Agriculture Statistics, p. 590.

TABLE 2.12A

UNITED STATES AGRICULTURE TRADE
(1957-59 = 100)

Year	Index of Exports	Index of Imports
1954	62	98
1955	70	85
1956	82	100
1957	113	92
1958	96	96
1959	91	104
1960	116	105
1961	124	100
1962	125	109
1963	124	114
1964	147	110
1965	145	103
1966	157	117
1967	153	114
1968	149	119

Source: United States Department of Agriculture, Agriculture Statistics, 1969, pp. 590, 591.

agriculture trade balance has been quite favorable and helped to alleviate the balance of trade problem in the nonagricultural sector.

The United States exports have been increasing more rapidly than the world average.

> The U.S. share of world trade has increased over the last 25 years. During this time, the U.S. share of total and agricultural imports by the developed countries increased from 15.7 to 17.3 percent and from 8 to 12 percent for total and agriculture imports, respectively. Also U.S. exports to the less-developed countries expanded faster than world trade or trade with the developed countries. Consequently, the percentage increases in imports from the United States by the less-developed countries were significantly higher than in the developed countries over the past two decades. The U.S. share of total imports of the less-developed countries increased from 18.1 to 22.8 from 1938 to 1959-61. The U.S. share of agricultural imports increased from 8.1 to 23.4 percent.[50]

At the same time exports of agriculture goods were rapidly increasing imports were increasing slower than the world average rate. In fact, the United States rate of increase of agriculture imports is among the slowest in the world as can be seen by comparing the index of imports in Table 2.12 to those indices in Table 2.11.

A large part of our exports, however, are concessional exports. In the last ten years increases in concessional imports have stabilized while total imports have continued to grow. Since 1961, there has been virtually no change in the quantity of concessional exports.

The following table gives a detailed breakdown of countries importing United States agriculture goods.

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[50]Mackie, Foreign Economic Growth and Market Potentials for U.S. Agriculture Products, p. iii.

TABLE 2.13

UNITED STATES' AGRICULTURE EXPORTS: VALUE BY COUNTRY OF DESTINATION

Country	Average 1961-65			1967			1968		
	Total agricultural exports	Under specified Government-financed programs [1]	Outside specified Government-financed programs [2]	Total agricultural exports	Under specified Government-financed programs [1]	Outside specified Government-financed programs [2]	Total agricultural exports	Under specified Government-financed programs [1]	Outside specified Government-financed programs [2]
	Million dollars	*Million dollars*	*Million dollars*	*Million dollars*	*Million dollars*	*Million dollars*	*Million dollars*	*Million dollars*	*Million dollars*
Japan	608.1	19.5	588.6	939.1	9.8	929.3	898.3	2.6	895.7
Canada	[3] 545.9	.2	545.7	[3] 593.8	----	593.8	[3] 543.4	----	543.4
India	371.7	352.1	19.6	505.8	488.1	17.7	511.1	521.5	−10.4
Netherlands	370.5	.9	369.6	472.6	2.5	470.1	493.2	2.4	490.8
United Kingdom	432.0	13.6	418.4	454.0	19.5	434.5	397.3	31.0	366.3
West Germany	380.1	7.3	372.8	494.3	17.8	476.5	387.2	6.7	380.5
Italy [4]	209.0	16.0	193.0	211.0	1.4	209.6	237.6	1.5	236.1
Korea, Republic of	93.6	78.5	15.1	116.0	85.0	31.0	176.9	101.0	75.9
Pakistan	124.1	122.4	1.7	120.7	108.4	12.3	169.0	158.9	10.1
Spain	125.3	38.5	86.8	157.8	10.1	147.7	158.2	12.2	146.0
South Vietnam	37.3	36.8	.5	196.0	177.1	18.9	153.9	146.5	7.4
France	116.8	2.6	114.2	152.9	----	152.9	144.7	----	144.7
Belgium-Luxembourg	136.8	.7	136.1	179.1	----	179.1	140.1	----	140.1
Republic of China	73.5	51.1	22.4	103.2	44.6	58.6	121.5	58.5	63.0
Brazil	98.7	88.1	10.6	103.3	91.7	11.6	112.2	89.5	22.7
Philippines	63.2	20.2	43.0	87.1	17.6	69.5	93.6	23.0	70.6
Venezuela	77.5	2.2	75.3	84.5	4.2	80.3	88.4	4.3	84.1
Israel	63.4	35.4	28.0	81.2	29.5	51.7	82.9	47.0	35.9
Denmark	66.5	.6	65.9	87.0	1.1	85.9	81.4	----	81.4
Hong Kong	47.4	4.2	43.2	48.7	1.0	47.7	77.6	.8	76.8
Mexico	70.3	6.8	63.5	74.4	----	74.4	71.1	.3	70.8
Switzerland	61.3	----	61.3	69.6	----	69.6	53.3	----	53.3
Poland	95.1	68.3	26.8	59.9	5.0	54.9	52.4	16.0	36.4
Sweden	47.5	.2	47.3	57.0	.5	56.5	49.7	----	49.7
Indonesia	27.2	24.4	2.8	37.3	37.3	----	49.3	43.0	6.3
Norway	35.2	1.1	34.1	47.1	1.0	46.1	47.3	1.4	45.9
Morocco	35.8	29.4	6.4	48.4	37.3	11.1	42.2	41.4	.8
Yugoslavia	94.1	86.9	7.2	64.2	40.8	23.4	41.2	4.2	37.0
Peru	25.6	11.6	14.0	41.5	16.2	25.3	30.6	22.3	8.3
Australia	34.7	.4	34.3	35.2	.5	34.7	30.5	.9	29.6
Tunisia	22.5	20.0	2.5	37.6	33.4	4.2	29.8	27.7	2.1
Thailand	12.5	.1	12.4	26.5	.3	26.2	28.7	.9	27.8
Colombia	25.4	14.3	11.1	25.0	19.9	5.1	27.0	16.1	10.9
Saudi Arabia	11.5	.1	11.4	24.4	----	24.4	26.8	----	26.8
Jamaica	14.4	1.4	13.0	24.1	4.1	20.0	26.2	4.5	21.7
Dominican Republic	15.2	7.1	8.1	22.8	22.8	----	24.8	18.0	6.8
Republic of South Africa	23.4	1.7	21.7	49.7	2.2	47.5	24.7	----	24.7
Chile	27.3	18.7	8.6	37.5	24.3	13.2	24.6	18.5	6.1
Ireland	25.9	3.6	22.3	30.3	5.0	25.3	24.3	2.6	21.7
Bahamas	9.2	----	9.2	19.7	----	19.7	24.0	----	24.0
Algeria	26.4	15.3	11.1	48.9	12.2	36.7	21.7	----	21.7
Nansei-Nanpo Islands	16.1	3.2	12.9	23.2	2.7	20.5	21.2	1.9	19.3
Greece	27.6	20.8	6.8	18.8	3.3	15.5	17.9	.7	17.2
Congo (Kinshasa) [4]	20.9	18.9	2.0	19.2	13.5	5.7	17.3	10.9	6.4
Panama	10.8	.4	10.4	15.4	2.0	13.4	16.5	1.9	14.6
East Germany	6.3	----	6.3	24.9	----	24.9	16.4	----	16.4
Lebanon	7.7	.8	6.9	17.0	1.0	16.0	16.1	1.2	14.9
Portugal	21.1	9.1	12.0	19.7	10.5	9.2	15.7	12.1	3.6
Turkey	55.2	54.6	.6	16.5	10.2	6.3	15.4	15.2	.2
Guatemala	10.2	1.8	8.4	13.7	4.7	9.0	15.1	7.4	7.7
Other	509.4	241.3	268.1	523.6	157.9	365.7	342.2	125.9	216.3
Total	5,467.2	1,553.2	3,914.0	6,761.2	1,578.0	5,183.2	6,312.5	1,602.4	4,710.1

[1] Includes sales for foreign currency, donations for disaster relief and economic aid, donations through voluntary relief agencies, barter, and long-term credit sales under P.L. 83-480, the Agricultural Trade Development and Assistance Act of 1954 as amended, and other legislation; and sales for foreign currency and economic aid under Mutual Security Acts, P.L.'s 665 and 165, and under P.L. 87-195, the Act for International Development of 1961 as amended. Also includes development loans (1965-68) under P.L. 87-195.

[2] "Agricultural exports outside specified Government-financed programs" (sales for dollars) include, in addition to unassisted commercial transactions, shipments of some commodities with governmental assistance in the form of (1) extension of credit and credit guarantees for relatively short periods, (2) sales of Government-owned commodities at less than domestic market prices, and (3) export payments in cash or in kind.

[3] Includes the estimated value of U.S. exports to Canada of grains and soybeans for finishing the loading at Canadian ports of vessels moving through the St. Lawrence Seaway as follows: 4-year average, 1962-65, $123 million; 1967, $116 million; and 1968, $79 million.

[4] Includes Trieste.

[5] Prior to 1964, not separately classified.

Source: United States Department of Agriculture, Agriculture Statistics, 1969 (Washington, D.C.: Government Printing Office, 1969). p. 598.

CHAPTER III

A DESCRIPTION OF THE METHOD OF ANALYSIS AND ITS PURPOSE

Hypothesis

This thesis shall contend that population and income are the main determinants of the demand for imports of food and agricultural goods. It is believed that the income elasticity for imports of food and agricultural goods is elastic at low levels of income, but declines and becomes inelastic at high levels of income.

In addition, the rate of economic growth is an important factor in determining the rate of increase of imports of food and agricultural goods. It is felt that where high rates of growth in per capita income are occurring, high rates of growth in food and agriculture imports will be occurring.

Therefore the rate of growth of agricultural and food imports in the future will be the greatest in countries in a "transitional state." These countries are the ones presently transforming from the class of countries described as developing to those described as developed. This occurs in an income range of approximately $500 to $1,000 per capita income. It is in this income range that the elasticity of imports for food and agriculture goods in relation to income growth is hypothesized to near its peak. It is also felt that within this income range

the rate of growth of per capita income will be nearing its peak. In this per capita income range population growth, although not as great as at lower levels of income, will still be at a substantial level of growth and therefore will also cause substantial increase in demand. These factors combined lead to the conclusion that the best future markets for agriculture and food items will be in the "transitional" nations which have incomes ranging $500 to $1,000 per capita. If past income growth rates continue, it will take an average of approximately 20 years for a nation to pass through this income range. During these 20 years, it is hypothesized that imports of food and agricultural goods will be growing rapidly.

In the past, import demand has increased most rapidly in other developed countries. Other developed countries have therefore become the United States best markets, such as Canada, United Kingdom, Netherlands, Japan, West Germany, and France. This thesis hypothesizes that in the future, these countries will not increase their imports of food and agricultural goods greatly but will continue to import approximately the same value of food and agricultural goods as in the recent past.

Following the United States top dozen customers, which are primarily developed countries, with the major exception of India which receives large volumes of concessional exports, are a number of developing countries which import a substantial amount of our exports. It is these countries which may hold the key to increased volumes of exports by the United States in the future. Their economic growth may be our source of increases in export markets.

Method of Analysis

This analysis has primarily used a computerized stepwise multiple regression and correlation program to derive desired equations and statistical values.

> STEPWISE is a FORTRAN IV program which does a stepwise multiple regression for a dependent variable Y and a set of independent variables X_1, X_2, ... X_n, showing the equation at each step of the regression,... The program computes and prints averages, standard deviations, and correlation coefficients for all variables, and for each step of the regression, reports the variable entered, the multiple correlation coefficient, the constant term, and the coefficient for each variable currently in the regression.... Considerable flexibility exist in the input form of the data and in the user's ability to modify input data by transformations of his own choice.[51]

Useful statistical significance data generated by the program includes, multiple correlation coefficients, F-test values, t-test values for the regression coefficients of each independent variable, and Beta coefficients for each independent variable.

Assumptions

The basic assumption of this study is that past relations and trends over the period studied will continue to exist. Therefore, such relations and trends can be used to project future trends. Implied in this assumption is the assumption that the data collected from the countries studied are representative of the actual trends that existed during the period studied. Furthermore it is implied that the functions used to measure the trends do so in an accurate manner.

This study attempts to quantitatively measure only the relations between various classes of agricultural goods to

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[51]Doug Crank, "Kansas State University Computing Center Program Description" (unpublished instruction bulletin, May 15, 1970), p. 1.

changes in income, population, and production of agriculture goods. Other factors affecting imports are assumed to be insignificant or held constant. Many of these other factors no doubt will be important in determining future changes in demand. However, due to inadequate and inaccurate data upon these variables as well as the unquantitative and unpredictable nature of the variables, it was felt that the variables and method used will provide as useful approximation as alternative and possibly more complex calculations.

In order to use correlation and regression techniques it must be assumed that all data have a normal distribution and equal random variance at all levels. Correlation procedure requires that the sample of the population be random. These conditions have been assumed even though these conditions are not strictly true of the data used. The data used were not selected randomly since they consist of data that was available and deletes data from countries in which such data were not available. Also the distribution of some of the data, such as per capita income levels, are skewed somewhat rather than being a normal distribution.

In making projections for the United States it was basically assumed that the United States would maintain a constant percentage of world exports of agriculture goods and therefore our exports would increase at the same rate as the world average. This may be a rather conservative assumption since the United States has been increasing its share of the world market in recent years, especially in the developing nations. Some

attempt to consider the effect of a continuation of the past increasing rate of control of the market has been made in Chapter V.

Data Collection

Data for the regression and correlation analysis were primarily collected from United Nations sources. All agriculture data were from the Food and Agriculture Organization of the United Nations. It may have been more desirable to have taken all data from one source or organization, but to get the most comprehensive amount of data possible it was necessary to use several sources. The disagreement among these sources does not appear to be great when one considers the difficulty in calculating this type of data in many countries.

Population data and income data were taken from the Demographic Yearbook and the Statistical Yearbook, respectively. Both are published by the United Nations Statistical Office.

Upon comparing data from various sources which overlapped or duplicated in their coverage, relatively close agreement was found in income and population data. The largest discrepancy quite reasonably was present in figures presented for developing countries. Very little disagreement appeared in data for developed countries. It is quite common to find population and caloric consumption level estimates varying by as much as 5 percent for various developing countries. Per capita income estimates usually were more consistent from source to source.

Collecting data for the regression analysis was somewhat difficult. Two main problems were finding sufficient quantities

of data and finding accurate or reliable data. Many sources indicated that data for developing countries were of questionable accuracy. Data used in this analysis are in some cases of questionable nature and are really only good estimates of the actual values.

The second problem was finding adequate quantities of data. There are nearly 150 nations or territories in the world today, however, many do not have or make available data upon population, income, trading activities, etc. Such data can quite readily be found for free-world developed countries but is lacking in communist or Soviet Block countries and developing nations. This study does not include data from U.S.S.R. or any of its so-called "satellite" nations, nor does it include data from mainland China. It is unfortunate that these nations which have approximately one-third of the world's population, do not provide such data. However, it is quite likely and will be assumed that trends in these countries follow those of other European and Asian nations and that their absence will not affect the results of this analysis.

Data of all types are noticeably missing in developing countries, especially for years prior to 1960. Much difficulty was encountered in finding data for the 1955-1965 time series study. Data around the 1955 period and earlier were difficult to find, and in addition, data more recent than 1965 were limited. Data more recent than 1967-68 are not available because of the time involved in reporting, calculating and publishing such data.

For these reasons, the time span covered could not be lengthened. Primarily because of the small number of countries for which data for the time series analysis were available, a 1965 cross-section study was done. The cross-section study included data from approximately 60 countries while the time series had data from approximately 40 countries. The data used in this study is shown in the Appendix in Table A.1 and A.2.

All agriculture index numbers computed in the time series data have a 1955 base and are figured by averaging three year periods which are centered on 1955 and 1965. The index numbers were computed by the following formula.

$$\frac{\frac{1954 + 1955 + 1956}{3}}{\frac{1964 + 1965 + 1966}{3}} \times 100 = \text{Index Number}$$

This was done to eliminate large year to year fluctuations that often occur in agricultural production and importation. All other index numbers were computed using only one year periods in the normal manner.

For the purposes of this study agriculture import data have been divided into three classifications. The first class is "food" which consist of all meat, fish, dairy products, fruits and vegetables, beverages, fats and oils, cereals, sugar, feeding stuff and miscellaneous foods. These items are numbered according to Standard International Trade Classifications (SITC) from 00 to 11 and 41 to 43 and are the items commonly referred to as "food" in most United Nations studies. A second class has been

termed "agriculture goods" and consist of all non-food agriculture goods and includes the following: forest products such as wood and paper, crude materials including hides, oilseeds, rubber, textile fibers, and tobacco. The third category of classification is actually the first two classes combined to produce the group called "total agriculture imports." On the average, this class consists of a little over 60 percent food goods and slightly less than 40 percent agriculture items. Data on these three classes of import goods were taken from the Trade Yearbook which is published by the Food and Agriculture Organization of the United Nations.

Correlation and Regression Technique

The basic objective of correlation and regression analysis is to relate a dependent variable to one or more independent variables by means of an algebraic function and then determine the amount of variation of the dependent variable that can be explained from this function.

For example, a regression analysis might establish that per capita imports of agriculture goods is a function of per capita income and is related according to the following equation.

(3.1) Per Capita Imports = 10 + .5 (Per Capita Income)

Knowing the relation is helpful. However, some measure of the accuracy of this relationship is needed. The correlation coefficient helps give this. This correlation coefficient tells to what extent the function actually explains variations in per capita imports. Stated more rigorously, the coefficient of

correlation when squared produces the "coefficient of determination (r^2)" which "shows what proportion of the variance in the values of the dependent variable can be explained by, or estimated from, the concomitant variation in the values of the independent variables."[52]

Another measure of accuracy of the function is the "standard error of estimate" which "indicates how nearly the estimated values agree with values actually observed for the variable estimated."[53]

The Stepwise Regression program described, will provide regression equations for both simple and multiple regression cases with a constant value and coefficients of regression for each independent variable. As mentioned, it also generates a number of statistical significance test values to help determine if the regression function is of any value. Of these, the most important and those considered in this study are the correlation coefficient from which the coefficient of determination is derived, the F-test which measures the function's ability to fit an equation to the data and explain the variation of the data, and the T-test which determines the accuracy of the estimates of the regression coefficients.

Statistical significance tables for these test values have been given in the Appendix in Table A.3 in order to help

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[52]Mardecai Ezekiel and Karl A. Fox, Methods of Correlation and Regression Analysis (New York: John Wiley and Sons Inc., 1959). p. 147.

[53]Ezekiel and Fox, Methods of Correlation and Regression Analysis, p. 147.

determine the significance levels of the test values given. In this study all values are assumed to have a significance level of 95 percent or greater unless otherwise noted by an asterisk. This allows an alpha level of 5 percent or the possibility that the relation may have occurred by random chance one in twenty times.

Without becoming too statistically involved a description of each of these statistical significance values and their use follows. The t-test is used to measure the accuracy of the regression coefficient which for example is .5 in equation 3.1. This value is only an estimate of the true regression value and is subject to error. The t-value indicates the accuracy of the estimates and is computed as follows.

$$(2.2) \quad t = \frac{\text{Regression Coefficient}}{\text{Standard Deviation Coefficient}}$$

The smaller the standard deviation of the regression value the larger is the t-value. A t-value of approximately 2.0 or greater is required in this study to achieve a 95 percent significance level. The exact t-value to reach given significance level depends upon the sample size. Larger samples require smaller t-values to be significant to a given level.

The F-test is a measure of the entire functions ability to explain the variance in the dependent variable. In some ways it is similar to the correlation coefficient. The F-value is calculated in the following manner.

$$(2.3) \quad F = \frac{\text{Explained Variation}}{\text{Unexplained Variation}}$$

The smaller the amount of variation left unexplained by the function the larger will be the F-value. An F-value greater than approximately 3.3 in this study will yield a 95 percent significance level.

The correlation coefficient and its purpose have been discussed previously. In order for the correlation coefficients to be significant at a 95 percent level in this study the correlation values must be greater than approximately .31 in the time series study and greater than .21 in the cross-section study.

One other statistical value will be referred to in this study in several cases. This value is the Beta Coefficient which is similar to the better known coefficient of partial correlation but is not the same. This value is applicable only in multiple correlation functions. The Beta Coefficient provides a means by which

> the importance of individual variables may be compared by their net regression coefficients. The size of the regression coefficients, however, varies with the units in which each is stated. They may be made more comparable by expressing each variable in terms of its own standard deviation.[54]

That is, for each increase of one standard deviation in the independent variable the dependent variable changes by a certain percentage of its standard deviation. That percentage is given by the Beta Coefficient. In this manner some measure of the relative importance of the effect of changes in each of the independent variables can be seen in multiple correlation

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[54]Ezekiel and Fox, Methods of Correlation and Regression Analysis, p. 196.

cases. "It is evident in simple correlation that the value Beta is the same as that of r,"[55] which is the simple correlation coefficient.

This study makes use of both simple and multiple correlation functions. The nature of the correlation coefficient becomes much more complicated in multiple correlation cases. In a simple correlation function with only one independent variable the correlation coefficient is calculated as follows where Sy' is the variance of the dependent variable values estimated by the function from the observed dependent variable values. Sy is the variance of the observed dependent variables.

$$(2.4) \quad r_{yx} = \frac{Sy'}{Sy}$$

In multiple correlation cases the correlation coefficient is more involved and is represented by the following equation.

$$(2.5) \quad S_{b1.234\ldots m} = \sqrt{\frac{\bar{S}^2_{1.2.3\ldots m}}{\bar{n}s^2_{2(1-R^2_{2.3.4\ldots m})}}}$$

> As with simple regression coefficients, the reliability of net (multiple) regression coefficients is affected by the number of cases in the sample and the standard error of estimates. In addition, it is affected by how closely the given independent variables can be estimated from the other independent variables. The more highly the independent variables are interrelated among themselves, the less reliably can the net regression of X_1 upon any of them be determined.[56]

Stated less rigorously the value $(1-R^2_{2.3.4\ldots m})$ represents the amount of correlation between the independent

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[55] Ibid.

[56] Ezekiel and Fox, Methods of Correlation and Regression Analysis, p. 283.

variables. The larger the amount of correlation between the independent variables the smaller this value will be and hence smaller the multiple correlation coefficient will be. The ideal case would be to have the independent variables "independent" of each other or uncorrelated. However, this rarely happens and therefore the addition of variables in multiple correlation functions often adds little additional value to the multiple correlation value.

High correlation between independent variables is commonly referred to as "intercorrelation." Intercorrelation can cause statistical problems in estimating multiple regression coefficient values. "Trained statisticians are aware that increasing levels of intercorrelation are reflected in increasing standard errors of net regression coefficients - that is high intercorrelation tends to mean lowered reliability for the individual regression constant."[57]

Because of the effect of intercorrelation, analyses in which it exists "frequently get results from multiple regression analysis that are unable to be explained."[58]

Examples given by Fox indicate that intercorrelation does not become a problem until the correlation values between the independent variables exceeds 0.5. In the cases studied in this thesis intercorrelation does not appear to be a serious

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[57]Karl A. Fox, Intermediate Economic Statistics (New York: John Wiley and Sons Inc., 1968), p. 257.

[58]Ibid.

problem. Simple correlation coefficients between the independent variables were generally around 0.2 to 0.3 and rarely above 0.5.

Types of Regression Functions

In determining a regression function, some type of equation must be specified. Thus the data is forced to conform to the nature of the equation specified. Different types of equations used on the same data will yield different results. Certain types of equations are better suited than others to describe some sets of data. An equation "shows the relation only insofar as it is possible to do so within the limits of the particular equation used."[59]

Part of the problem of a regression and correlation analysis is to determine which type of equation explains the nature of relationship of the data best. This study has used three types of equations in its analysis; linear, quadratic, and Cobb-Douglas or power functions. Each has its limiting properties. The most restrictive is probably the linear function. However it is simple and provides an easily computed general picture of the relation. The quadratic equation is restrictive in that it requires that a maximum or minimum value exist. The quadratic equation however does allow elasticity to change over the range of the function. The third type of equation, the Cobb-Douglas does not allow elasticity to change over the range of the equation, but instead assumes a constant elasticity. The

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[59]Ezekiel and Fox, Methods of Correlation and Regression Analysis, p. 102.

Cobb-Douglas equation which is of the form shown below expresses the elasticity assumed over the entire range by the exponent b.

$$(2.4) \quad Y = aX^b$$

Because the elasticity is easily determined in this function it is often used to obtain an average elasticity value.

In using regression equations to estimate or predict certain cautions and considerations should be used.

> Whether such estimated values, for cases not included in the original study, can be expected to agree with the true values if they could be determined depends upon two groups of considerations: (1) the descriptive value of the curve; and (2) its representative reliability when it comes to applying it to new observations... The reliability of a curve depends upon the number of observations from which its position was determined and how closely the curve as determined "fits" those observations. Since the number of observations usually differs along different portions of a curve it may be much more reliable in its central portions, where the bulk of observations occurs, than in the extreme portions where the number of observations may be much less.... It is particularly to be noted that determination of the line or curve of relationship gives no basis for estimating beyond the limits of the values of the independent variable actually observed.[60]

Even though regression and correlation analysis can give a good description of the relation of various variables it cannot determine causation. This must be done by the experimenter. The determination of causation is done or implied by the selection of which variables are to be the independent and dependent variables. "Causation in social science is never simple and single as in physics or biology, but always multiple and complex."[61] It is with the problem of determining the causes of changes in imports of agricultural and food items this study is concerned with.

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[60] Ezekiel and Fox, Methods of Correlation and Regression Analysis, pp. 114-15.

[61] Ibid., p. 2.

CHAPTER IV

THE ANALYSIS RESULTS

In this chapter, the functions derived and their results for both the time series and cross-section analysis will be given and discussed. The cross-section analysis consisted of sixty observations or countries while the time-series data dealt with approximately forty countries. However, in the time-series study, equations where food and agriculture production values are involved have only thirty-three countries considered in their calculations since these values are not available for some countries. The data used are found in the Appendix in Tables A.1 and A.2.

The elasticity values found in the two studies are not comparable. In the cross-section study, elasticities compare dollar values of imports to dollar values of per capita income. The elasticities in the time-series study are derived from comparison of index numbers or rates of growth. Despite the difference in the types of values being used in these two studies, their results should tend to support each other and be able to be combined to draw conclusions.

The time-series study would appear to be especially relevant to development economics. Development economics in many cases is concerned with rates of change. The values in the time-series study are in the form of index numbers or rates.

The Cross-Section Analysis

Cross-section studies in economics have been faulted because they are felt not to be "dynamic" in their approach. Because of their static nature, extrapolations or predictions from such studies have been questioned by some.

In spite of these criticisms, much has been and can be learned by cross-section analyses. Because of the nature of availability of data in this study, a much more comprehensive coverage of countries of the world could be obtained in the 1965 cross-section data than with the time-series data. Data from eighty-two countries of the world could be obtained in the 1965 cross-section study. Of these eighty-two countries, complete data are available for sixty countries. Equations derived in this section are from the set of sixty countries for which complete data are available. These sixty nations had a combined population of approximately 1.83 billion people. The world's population during this period was roughly 3 billion people with one billion of these people living in communist countries. The sixty nations used to derive the equations in this section, therefore, consist of approximately 92 percent of the free world's population. The total population of the countries used in the time-series study consisted of 1.27 billion people or nearly 64 percent of the free world's population.

As a matter of interest, some relations which included only data variables that were available for all eighty-two nations were run. The same relations ran with data from the sixty nation set were nearly identical to those found with the eighty-two

country set. Also several relations were tested with a set of thirty nations. This set was made up of all countries for which data were available having a population of 10 million or more. These thirty countries contained 1.75 billion people or over half of the world's population and nearly 88 percent of the free world's population. In this case, again the relations were similar to those found with the set of sixty countries used to derive the equations in this study. However, the equations found with the thirty country set were slightly weaker in terms of statistical significance. One might possibly deduct from this comparison that the population size of a country has little effect upon the relation of agriculture imports per capita and per capita income and other independent variables.

Perhaps the best relation to consider first may be that between gross domestic product (GDP) and imports of food (Food) and total agriculture goods (Total Ag).[62]

		F	r
(4.1)	Total Ag=663.14+.01165 GDP (4.7)	21.91	.66
(4.2)	Total Ag=-325.63+.0636 GDP-.0000001 GDP^2 (10.6) (8.8)	80.28	.93
(4.3)	Food=396.15+.00758 GDP (4.7)	24.50	.68
(4.4)	Food=-194.75+.0378 GDP-.00 GDP^2[63] (10.6) (8.8)	62.75	.91

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[62]Gross domestic product is very similar to GNP except that it excludes from a nation's product all goods produced in the country by foreign owned enterprises and adds all goods produced by enterprises located abroad but owned by sources within the country.

[63]The regression value of 0.000 indicates the coefficient is very small and rounded to zero in the computer's calculations. However, the fact that the sign is negative indicated the curve is concave to the x-axis.

These four equations all have strong statistical significance values. (The values below each variable in the equations are the t-values for each respective regression coefficient). The F and r values to the right of each equation are F distribution and correlation coefficient values respectively. (Critical values of significance of the statistical measures can be found in the Appendix in Table A.3). These equations indicate what is readily apparent and generally known. Large GDP's are associated with countries which have either large populations or high per capita income or both. These are the countries which can and or need to import large quantities of food and agriculture goods.

In order to obtain a more accurate relationship of imports to economic growth and population growth, GDP must be broken down into its component parts, per capita income and population. Also imports must be considered on a per capita basis. This has been done in the following nine equations which relate per capita income (PCI) to per capita imports of food (PC Food), per capita imports of agriculture goods (PC Ag), and per capita imports of total agriculture goods (PC Total Ag).

		F	r
(4.5)	$\underset{}{\text{PC Food}=6.4+.0235\underset{(7.0)}{\text{PCI}}}$	49.07	.68
(4.6)	$\text{PC Food}=-3.97+\underset{(6.7)}{.06\text{PCI}}-\underset{(4.3)}{.0000152\text{PCI}^2}$	41.09	.77
(4.7)	$\text{PC Food}=\underset{(9.7)}{.027\text{PCI}^{1.00}}$	93.42	.79
(4.8)	$\text{PC Total Ag}=7.1+\underset{(7.7)}{.04\text{PCI}}$	58.80	.71
(4.9)	$\text{PC Total Ag}=-10.23+\underset{(7.6)}{.0998\text{PCI}}-\underset{(5.0)}{.0000254\text{PCI}^2}$	41.09	.81
(4.10)	$\text{PC Total Ag}=\underset{(11.8)}{.022\text{PCI}^{1.10}}$	93.42	.84

	F	r
(4.11) PC Ag=1.13+.015PCI (7.2)	93.42	.84
(4.12) PC Ag=-.6.51+.0412PCI-.000011PCI^2 (7.8) (5.2)	53.65	.81
(4.13) PC Ag=.0009PCI$^{1.44}$ (12.9)	138.25	.81

In all three classes of imports, three types of equations were determined, linear, quadratic and power functions. In each of the three types of imports, the power function seems to describe the relation best. The power and quadratic functions have been graphed in Figure 4.1 on the following page. These two types of functions appear to indicate relatively close agreement upon the relationships up to an income level of approximately $1,500. The accuracy of the functions beyond the $1,500 income level begins to become somewhat questionable since this is approaching the upper range of the data. It may be noted that only four countries considered in this study have a per capita income exceeding $2,000.

The average value of per capita imports of food, agriculture, and total agriculture goods in the sixty countries studied were respectively $23.04, $11.47, and $34.51. The average income per capita was $708.58. This indicates that on the average people spend 3.25 percent of their income on food imports, 1.62 percent on non-food or agriculture imports and 4.88 percent of their income on total agriculture imports.

Figure 4.1 presents the quadratic and power equations in the series of functions numbered from 4.5 to 4.13. Each of the curves is related to the function it represents by the equation's number and by the name of the dependent variable. One relation in Figure 4.1 occurs just beyond the $2,000 income level which

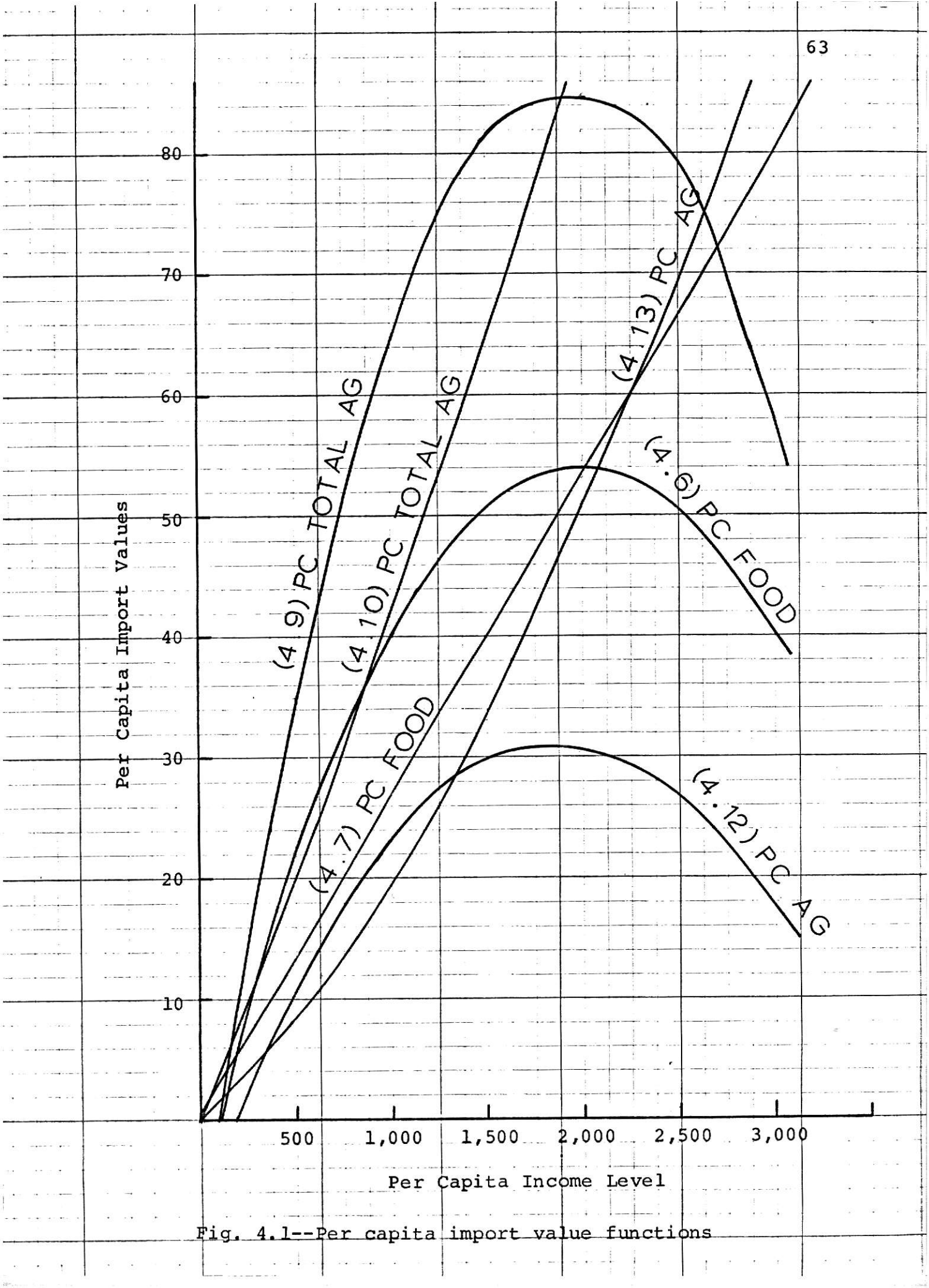

Fig. 4.1--Per capita import value functions

may appear unrealistic. Per capita imports of agriculture goods surpasses per capita imports of food according to the power functions. The cause of this relation is the relative elasticities of the two types of imports. Agriculture imports have a higher elasticity of 1.44 as compared to 1.00 for food imports. Whether or not this relation actually occurs may be questioned since it occurs at the upper end of the income range and is based on only a few observations. The most accurate range of these equations is in the range from $100 to approximately $1,500. Above $1,500, the individual characteristics of the types of functions and the scarcity of data tend to cause the relations to become invalid.

As stated, the elasticity of agriculture goods is 1.44 according to the power function and the elasticity of food imports is 1.00. When these two classes are combined to form the class of total agriculture imports, the elasticity is 1.10. The nature of the power function requires that the elasticity be constant throughout the range of the data. On the other hand, the quadratic functions shown require elasticity to decline throughout the range of per capita income. In this case for example, elasticity declines from 2.93 to -3.98 for food and from 2.02 to -4.72 for total agriculture imports. The quadratic functions indicate that average elasticities for food and total agriculture imports are .90 and 1.00 respectively. These elasticities are in approximately the same relation expressed by the power functions but slightly lower. However, neither of these types of functions can really determine how elasticities change as per capita income levels change. A key question in determining the nature of

demand for agriculture imports is whether the elasticity of imports does decline as income levels increase. To aid in determining this, the data were divided into three sets of twenty observations in which per capita income was at low, medium, and high levels. The power functions for each of these three levels of income are as follows.

Low PCI Range: \$0-250
Average PCI \$164.80

		F	r
(4.14)	PC Food=.036PCI$^{.95}$ (2.2)	4.72	.46
*(4.15)	PC Ag=.861PCI$^{.91}$ (1.5)	2.26	.34
(4.16)	PC Total Ag=.045PCI$^{.94}$ (2.2)	4.72	.46

Medium PCI Range: \$250-750
Average PCI \$478.50

*(4.17)	PC Food=.019PCI$^{1.05}$ (1.8)	3.11	.38
(4.18)	PC Ag=.003PCI$^{1.96}$ (3.3)	10.61	.63
(4.19)	PC Total Ag=.005PCI$^{1.33}$ (2.7)	7.15	.53

High PCI Range: \$750-3,000
Average PCI \$1,718.10

*(4.20)	PC Food=6.73PCI$^{.25}$ (0.5)	.29	.13
*(4.21)	PC Ag-61.9PCI$^{.50}$ (1.2)	1.55	.28
*(4.22)	PC Total Ag=9.45PCI$^{.24}$ (1.0)	.28	.13

*Not significant at the 95 percent level

The elasticities determined by these power functions tend to indicate that from a per capita income range of about $0-750 the elasticities are constant or increasing slightly. Above this range, the elasticities begin to decline sharply. There is one statistical problem in drawing this conclusion. Some of the equations do not have strong statistical significance levels. This is especially true of the equations for the high income range. Equations 4.15 and 4.17 have significance levels of approximately .90 which is acceptable. However, 4.20, 4.21, and 4.22 have significance levels of around .80. In spite of this weakness, they are the best estimates that can be made with the data available. The standard deviation of the elasticity estimate coefficients of equations 4.20, 4.21, and 4.22 is approximately .45. Even if this value were added to the elasticity estimates the functions would still indicate a decline from previous elasticity levels as income per capita increased above $750.

It is interesting to note that the elasticity coefficients indicate an elastic relation only at the medium income level. Considering that many economists have arbitrarily set the per capita income breaking point between developed and developing countries at $700, the group of countries which have elastic import relations are those in the upper portion of the developing countries income range. Many of these countries are approaching or are in a stage which Rostow has termed the "take-off stage" where rapid and sustained economic growth occurs.

The figure on the following page makes use of population and per capita income time-series data to illustrate the per capita income level at which rapid rates of growth in per capita income occur. Per capita income growth surpasses population growth rates at approximately the $400 income level. Per capita income growth rates in the medium income range are at substantial rates and rising.

The income range in which elasticity of food and agriculture imports is the highest, appears to be the range in which the rate of economic growth has reached a substantial level and is being increased relatively rapidly. Over the medium income range, the rate of economic growth increases from approximately 2.9 percent to 3.9 percent. Further raises in per capita income growth increase the growth rate only about .3 percent to a high of approximately 4.2 percent. Maximum economic growth rates occur between the income levels of approximately $900 and $1,800. This income range includes such countries as Italy, Venezuela, Japan, Israel, and West Germany. The equations used to derive Figure 4.2 are the following.

	Equation	F	r
*(4.23)	$PCI=122.3+.029PCI\ Level-.000001PCI\ Level^2$ (2.0) (1.9)	2.09	.30
(4.24)	$Pop=146.78-.0432PCI\ Level-.0000012PCI\ Level^2$ (4.4) (3.2)	13.92	.63

There is no question that the population function is a strong relation, however, the PCI function is only significant to approximately .90 level. In spite of its weaker significance, it is still a strong enough relation to be acceptable with reasonable confidence.

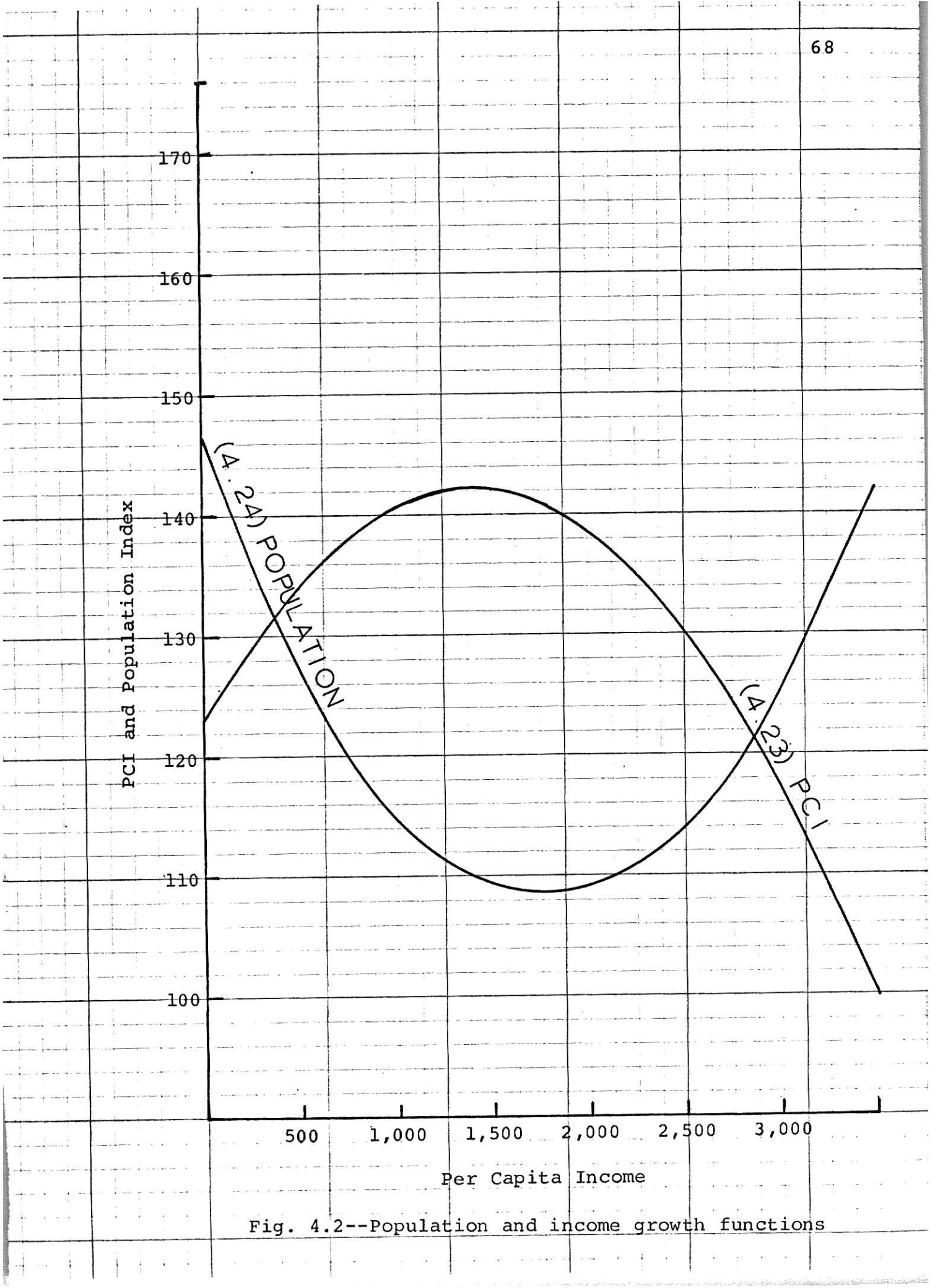

Fig. 4.2--Population and income growth functions

One other set of regression relationships derived in the cross-section study should be considered. This set of equations relates caloric consumption levels to per capita income.

		F	r
(4.25)	$\text{Calories}=2280.8+.44\text{PCI}$ (8.1)	57.04	.73
(4.26)	$\text{Calories}=2165.87+.8835\text{PCI}-.0002\text{PCI}^2$ $(5.3)\quad(2.9)$	36.56	.76
(4.27)	$\text{Calories}=1{,}220\text{PCI}^{.12}$ (9.1)	70.62	.77

All three of these relations are in close agreement over the relevant portion of the income range. This is shown quite clearly in Figure 4.3 on the following page. Caloric levels appear to increase approximately 100 calories for each $200 rise in per capita income. The level of caloric consumption considered to be needed at a minimum varies in different countries but averages around 2,500 calories per person. This level is not reached until income is nearly $500 per person. The linear and quadratic equations indicate that caloric levels do not fall below 2,160 calories per person. However, this is not true and the power function more nearly represents the true relation at very low income levels. Some countries caloric consumption levels drop well below 2,000 calories per capita. Table A.1 in the Appendix gives average per capita caloric consumption levels for various countries.

In relation to Figure 4.3 and the equations from which it is derived, it is interesting to consider one other equation.

		F	r
(4.28)	$\text{PC Food Imports}=.000001\ \text{Calories}^{4.8}$ (5.8)	15.53	.60

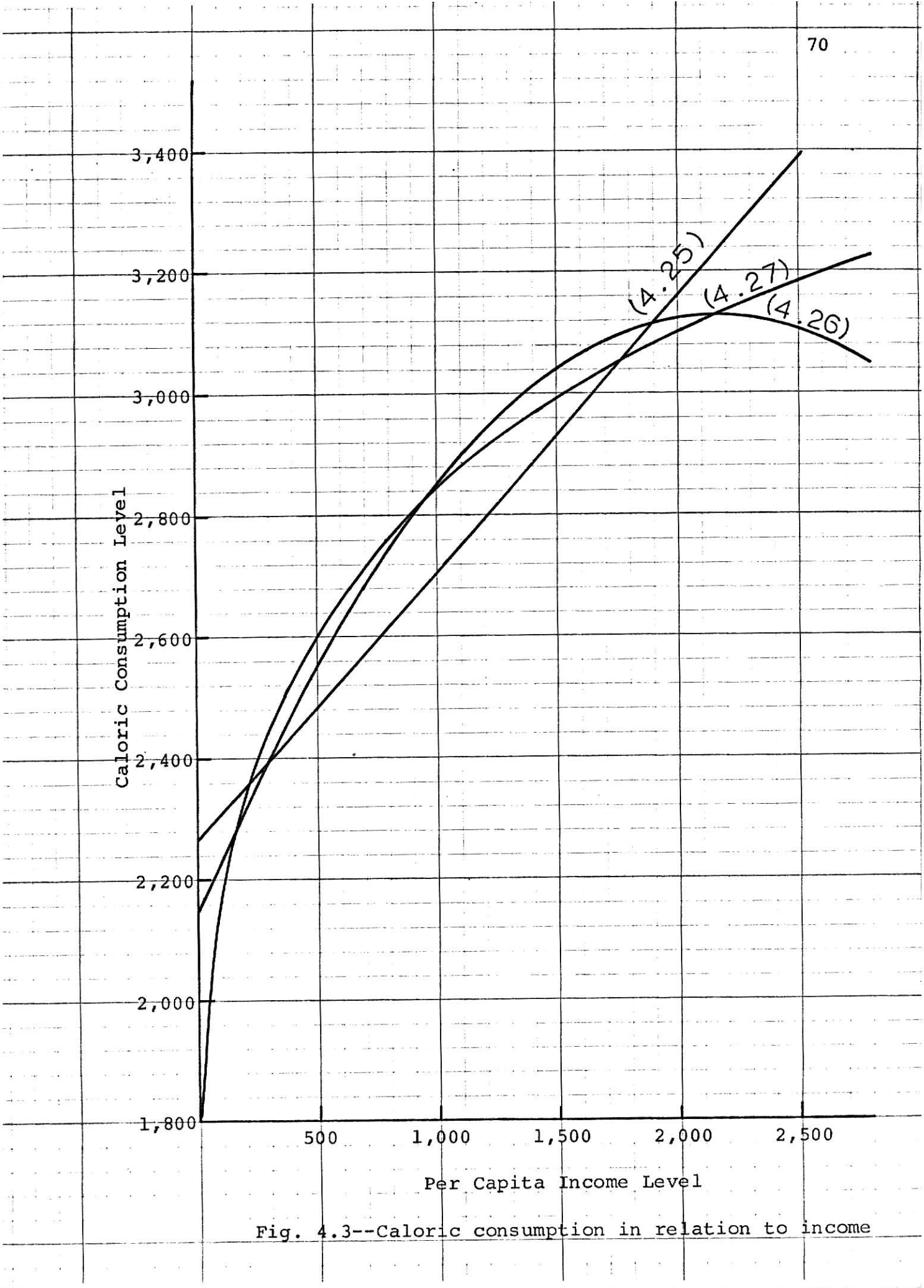

Fig. 4.3--Caloric consumption in relation to income

The value of interest in this equation is the elasticity value of 4.8. It shows that countries do not generally decrease per capita food imports as caloric consumption levels increase. In fact, they increase imports as caloric consumption levels rise. This may occur for two reasons. First there may be a need to increase imports to increase consumption. However, the more likely reason may be hidden in this equation. The correlation seen in equation 4.29 may be a result of the fact that caloric consumption levels and per capita income are strongly correlated. Therefore the real cause of increases in food imports is probably caused by the increased purchasing power caused by income growth. The point of this equation is that because people are well fed does not mean that they will not desire to import food.

It may be reassuring to point out that several of the relations discussed and derived from the data of this study are consistent with generally accepted economic relationships. For example it is generally felt that population growth declines as income levels rise. Also it is known that countries with higher incomes generally have higher average caloric consumption levels. These relations tend to indicate that the data sample being used is representative and in agreement with previous studies.

Time-Series Analysis

Time-series data have received extensive use in economics. As mentioned, they are often favored over cross-sectional data because they are felt to be more dynamic in nature. However, time-series data in many cases have certain disadvantages not

generally found in cross-sectional data. Time-series data are more prone to problems of autocorrelation. The major problem usually results from the fact that variation in time series data is caused by several sources. Fox, in his text, Intermediate Economic Statistics has described the variation found in economic time-series data to be made up of the components of the following function,

$$A = f(R,S,T,C)$$

where (A) stands for the actual variation and is a function of (R) the random variation, (S) seasonal variation, (T) trend variation, and (C) cyclical variation. The variation of each of these components must be isolated in order to find a true measure of each. This study has attempted to measure (T) the trend variation over a ten-year period. Seasonal or short-term variation was attempted to be eliminated by averaging three-year periods at the beginning and end of the series and using these averages to compute changes and growth. It is hoped that cyclical variation will be eliminated by the length of the time period and by the fact that the data are world wide in nature and would therefore eliminate local cyclical patterns. If these two sources of variation have been sufficiently neutralized the remaining variation should indicate the trend fluctuation, if any exist, and the random error variation. The statistical measures of accuracy can be used to account for and isolate random error.

It appears that the ten-year period used in this study may not have been a long enough time to consider. A longer period would have been better since it would have allowed more

significant amounts of change to have occurred. However, due to data limitations, this period was the best that could be obtained. A study of this type in a few years from the present could obtain much more reliable and complete data since data collection has improved considerably from 1960 to the present.

Several of the key equations of this section are rather weak statistically. If a larger number of countries could have been considered it may have helped to strengthen the significance of the equations.

The following six equations present the basic relations found between imports and income growth rates.

		F	r
(4.29)	$PC\ Food=-63.025+1.585PCI$ (3.1)	9.43	.43
(4.30)	$PC\ Food=-123.41+2.43PCI-.000285PCI^2$ $(.8)\quad(.3)$	4.65	.43
(4.31)	$PC\ Food=.386PCI^{1.20}$ (3.4)	11.62	.47
(4.32)	$PC\ Total\ Ag=-56.875+1.45PCI$ (5.1)	25.81	.62
(4.33)	$PC\ Total\ Ag=-116.46+2.3PCI-.000282PCI^2$ $(1.3)\quad(.5)$	12.78	.62
(4.34)	$PC\ Total\ Ag=.189PCI^{1.34}$ (5.1)	25.96	.62

The functions have been shown graphically in Figure 4.4. The quadratic functions have been shown as dotted lines since they differ greatly from the linear and power functions. The reason for this is probably due to the very low t-values found for the regression coefficients. Also it appears that the relations are nearly linear and it is difficult for the quadratic to fit such a relation.

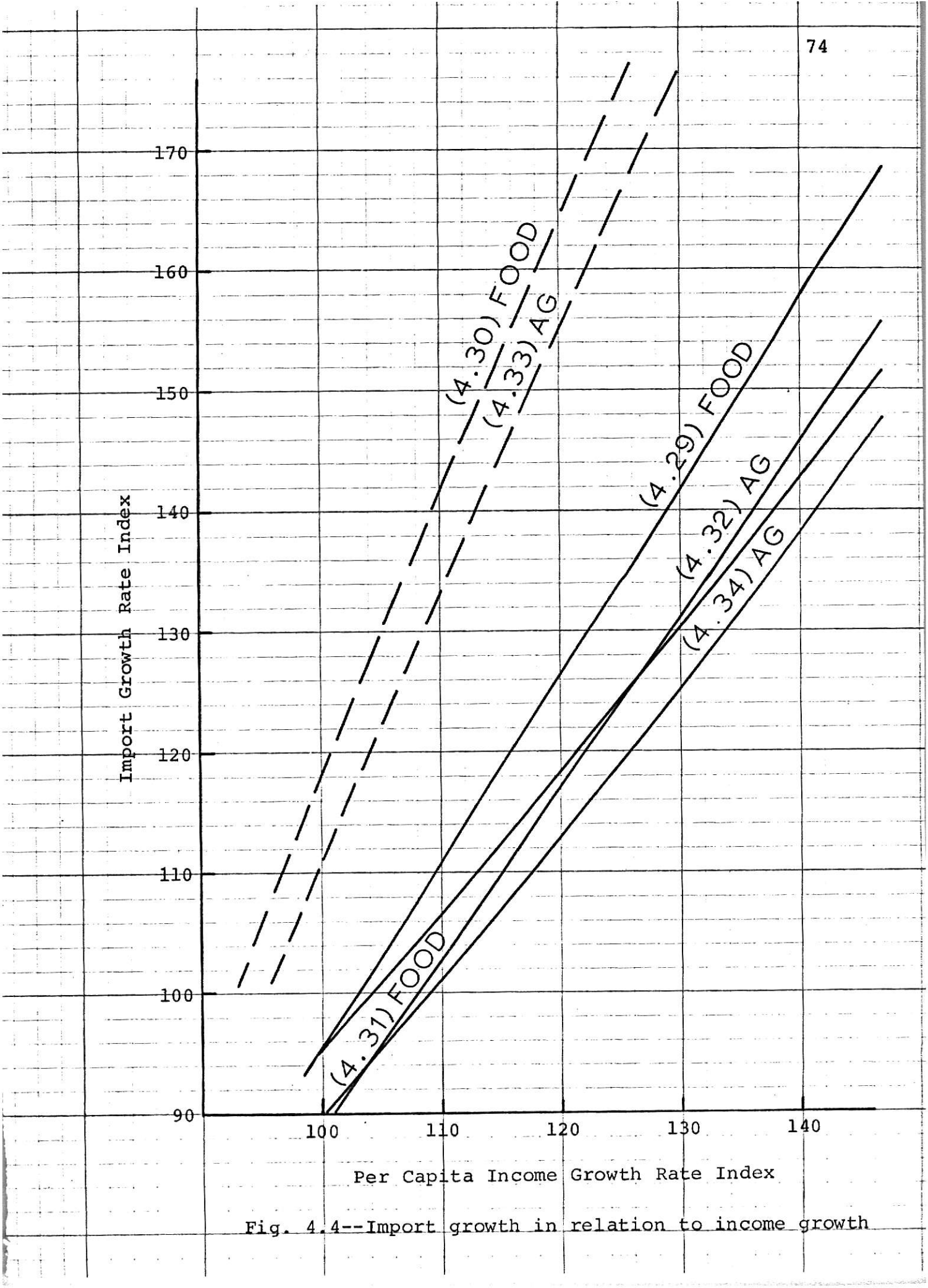

Fig. 4.4--Import growth in relation to income growth

The vertical axis in Figure 4.4 measures the rate of growth in imports per capita while the horizontal axis measures the rate of growth of per capita income. It is important to remember that both axis are dealing with rates of growth in this figure.

Figure 4.4 shows that countries with the highest rates of income growth also have the highest rates of import growth. In relation to Figure 4.4, it is helpful to recall from Figure 4.2, that the countries with the highest rate of income growth are those with per capita incomes ranging from $800 to $1,700. It appears that these countries will be the countries in which market opportunities will be expanding rapidly in the future. Those countries whose incomes have surpassed approximately $1,400 per capita are experiencing declines in per capita income growth rates and therefore also will be decreasing the rate at which they increase per capita imports of agriculture and food goods. On the other hand, countries with incomes below $1,400, will in general, still be increasing the rates at which they increase their demand for imports. Hence, of the two groups, those countries with incomes under approximately $1,400 will be the more rapidly growing markets in the future on a per capita basis.

As indicated by the power functions, the relation of food and agriculture imports to per capita income is elastic. Total agriculture goods are shown to have the most elastic relation with an elasticity of 1.34 as compared to food import's elasticity of 1.20.

The elastic relations given by the power functions indicate that on the average, the import growth rates are increasing faster than per capita income growth rates. For example, if per capita income growth rates changed from 1 to 2 percent, food import rates which had been increasing one percent per year would now increase 1.2 percent per year. In short, imports of food and agriculture goods will increase at a rate more rapid than the increases in per capita income growth rates.

Again, recall from Figure 4.2 on page 68 that the income range in which per capita income rates were rising the most rapidly was generally in countries with per capita incomes below $750. Above this per capita income level, the curve flattens out very rapidly. This implies that markets that will be increasing their rates of per capita imports growth the most rapidly are those countries with incomes below $750.

The following four functions present the points being discussed in relation to Figures 4.2 and 4.4. These four relations also present more clearly than any others the basic hypothesis of this study.

		F	r
*(4.35)	$PCI = 122.3 + .029\underset{(2.0)}{PCI\ Level} - .00001\underset{(1.9)}{PCI\ Level^2}$	2.09	.30
(4.36)	$Pop = 146.78 - .0432\underset{(4.4)}{PCI\ Level} + .000012\underset{(3.2)}{PCI\ Level^2}$	13.92	.63
(4.37)	$Pop = 222.2\underset{(5.4)}{PCI\ Level^{-.09}}$	29.48	.64
*(4.38)	$PC\ Total\ Ag = 125.84 + .038\underset{(1.1)}{PCI\ Level} - .000016\underset{(1.2)}{PCI\ Level^2}$	1.78	.19
*(4.39)	$PC\ Food = 139.72 + .04\underset{(.7)}{PCI\ Level} - .000019\underset{(.9)}{PCI\ Level^2}$	1.54	.16

It is unfortunate that the per capita food and agriculture import relations could not have stronger statistical relations so that a more precise and reliable relation could be found and the hypothesized relations accepted or rejected more firmly. As they stand, however, these relations are the best estimates possible from the data available. Equations 4.38 and 4.39 have significance levels of approximately .80.

The four above functions are presented graphically in Figure 4.5 on the following page. The rate of growth of per capita imports appears to be most rapid between the income levels of approximately $500 to $1,800. This approximate wide range includes those countries in a "transitional state" and also those countries considered to be in the "take-off stage." The rate of increase in food imports reaches its peak at an income level of about $1,100 while per capita agriculture import growth reaches a peak at about $1,200 per capita income. Per capita income growth peaks slightly later at an income level between $1,300 and $1,400.

This figure clearly shows that countries with income levels between $500 and $1,800 have the most rapid rate of import growth. However, import growth rates are increasing most rapidly over the income range below $700.

It is interesting to note the time it will take a country to increase its income level from $100 to $500 and from $500 to $1,000. At the growth rates indicated by the PCI curve, it would require over 50 years to move from an income level of $100 to a $500 level. However, it would take only about 20

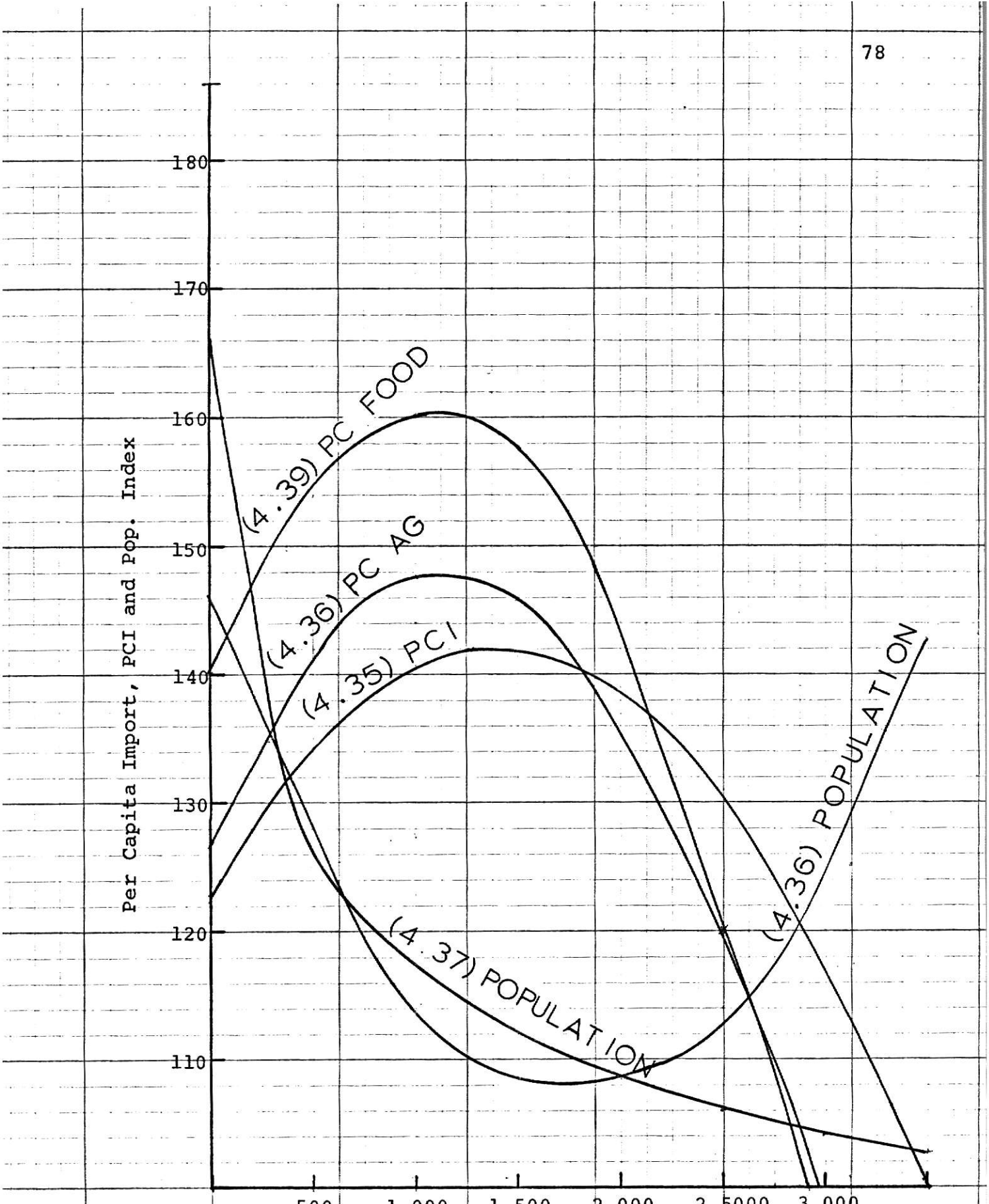

Fig. 4.5--Import, population, and PCI functions

years to move from $500 income per capita to $1,000 per capita. Moving from $1,000 to $1,500 per capita income would require only about 10 years. Hence, those countries with an approximate income level of $500 at the present will be expanding their imports very rapidly in the near future. On the other hand, countries with incomes ranging from $100 to $300 or $400 will not provide rapidly expanding markets for sometime.

Countries with incomes around and above $2,000 do, of course, import more per capita than lower income nations and are vital markets to maintain. But these countries will not be expanding or increasing their per capita import rates as rapidly as countries with lower incomes. Also we must remember that these figures and rates referred to are per capita rates and that population growth appears to be faster at lower incomes than high incomes.

The fact that population growth rates are declining while per capita import rates are increasing is of interest. This produces an elasticity relation between population and imports which is negative. The following two power functions give the average elasticity between rates of food and agriculture import growth and population growth.

		F	r
(4.40)	PC Food=3.98Population$^{-1.77}$ (2.9)	8.21	.46
(4.41)	PC Total Ag=3.53Population$^{-1.61}$ (3.3)	11.06	.51

One might expect that the rate of population growth would have no effect upon the rate of per capita imports, other things being equal. However, other things are not equal. As population growth declines, the result is that per capita income

growth is aided. The rise in per capita income then causes an increase in the rate of growth of per capita imports.

The next set of relations to be considered is between per capita production growth rates and per capita income growth rates and levels. It might be expected that per capita production growth of agriculture goods and income growth would be well correlated, especially in low income countries. Also, it is to be expected that population growth rates would be strongly inversely related to income growth rates. The following relations prove these expectations to be valid.

		F	r
(4.42)	PC Food Production=75.20+268PCI (2.7)	7.54	.46
(4.43)	PC Food Production=-29.97+1.64PCI-.0043PCI^2 (2.3) (1.9)	6.03	.56
(4.44)	PC Ag Production=77.88+.257PCI (2.7)	7.45	.47
(4.45)	PC Ag Production=-10.10+1.40PCI-.0036PCI^2 (2.1) (1.7)	5.33	.54
(4.46)	Population=160.01-.29PCI (3.1)	9.76	.47
(4.47)	Population=296.35-2.09PCI+.00569PCI^2 (3.1) (2.7)	9.54	.60
(4.48)	Population=865.6PCI$^{-.40}$ (3.2)	10.09	.44

All of these functions except the linear population function are shown in Figure 4.6. The two types of per capita production equations, linear and quadratic, differ somewhat at the lower ranges of per capita income growth but are in close agreement at higher ranges of per capita income growth.

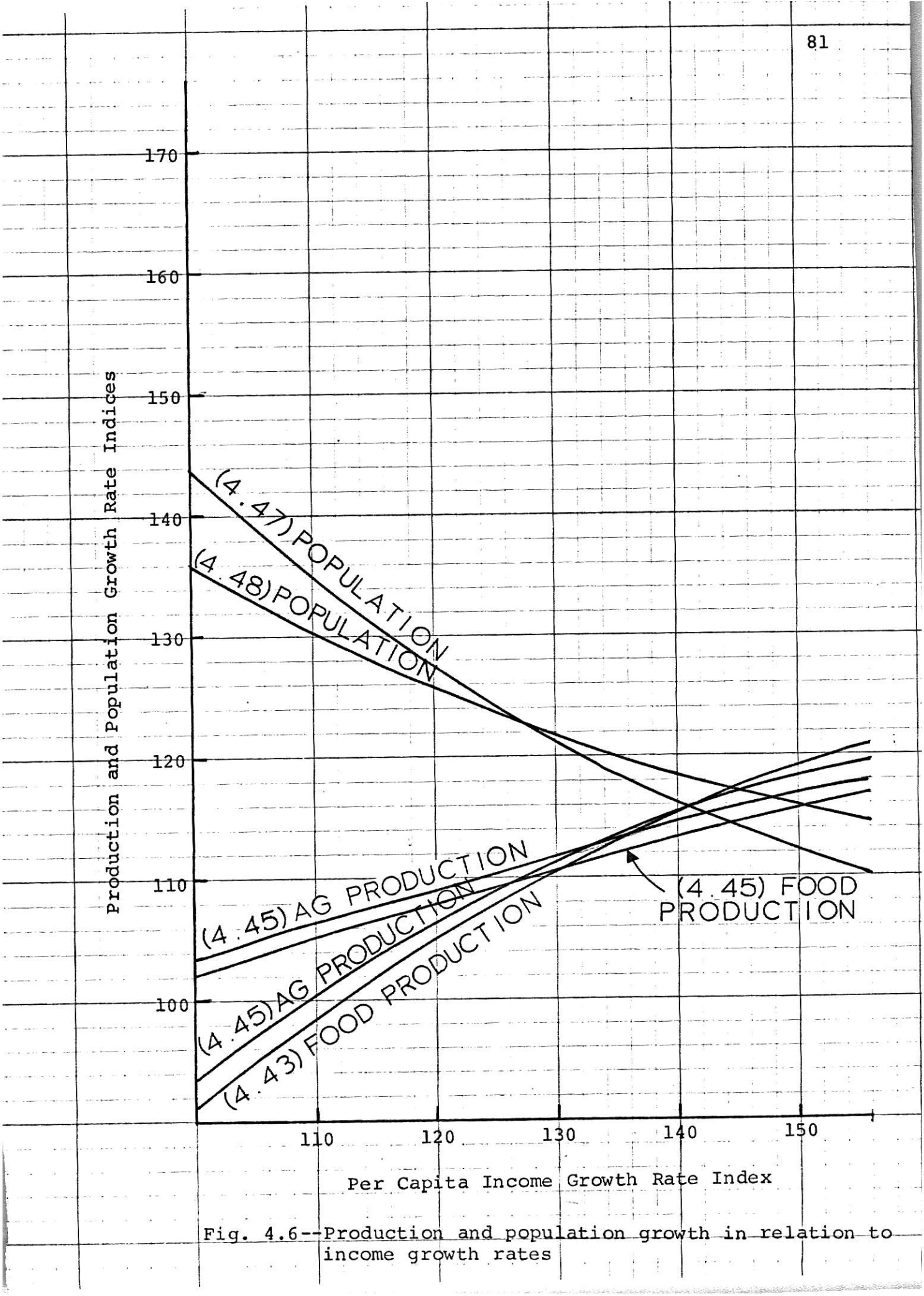

Fig. 4.6--Production and population growth in relation to income growth rates

The quadratic functions indicate per capita income must be increasing slightly in order for per capita agriculture and food production to be holding its own. However, the linear functions indicate a slight decline in per capita income growth can occur and food and agriculture production will still hold itself at present per capita levels.

The relation between the population and production functions indicates that declines in population growth rates are associated with and are helpful in increasing food and agriculture production per capita. Also declines in population growth rates are associated with and appear to aid in increasing rates of per capita income growth.

The rises in per capita income and food production per capita that are associated with the fall in population growth rates do much to increase the welfare of people in poor countries. Hence the relations shown in Figure 4.6 are at the heart of the argument for population growth control.

Another means of viewing per capita agriculture and food production in relation to income is according to per capita income levels. The next two functions present these relations and are presented in Figure 4.7.

		F	r
(4.49)	PC Ag Production=114.24+.0048PCI Level (.5) -.0000037PCI Level^2 (1.2)	2.18	.36
(4.50)	PC Food Production=109.2+.011PCI Level (1.2) -.0000045PCI Level^2 (1.4)	1.05	.26

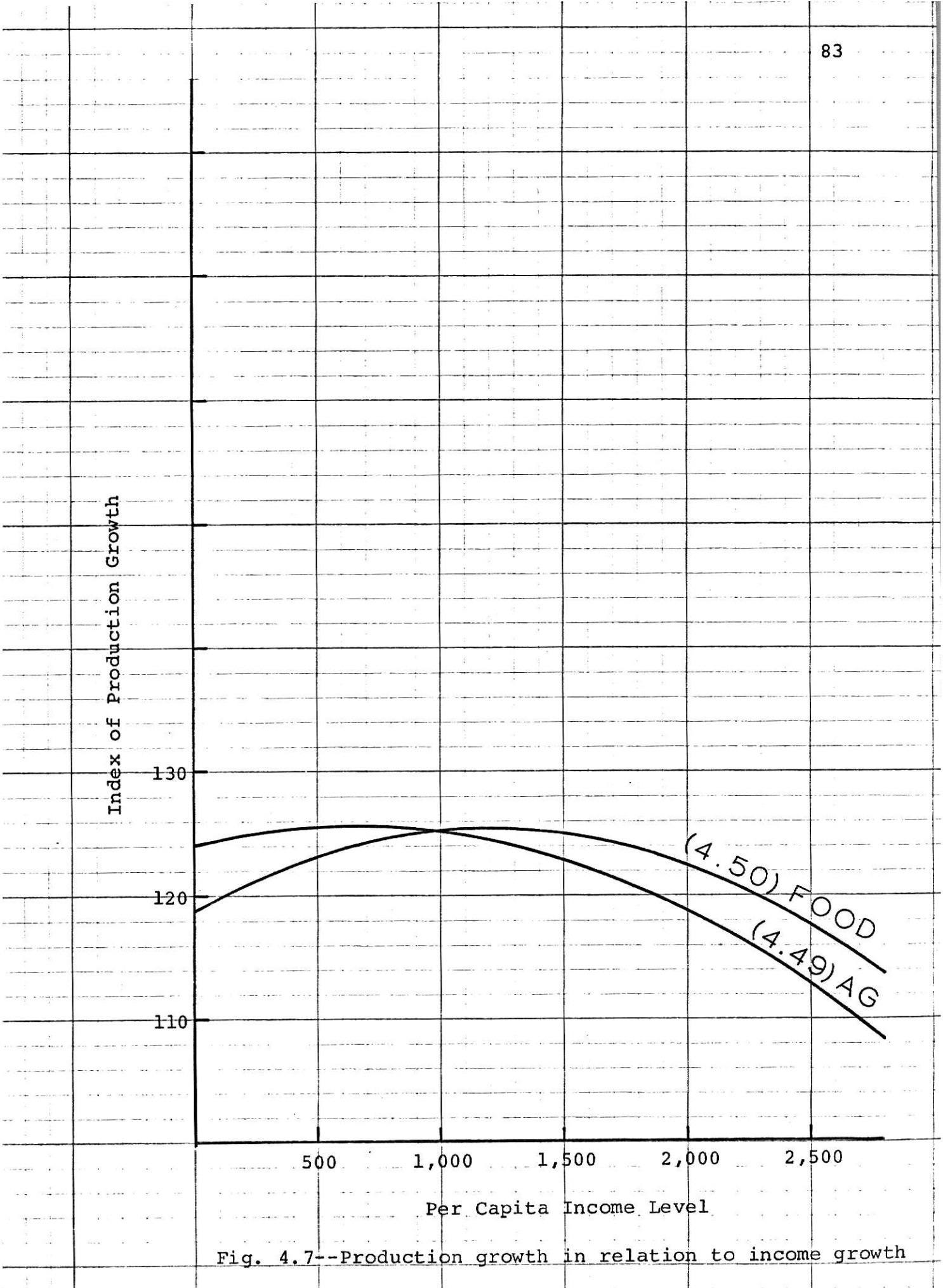

Fig. 4.7--Production growth in relation to income growth

Food production is expanding most rapidly in those countries which have per capita income levels between $700 and $1,700. These countries are all classified as developed countries since their income exceeds the arbitrary dividing income level between developed and developing countries which is assumed to be $700 in this study. These countries also are roughly the same ones in which per capita income and per capita imports of agriculture and food goods are growing most rapidly.

Agriculture production per capita seems to hit its peak at a lower income level than food production. One might hypothesize that rapid agriculture growth at low levels of income is the source which starts the country on the road to development. But as further development occurs the emphasis in production shifts from agriculture to industrial goods. As a result, per capita agriculture growth rates decline as development continues.

One must remember in considering per capita growth rates of food production that the developed countries have adequate levels of food per capita and have no pressing need to increase production per capita. On the other hand, developing countries do not have adequate levels of food per capita to meet their food demands.

Relating Figure 4.6 to Figure 4.4 the question arises, what is the relation between per capita imports of food and agriculture goods and per capita production of food and agricultural goods. It might be expected that as a country increased its rate of production of food and agriculture goods per capita,

it would decrease its rate of imports of them per capita. This is not the general case for food and agriculture goods.

The following relations show that as production growth rates per capita increase, so do import growth rates per capita. The power functions show the relation to be a positive elasticity figure.

		F	r
*(4.51)	PC Food Imports=2.26 Food Production$^{.87}$ (1.2)	1.45	.21
*(4.52)	PC Ag Imports=2.53 Ag Production$^{.84}$ (1.5)	2.25	.26

In speculating why an increase in per capita production growth rates would case an increase in per capita import growth it must be remembered that both production and import growth are significantly correlated to per capita income growth. Therefore, the added income growth caused by production growth is the same income growth which may be causing increases in import growth. Hence, increased production of food and agriculture goods because of its income producing effect may be helpful in creating demand and markets for other countries' exports.

Another possible cause of this relation is that as production growth rates increase more specialization occurs. This of course increases the need for trade.

In developing countries, a large amount of the agriculture goods produced are exported. As agriculture production increases so do exports of agriculture goods. This makes available more income and foreign currency with which to purchase imports.

One further comment should be made about the positive sign of the elasticity values in equations 4.51 and 4.52. At low

income levels, both per capita income and per capita production growth rates are rising, hence the elasticity relation is positive. At high income levels, both per capita income and per capita production growth rates are declining and the elasticity relation is again positive but at this level of income the meaning is different than that for lower income levels. One usually thinks of an elasticity value as relating a 1 percent rise in one variable to the corresponding rise or fall in another variable. However, at high income levels the positive elasticity value is relating a 1 percent fall in one variable to a corresponding fall in another variable. The power function determines an average elasticity over the entire range of the function regardless of whether the relations are increasing or decreasing relations. Therefore, elasticity values in cases where the two functions being related are both concave to the x-axis should be accepted with the knowledge that the average value is made up of two different types of elasticity relations.

Having considered the relationships of per capita imports of food and agriculture to per capita income growth, population growth and per capita production growth, the next step is to compare the rate of growth of total import growth to these various independent variables. World exporters are probably more concerned with the rate of growth of total imports than with per capita import growth rates.

As was seen previously at low income levels, population growth rates were generally declining when per capita import

rates were rising. At high income levels rates of population growth were increasing slightly while per capita import rates were falling. In general the two curves moved in opposite manners. The question arises then, what will happen when these two relations are combined and a total import growth index derived.

The relation of the rate of growth of total imports to the per capita income level depends largely on whether the population effect or the per capita income effect is dominate. The population affect will tend to cause the rate of total import growth to fall as population growth slows. On the other hand, the rising rates of growth of per capita income at low income levels is a primary cause of increased rates of per capita imports. Since, increasing per capita income growth rates will tend to increase the rate of total import growth.

The following six equations give the relation of total import growth rates and per capita income levels.

	F	r
*(4.53) Total Food=220.87-.035PCI Level (1.5)	2.23	.26
*(4.54) Total Food=221.86-.0375PCI Level (.5) -.0000009PCI Level^2 (.1)	1.08	.26
*(4.55) Total Food=367.0PCI Level$^{-.12}$ (1.5)	2.38	.27
*(4.56) Total Ag=190.8-.0212PCI Level (1.5)	3.20	.26

	F	r
*(4.57) Total Ag=188.47-.0153PCI Level (.3) -.0000022PCI Level^2	1.12	.26
*(4.58) Total Ag=259.0PCI Level$^{-.08}$ (1.5)	2.38	.27

All of the equations above, do not have .95 significance levels. However, the power functions and linear functions appear to be the strongest and have significance levels of approximately .85. The linear and power functions are shown in Graph 4.8. The important relation shown in the figure by these functions is that the rate of total imports declines as income levels grow. Even though the significance levels of these equations are slightly weak, it appears certain that these functions indicate a relation that slopes downward to the right. The standard deviations of the elasticity values and the slope regression coefficients are not large enough to change these values to positive values when added to the predicted values. It may be noted here that in order for the sign of an elasticity figure or a regression coefficient to change when one standard deviation value is added or subtracted from the predicated value, the t-value must be less than 1.0. A t-value of less than one would indicate that the standard deviation was larger than the estimated elasticity or regression value. In the previous set of equations the t-values on the power and linear functions are all greater than 1.0. Hence it is relatively certain, the functions do slope downward to the right. The exact rate of decline cannot really be predicted with any accuracy from these functions.

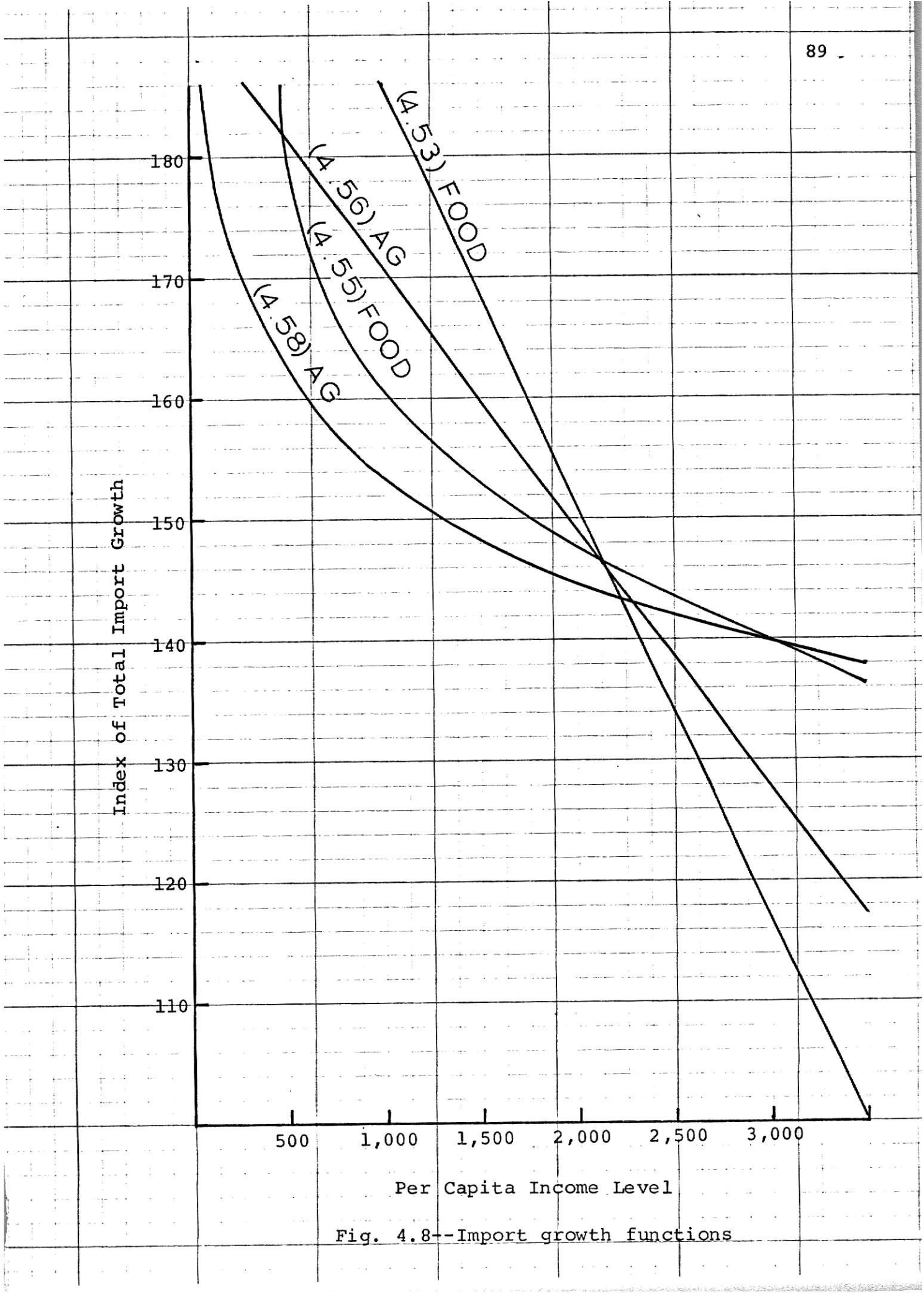

Fig. 4.8--Import growth functions

The relation between total import growth and per capita income levels could also be found by calculations based upon the population growth rate curves and per capita import growth rate curves in Figure 4.5. By means of the following formula, as "Index of Total Imports" can be derived from values found by the population and per capita import growth rate functions in Figure 4.5

$$\frac{\text{(Per Capita Import Index)} \times \text{(Population Index)}}{100} = \text{Total Import Index}$$

If this is done with the index values given by the functions referred to above, the results are as indicated by the table below.

TABLE 4.1

INDICES OF TOTAL IMPORTS

Income Level	Index of Total Ag Imports		Index of Total Food Imports	
100	187.6[1]	184.7[2]	207.9[1]	204.6[2]
500	175.6	180.6	193.3	198.7
1,000	173.0	171.0	188.1	185.9
1,500	165.5	160.2	176.9	171.2
2,000	151.4	149.6	157.9	156.0
2,500	130.2	141.7	129.8	141.2
3,000	101.5	120.3	94.0	111.4

[1]Population index numbers were derived by power function 4.37.

[2]Population index numbers derived by quadratic function 4.36.

The indices in Table 4.1 decline as per capita income levels increase. The index numbers in the Table appear to agree relatively well with those predicted by the linear functions 4.53 and 4.56. Based upon these indices and Figure 4.8, it appears that population has the dominate effect upon total imports since the rate of growth of total imports declines over the income range.

The following twelve functions relate the rate of growth of total agriculture and food imports to PCI, population, and production growth rates. The quadratic equations have been omitted since they generally did not show stronger correlation values than the linear functions and had weaker t and F values.

	F	r
(4.59) Total Food=-36.14+1.60PCI (2.1)	4.35	.35
(4.60) Total Foods=.551PCI$^{1.16}$ (2.6)	6.67	.42
*(4.61) Total Food=253.4-.0047 Population (.9)	.87	.17
*(4.62) Total Food=6,400 Population$^{-.77}$ (1.2)	1.54	.22
*(4.63) Total Food=81.34+.918 Production (.6)	.41	.11
*(4.64) Total Food=5.73 Production$^{.65}$ (1.0)	.95	.17
(4.65) Total Ag=-27.83+1.43PCI (3.4)	11.72	.52
(4.66) Total Ag=.383PCI$^{1.23}$ (3.8)	14.56	.57
*(4.67) Total Ag=261.41-.77 Population (1.0)	1.07	.18
*(4.68) Total Ag=2,960 Population$^{-.61}$ (1.3)	1.58	.22
*(4.69) Total Ag=46.61+1.08 Production (1.3)	1.76	.23
*(4.70) Total Ag=4.84 Production$^{.74}$	2.30	.26

The power functions appear to be the strongest relations in this set of equations. Therefore, only the power functions have been graphed in the following two figures. In this manner, cluttering of the figure and confusion as to which curve

represents which function was avoided. The linear functions indicate the same general relationship but disagree as to the slope and exact level somewhat. The quadratic functions which were not included in the previous set also agree with the power functions in general. The quadratic functions did not reach maximum or minimum values within the range of the figures presented on the next two pages.

The PCI relations in the previous set of equations have good statistical significance levels. However, the other equations have weaker significance levels. The population power functions, 4.68 and 4.62, have significance levels around .75 to .80. The total ag-production power relation given by equation 4.69 has a significance level of about .85. The total food import-production power function, equation 4.63, has a very weak significance level of approximately .62. However, in spite of these weak significance levels, the same statement may be made here as was previously made. The standard deviations do not appear large enough to cause one to believe that the general slopes shown by the elasticity signs are different from those indicated. That is, the PCI and production relations appear to slope upward to the right and the population functions downward to the right. No t-value on a power function has a value of less than one in this set of equations.

Examination of Figures 4.9 and 4.10 yields some implications that conflict with previous results and implications of this study. First, consider the implications of the production curves. They indicate that when high rates of production occur

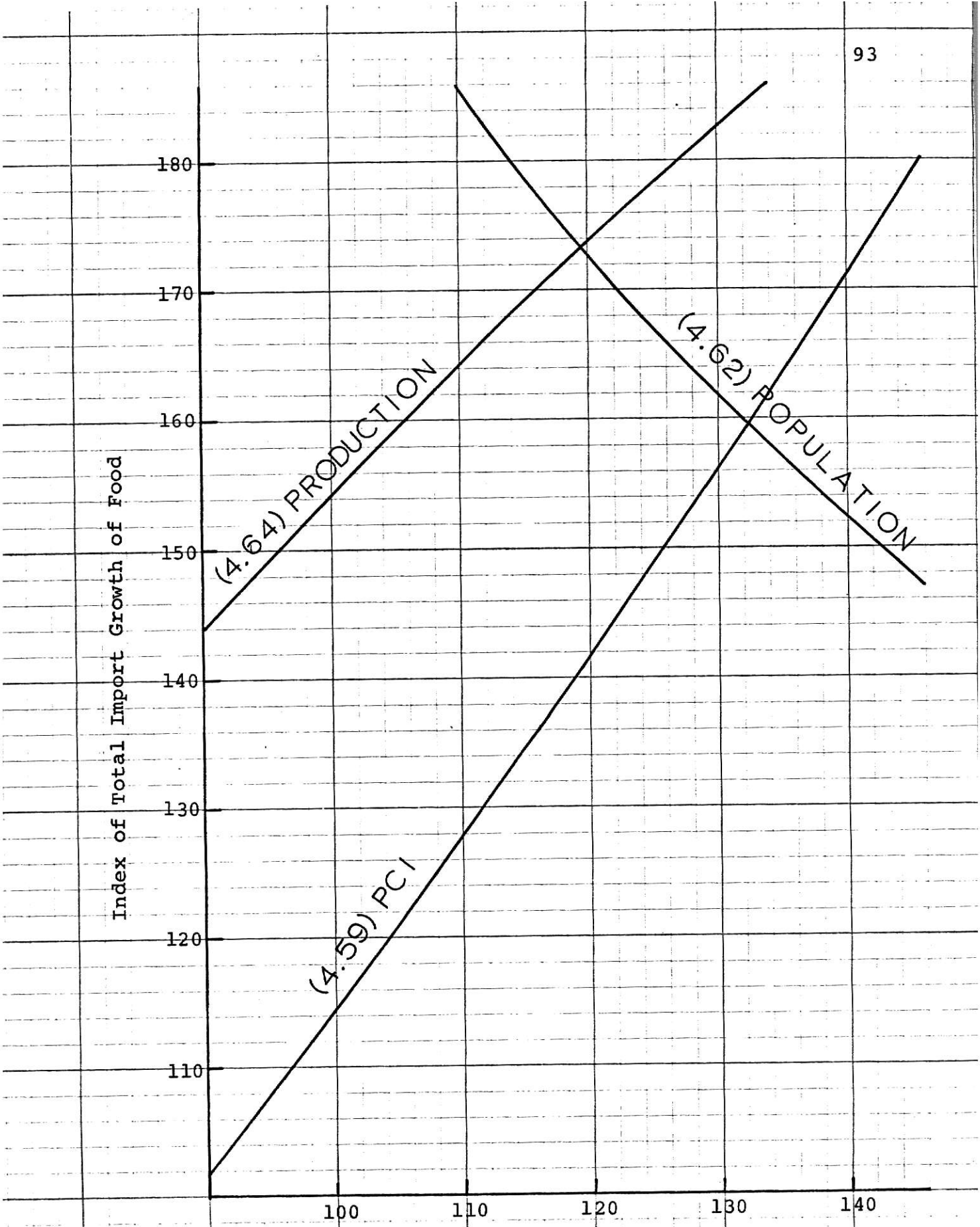

Fig. 4.9--Import growth rates of food related to PCI, population, and production growth

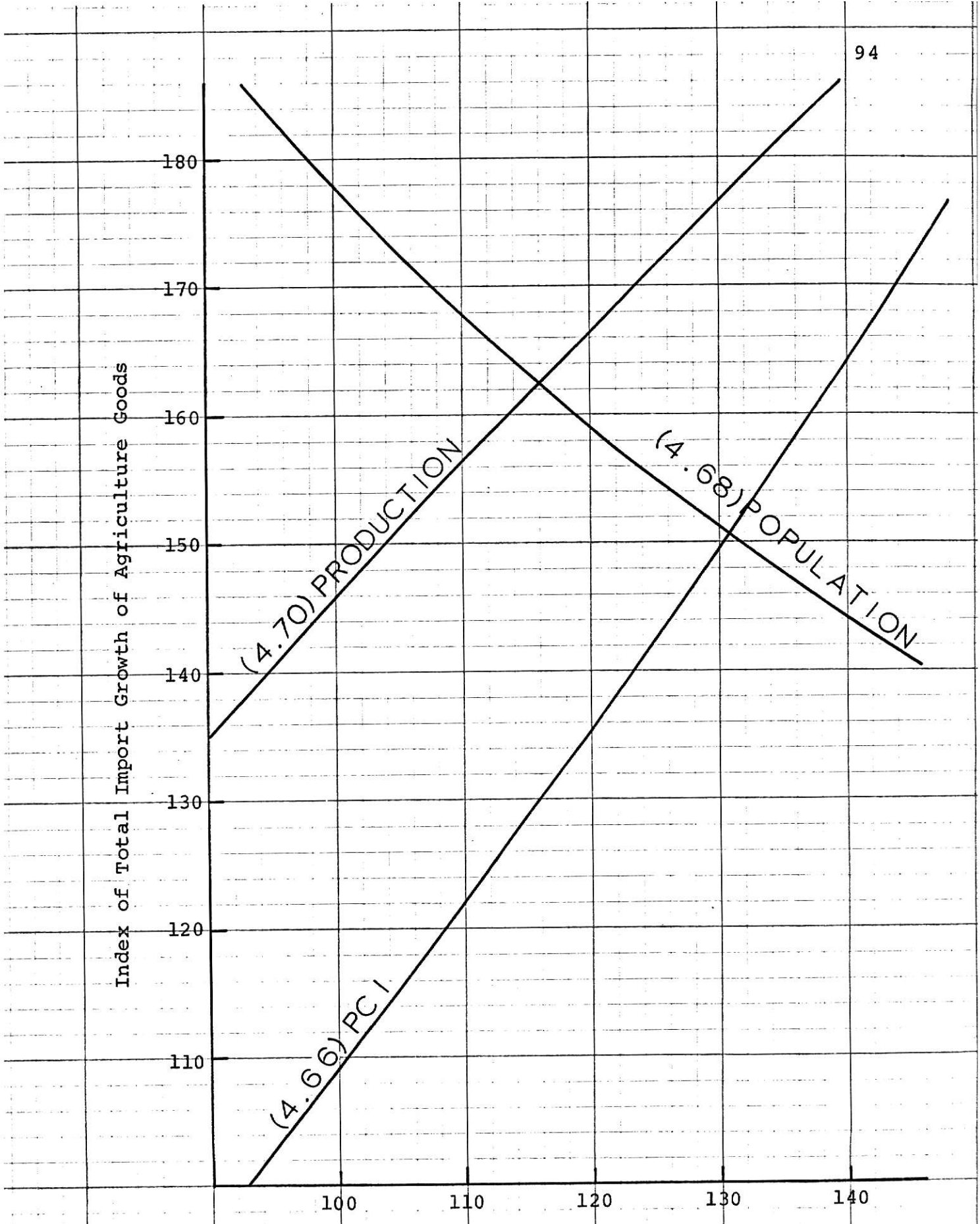

Fig. 4.10--Import growth rates of agriculture goods related to PCI, population, and production growth

high import growth rates also occur. This relation unlike the others in these figures in consistent with previous results. Next consider the PCI curves. They too indicate that the highest rates of import growth occur when PCI growth is the most rapid. However, Figure 4.8 leads one to believe that import growth is the most rapid at income levels where per capita income growth is at a rate less than maximum. Figure 4.8 would indicate that the PCI curve should peak at an income growth rate of approximately 2 to 3 percent. This is not the case even in the quadratic function for this relation. Perhaps the largest conflict with previous results occurs in the population-import relations. The relations indicate that low population growth rates are associated with high import growth rates. Or in other words, declining population growth rates appear to be associated with rising import growth rates. This may seem unreasonable, and especially if population growth is considered to have the dominate effect on the growth of total imports. The population functions in Figure 4.5 indicated with very strong statistical significance that population growth rates declined at least to a per capita income level of approximately $1,800. Above $1,800, the two types of functions for population growth disagreed somewhat and it was concluded that the true relation probably was somewhere between the two functions' predictions. Previous results led one to believe that population and total import growth rates both declined over most of the income range. Therefore it appeared that high population growth rates were associated with high import growth rates.

The cause of these conflicts lies in the uncertainty of the nature of the total import growth rate function in relation to per capita income levels. The per capita income and population functions in relation to per capita income levels shown in Figure 4.5 on page 78 have relative good statistical significance levels and have been thought to be of the nature indicated by the curves shown by most economists. However, the total import curves shown in Figure 4.8 on page 89 are rather weak statistically with significance levels of around .85. But it is thought to be relatively certain that their slope is negative or downward to the right. In the literature surveyed in this study, no author has really ever pinned down this relation. Hence it is quite certain that the population and PCI curves referred to are good representations of the true relations but it is not nearly as certain that the total import functions shown in Figure 4.8 are representative of the true relation.

The curves in Figures 4.9 and 4.10 would begin to appear reasonable if one assumed the total import-per capita income level functions are concave to the x-axis. Indeed this is what the functions in Figure 4.9 and 4.10 indicate. Predictions of the total import growth rate curves in relation to per capita income levels were made in Figure 4.11 on the following page. These predictions were based on the relations in Figures 4.9 and 4.10. The predictions were derived by plotting the import growth rate values associated with various per capita income and population growth rates. For example, Figure 4.9 indicates that when per capita income is growing at an index rate of 130, total imports of food are growing at an index rate of approximately

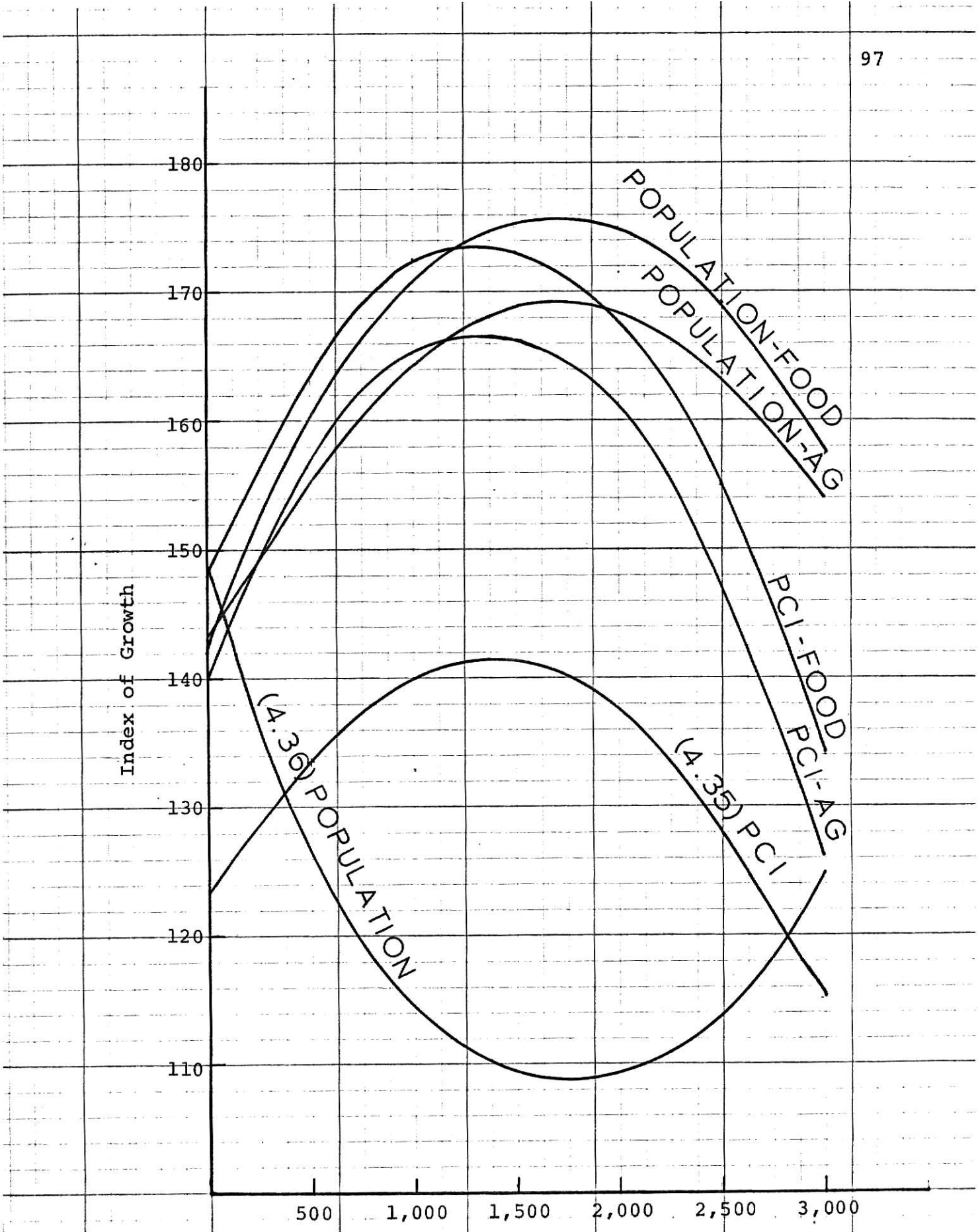

Fig. 4.11--Estimated food and agriculture import functions

156.5. The value 156.5 was plotted directly above the point in Figure 4.11 where per capita income was growing at an index rate of 130. In this manner, the four predicted curves in Figure 4.11 were determined. The PCI-Food and Population-Food labeled curves are predictions of the total import growth rate curves for food and were derived from the PCI and Population curves respectively in Figure 4.9. The curves labeled PCI-Ag and Population-Ag are predictions for the total agriculture growth rate curve and were derived from the PCI and Population curves respectively in Figure 4.10. The predicted curves are clearly concave to the x-axis. Strangely they seem to peak at about the same or slightly higher income levels as the per capita import growth rate curves shown in Figure 4.5 on page 78. The curves in 4.9 and 4.10 are reasonable in relation to these predicted total import curves. Population growth is falling as import growth increases at low levels of income. Above an income level of $1,800 the opposite relation is occurring. However at both high and low income levels high population growth rates are associated with low import growth rates. Also per capita income growth rates are highest when income growth rates are highest.

The predicted curves in Figure 4.11 would tend to indicate that changes in per capita income growth would have a larger effect upon import growth than changes in population growth. It also infers that the aid given to per capita income growth in developing countries by reduction in population growth rates more than offsets the decline in demand caused by decreased population growth rates.

Which of these two total import-per capita income functions is the true or most representative curve? The concave functions predicted in Figure 4.11 or the constantly declining functions in Figure 4.8 on page 89? The data and methods used in this study cannot conclusively determine the concave function predicted in Figure 4.11 is more representative.

However, for the purposes of determining which countries will be the most lucrative markets in the future the difference between the two types of predicted curves may not mean too much. Both types of curves indicate that after a country has become fully developed with an income greater than approximately $1,500 it will be a market with a declining rate of import growth. Hence, the highest rates of growth in demand will be in the countries with lower income levels. If the declining functions of Figure 4.8 are accepted, then the indication is the lower the income level the higher the import growth rate. If the concave type functions are accepted as more representative the transitional and recently developed countries will be increasing imports the most rapidly with developing countries continually increasing their import growth rates as economic growth continues. The developed countries however, will be continually decreasing their import growth rates as economic growth continues.

A very favorable implication of adopting the concave type total import functions is that population control efforts in developing countries will not be harmful to agriculture export markets. Demand will continue to increase because of the

increase in per capita income, specialization, education, etc. which appear to be aided by population growth rate declines.

Perhaps the question of which of the two total import functions is most representative reduces to a question of whether per capita income or population is the dominate or more closely correlated factor in determining the rate of growth of total imports. An indication of which is most important can be found from the following multiple regression power functions. Previous equations have differed from the following equations in that they have only related one independent variable to one dependent variable. These equations relate three independent variables simultaneously to total imports of food and agriculture goods.

					F	r
(4.71)	Total Food=.213PCI$^{1.18}$Pop.$^{.08}$Production$^{.09}$				2.09	.42
	t	(2.0)	(.10)	(.10)		
	Beta	(.43)	(.03)	(.02)		
(4.72)	Total Ag=.021PCI$^{1.36}$Pop.$^{.37}$Production$^{.11}$				4.86	.58
	t	(3.1)	(.70)	(.20)		
	Beta	(.63)	(.13)	(.04)		

The Beta coefficients of each of the terms have been given in order to help determine which independent variables variation has the greatest effect upon import rates. The Beta values indicate in both equations that per capita income variation has the largest effect. The second most important variable is population followed by production.

Another indication of the power of each independent variable to explain variation in the dependent variable is given by the order in which the Stepwise Regression Program adds variables to the multiple regression function. In both of the

above equations per capita income was considered first by the computer program indicating it was the most important variable in explaining variation of total imports of food and agriculture goods.

Referring back to the set equations numbered from 4.59 to 4.70 on page 91 it can be seen that when the two above equations are broken into three simple regression power functions and only one independent variable is related to the dependent variable in each equation, the independent variable per capita income has the strongest correlation to total import growth of food and agriculture goods.

The same types of equations have also been found for per capita imports of food and agriculture.

					F	r
(4.73)	PC Food=22.3PCI$^{1.18}$Pop.$^{-.91}$Production$^{.08}$				4.50	.56
	t	(2.0)	(1.3)	(.10)		
	Beta	(.39)	(.23)	(.02)		
(4.74)	PC Food=.053PCI$^{1.6}$ [64] (3.5)				12.03	.53
(4.75)	PC Food=3.98Population$^{-1.77}$ (2.9)				8.21	.46
*(4.76)	PC Food=2.26Food Production$^{.87}$ (1.2)				2.29	.21
(4.77)	PC Ag=2.06PCI$^{1.36}$Pop.$^{-.63}$Ag Production$^{.11}$				9.08	.70
	t	(3.1)	(1.2)	(.20)		
	Beta	(.55)	(.20)	(.03)		
(4.78)	PC Ag=.037PCI$^{1.66}$ [64] (5.1)				26.12	.68

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[64] A discrepancy between these two equations and equations 4.31 and 4.34 on page 73 may appear to exist. This due to the fact that equations 4.74 and 4.78 were derived with a smaller set of data including only 33 countries so they would be comparable to equations with production relations for which data is available from only 33 countries. Equations 4.31 and 4.34 were derived from observations of 44 countries.

The equations show, that just as per capita income is the most strongly correlated variable for total import growth rate changes, it is also the most strongly correlated variable to change in per capita income growth rates. Hence, the multiple regression functions lend more support to the belief that the concave type total import growth functions predicted in Figure 4.11 on page 97 are the most representative, since per capita income growth is the dominate or most strongly correlated independent variable in relation to total import and per capita import growth rates of food and agriculture goods.

The conclusion that per capita income is the dominate or most highly correlated independent variable in relation to total import growth rather than population growth may appear to be contrary to Mellor and the FAO's findings presented in Chapter II. Their results indicated that population growth was responsible in most cases for over half of the growth in imports of food. In a few cases where population growth was slow and per capita income growth was near its peak rate of growth, per capita income growth had the largest effect.

The conclusion that per capita income is the most highly correlated variable to total import growth is somewhat different from the conclusion that per capita income growth causes the majority of growth of total imports. The fact that per capita income growth is the most highly correlated variable implies only that changes in per capita income are the most closely associated with or can be used best to explain variation in

total imports. The larger Beta coefficients for per capita income indicate that total import growth is more responsive to a given change in per capita income in terms of changes measured by standard deviations than it is to changes in other independent variables.

The stronger correlation relations of per capita income make no indications as to whether population or per capita income growth is changing the most rapidly in the cases referred to. They only indicate the result when given changes do occur. Thus it is possible that while per capita income is the highest correlated variable, it may not be the most rapidly changing variable and therefore would not be accountable for the major portion of change in imports.

For example, while per capita income may be more highly correlated to per capita import growth through the entire income level range, population growth appears to account for the major portion of import growth in all per capita income level ranges where population is growing faster than per capita income. In Figure 4.11 on page 97 if population growth is assumed to account for the same percentage increase in imports as its rate of growth and per capita income growth accounts for the rest of total import growth, then population growth accounts for over half of the import growth below the income level of approximately $400 and above the income level of approximately $2,800. Countries outside the income range of $400 to $2,800 account for nearly half of the sixty countries in this study. Nearly 70 percent of the developing countries in this study had income levels below $400.

So population growth is responsible for the major portion of import growth in most developing nations.

Within the developing countries where population growth accounts for the major portion of import growth, per capita income growth and hence per capita import growth is slow. Per capita import growth is slow because of a lack of purchasing power caused by the lack of income. Therefore population growth is the dominate factor in causing increases in total imports of food and agriculture goods.

However, in very high income nations population growth becomes the dominate factor also. This occurs because such nations are importing all of the food and agriculture goods per capita that they desire and are not inclined to increase per capita imports even with further economic growth. Hence total import growth occurs mainly through population growth which itself is usually rather slow. As a result total import growth is also slow.

There is a very wide income level range in which per capita income is the factor causing the majority of increases in total imports. The income range where per capita income is indicated to be the dominate factor by this study is somewhat wider than the range indicated by Mellor or the FAO's study. This range also includes in its central portion the countries in which per capita and total import growth have been found to be growing the most rapidly by this study. That income range has been referred to as the "transitional" or "take-off stage" income range.

Even though population growth is not responsible for the major portion of import growth in the income range $400 to $2,800 it must be remembered that per capita income growth is at high rates in this income range partially because of the fact that population growth rates have declined. Therefore population growth is indirectly the cause of per capita income and per capita and total import growth.

CHAPTER V

SUMMARY AND CONCLUSIONS

The review of literature in this study found that malnutrition is a major problem of the world today. This problem is currently caused by unequal distribution of food since enough food is currently produced to feed the people of the world.

Considering the world food problem is presently one of distribution, the determinates of demand for imports of food were considered. It was found that income and population growth were the major causes of increased demand for food. When growth in demand for food and other agriculture products is not met by internal production demand for imports arises. Also with income growth people desire a wider variety of goods and luxury foods which may not be available within the country and must be imported.

Literature reviewed, indicated that the average elasticity of imports for agriculture goods was approximately 1.06 for developed countries and 1.34 for developing countries. Indications were that the elasticity rose with economic growth in developing nations but declined with further economic growth in developed nations.

In reviewing agriculture trade, it was found that agriculture trade has not been growing as rapidly as trade in other goods. The United States' share of the world agriculture market

has been increasing over the last 25 years. In 1965, the United States controlled 12 percent of the developed countries' markets and 23.4 percent of the developing nations' market. United States' exports have grown at slightly over 6 percent per year. This growth rate is due to increases in demand abroad and to the United States gaining a larger share of the market.

Two related analyses were conducted in this study, a cross-section and time-series regression and correlation analysis. The cross-section study determined that the average elasticity of imports of food, agriculture, and total agriculture goods in relation to per capita income growth was 1.00, 1.44, and 1.10 respectively. Further analysis showed the elasticities increased with per capita income growth at low per capita income levels but decreased rapidly with income growth at high income levels. In addition, it was found that caloric consumption levels rose as income levels increased.

In the time-series study, it was found that in general rapid rates of growth of per capita income are associated with rapid rates of per capita and total import growth. The statistical significance of this relation was not as strong as desired but strong enough to warrant the conclusion that the general relation existed. Import growth rates were found to be highest when per capita income growth was near maximum growth rates and population growth was at low to moderate rates.

It was found that declines in the population growth rate were actually associated with increases in the rate of import growth. This was felt to occur because declining population

growth rates are conducive to and correlated with increasing income growth rates which cause increased purchasing power.

It was found that increases in production growth rates were not harmful to import growth rates. It is believed this relation exists also because of the strong relation between increasing agriculture production rates and increasing per capita income growth rates, particularly in developing countries.

From a discussion of the effects of population and income growth on increases in demand for imports, it was concluded that income growth is the most strongly correlated variable to import growth. However, in approximately 70 percent of the developing nations, population growth accounts for over half of the import growth.

From the results of the analysis it was concluded that countries with incomes between the range of $500 to $1,800 per capita would be increasing imports the most rapidly. In looking to the future to determine which countries will provide the best potential markets for expanding United States' exports, one must consider that nations with per capita incomes above $1,200 to $1,400 may be expanding imports rapidly today but in the near future, they will move out of the income range where rapid import growth occurs. Countries with incomes in or approaching the $500 to $1,000 per capita income range, appear to offer the most rapid expanding markets for the next 30 years. It must be kept in mind that countries with incomes above $1,000 per capita will be importing larger amounts of imports per capita than

those below $1,000 incomes per capita. Therefore, they will have large markets which it is important to maintain the United States trade positions in, but even though these markets are large, they will not be expanding very rapidly.

The following two tables, Tables 5.1 and 5.2, make use of various functions and elasticities derived in this analysis to make total import growth rate projections for nearly one hundred countries.[65] The projections are in terms of average percentage growth of imports per year from 1965 to 1985.

The following function, which will be referred to as the elasticity function, was used to derive the estimates in Columns 1 to 6 in Table 5.1 where (G) is the average import

$$G = P + E(PCI)$$

rate per year, (P) the projected average population growth rate per year, (PCI) the projected per capita income growth rate per year, and (E) the elasticity of various classes of imports. The estimates in Columns 1 to 3 respectively use the average elasticity values 1.00 for food, imports, 1.44 for agriculture or non-food imports, and 1.10 for total agriculture imports. Columns 4 to 6 make use of the varying elasticities found for different income levels in equations 4.14 to 4.22 on page 65. The appropriate elasticity has been used for each country according to its income level. The elasticities found by these equations on page 65 are as follows:

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[65]Centerally planned nations are not included.

Income Range $0 - 250
- Food..... .95
- Agriculture..... .91
- Total Ag..... .94

Income Range $250 - 750
- Food..... 1.05
- Agriculture..... 1.96
- Total Ag..... 1.33

Income Range $750 - 3,000
- Food..... .25
- Agriculture..... .50
- Total Ag..... .24

The estimates in Columns 7 and 8 were derived from the two following power functions.[66]

$$\text{Total Ag Imports} = 0252\ PCI^{1.3987}\ Population^{.3883}$$

$$\text{Food Imports} = .2872\ PCI^{1.2036}\ Population^{.0634}$$

The projected values of per capita income and population growth used to derive the estimates were taken from the Food and Agriculture Organization publication, Agriculture Commodities Projections for 1975 and 1985. This publication presents a high and low estimate range for income and population growth. For these projections, average values of income and population growth were computed from this source and used in the equations indicated above.

The estimates vary somewhat according to the functions and elasticities used. Large variation occurs between the estimates in Columns 1 to 3 and 4 to 6 for countries with incomes above $750. Elasticities for this group of countries are far below the average values. The estimates in Columns 4 to 6

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[66]Due to the nature of the methods used to derive these equations values used for PCI and population must be in the form of ten year growth-index numbers. One year rates can be found by division of the resulting index numbers.

TABLE 5.1

POTENTIAL IMPORT GROWTH RATES FROM 1965 TO 1985
(Values Are Expressed As Average Yearly Rates of Growth)

	1	2	3	4	5	6	7	8
Country	Food Imports	Ag Imports	Total Ag Imports	Food Imports	Ag Imports	Total Ag Imports	Total Ag Imports	Food Imports
World	4.40	5.50	4.65	4.53	4.30	5.22	3.81	3.22
Developed Countries	4.00	5.31	4.30	1.77	2.51	1.74	4.12	3.52
Developing Countries	4.70	5.69	4.93	4.81	4.61	5.44	3.66	2.71
North America	3.75	4.82	4.00	1.93	2.54	1.90	3.45	2.86
Canada	3.84	4.95	4.09	1.95	2.58	1.92	3.58	2.97
United States	3.67	4.70	3.91	1.91	2.50	1.88	3.32	2.76
Europe	3.99	5.43	4.32	1.54	2.36	1.50	4.42	3.86
Belgium-Luxemburg	3.42	4.74	3.72	1.17	1.92	1.14	3.86	3.50
Germany	4.04	5.68	4.41	1.25	2.18	1.21	1.49	1.44
France	4.24	5.83	4.60	1.53	2.43	1.49	4.90	4.30
Italy	4.17	5.87	4.54	1.42	2.34	1.38	4.91	4.35
Netherlands	3.94	5.27	4.24	1.67	2.43	1.64	4.14	3.56
Austria	3.67	5.28	4.04	.93	1.84	.90	4.61	4.28
Denmark	4.25	5.90	4.63	1.44	2.38	1.40	5.03	4.45
Finland	4.35	5.93	4.71	1.65	2.55	1.61	4.94	4.29
Iceland	4.45	5.84	4.77	2.09	2.88	2.06	4.53	3.76
Ireland	3.65	5.23	4.01	.95	1.84	.91	4.56	4.22
Norway	4.09	5.55	4.42	1.60	2.43	1.57	4.37	3.81
Sweden	3.72	5.15	4.05	1.28	2.09	1.25	4.27	3.82
Switzerland	3.50	4.58	3.75	1.66	2.28	1.64	3.35	2.87
United Kingdom	3.19	4.47	3.48	1.00	1.73	.97	3.66	3.39
Cyprus	4.25	5.91	4.63	4.43	4.10	5.50	5.06	4.49
Greece	4.88	6.79	5.31	5.10	4.71	6.31	5.96	5.20

TABLE 5.1 CONTINUED

Country	1 Food Imports	2 Ag Imports	3 Total Ag Imports	4 Food Imports	5 Ag Imports	6 Total Ag Imports	7 Total Ag Imports	8 Food Imports
Israel	7.08	9.43	7.62	3.07	4.40	3.02	8.30	6.61
Malta	3.65	5.04	3.97	3.81	3.52	4.69	4.12	3.70
Portugal	4.63	6.52	5.06	4.85	4.46	6.05	5.78	5.14
Spain	4.78	6.67	5.28	5.08	4.71	6.22	5.73	4.92
Turkey	5.23	6.34	5.48	5.36	5.13	6.06	4.21	3.08
Other Developed Nations	5.84	7.87	6.30	2.38	3.53	2.33	6.81	5.63
Japan	6.50	9.01	7.07	2.23	3.65	2.17	8.30	6.99
Australia	4.25	5.44	4.52	2.22	2.90	2.20	3.96	3.22
New Zealand	4.00	4.86	4.20	2.54	3.02	2.52	3.03	2.32
South Africa	4.50	5.29	4.68	4.59	4.43	5.09	3.07	2.17
Latin America	4.93	5.94	5.16	5.05	4.84	5.69	3.82	2.79
Mexico	5.16	6.10	5.37	5.27	5.07	5.86	3.71	2.60
Costa Rica	5.38	6.28	5.59	5.48	5.30	6.06	3.71	2.52
El Salvador	5.76	6.98	6.04	5.90	5.65	6.68	4.74	3.42
Guatamala	4.83	5.66	5.02	4.92	4.75	5.45	3.29	2.28
Honduras	4.56	5.12	4.69	4.50	4.44	4.48	2.49	1.56
Nicaragua	5.80	6.91	6.05	5.93	5.70	6.64	4.45	3.11
Dominican Republic	5.13	5.86	5.29	5.05	4.98	5.03	3.14	2.03
Haiti	3.70	4.23	3.82	3.64	3.59	3.63	2.07	1.42
Jamaica	5.28	7.14	5.70	5.49	5.11	6.68	6.09	5.11
Puerto Rica	7.28	10.00	7.90	2.64	4.19	2.58	9.28	7.64
Trindad and Tobago	7.06	9.10	7.52	7.30	6.87	8.59	7.51	5.74
Panama	5.48	6.54	5.72	5.60	5.38	6.27	4.17	2.94
Venezuela	4.81	5.44	4.95	3.74	4.10	3.72	2.76	1.75
Bolivia	4.41	5.30	4.61	4.31	4.23	4.29	3.29	2.44
Chile	4.58	5.61	4.81	4.70	4.49	5.35	3.70	2.80

TABLE 5.1 CONTINUED

Country	1 Food Imports	2 Ag Imports	3 Total Ag Imports	4 Food Imports	5 Ag Imports	6 Total Ag Imports	7 Total Ag Imports	8 Food Imports
Columbia	4.76	5.63	4.96	4.85	4.68	5.41	3.38	2.40
Ecuador	4.98	5.87	5.18	4.88	4.80	4.86	3.53	2.47
Peru	5.08	6.17	5.33	4.96	4.86	4.93	4.09	3.01
Argentina	3.63	4.51	3.83	2.13	2.63	2.11	2.93	2.35
Brazil	5.08	6.17	5.33	4.96	4.86	4.93	4.09	3.01
Paraguay	4.27	4.96	4.43	4.19	4.13	4.18	2.71	1.88
Uruguay	2.88	3.75	3.08	2.97	3.80	3.53	2.57	2.27
Near East	5.23	6.40	5.50	5.36	5.12	6.10	4.35	3.22
Iran	5.38	6.73	5.69	5.23	5.10	5.20	4.91	3.75
Iraq	5.78	6.81	6.02	5.90	5.69	6.56	4.23	2.90
Jordan	5.90	7.00	6.15	5.77	5.67	5.75	4.46	3.09
Lebanon	4.88	5.85	5.10	4.99	4.79	5.61	3.67	2.67
Sudan	4.60	5.59	4.83	4.49	4.40	4.47	3.62	2.71
United Arab Republic	5.73	7.00	6.02	5.59	5.47	5.56	4.84	3.53
Far East	4.48	5.46	4.70	4.37	4.28	4.35	3.55	2.68
Ceylon	4.78	5.48	4.94	4.70	4.64	4.68	2.92	1.93
India	4.18	5.04	4.38	4.08	4.00	4.06	3.11	2.33
Nepal	3.63	4.33	3.79	3.55	3.49	3.54	2.49	1.88
Pakistan	4.71	5.72	4.49	4.59	4.50	4.57	3.73	2.77
Burma	4.53	5.54	4.76	4.41	4.32	4.39	3.65	2.76
Cambodia	4.06	4.62	4.19	4.00	3.94	3.98	2.30	1.53
Taiwan	5.20	6.54	5.51	5.05	4.93	5.02	4.79	3.70
Philippines	5.23	5.93	5.39	5.15	5.09	5.13	3.12	1.98
Korea	4.58	5.42	4.77	4.49	4.41	4.47	3.22	2.29
Vietnam	3.31	3.96	3.46	3.24	3.18	3.22	2.23	1.72
Thailand	4.98	6.01	5.21	4.86	4.77	4.84	3.88	2.83

TABLE 5.1 CONTINUED

Country	1 Food Imports	2 Ag Imports	3 Total Ag Imports	4 Food Imports	5 Ag Imports	6 Total Ag Imports	7 Total Ag Imports	8 Food Imports
Africa	4.45	5.29	4.64	4.54	4.37	5.08	3.16	2.28
Algeria	4.55	5.34	4.73	4.46	4.39	4.44	3.09	2.17
Libya	6.33	7.88	6.68	6.51	6.19	7.49	5.87	4.36
Morocco	4.63	5.28	4.78	4.56	4.50	4.54	2.75	1.80
Tunisia	3.95	4.72	4.13	3.86	3.79	3.84	2.79	2.08
Uganda	3.78	4.57	3.96	3.69	3.62	3.67	2.78	2.13
Zambia	4.75	5.56	4.94	4.66	4.58	4.64	3.23	2.24
Gambia	3.28	4.02	3.45	3.20	3.13	3.18	2.44	1.95
Ghana	5.06	5.95	5.26	5.16	4.98	5.73	3.56	2.48
Ivory Coast	4.82	5.93	5.08	4.70	4.61	4.68	4.00	3.02
Liberia	3.86	5.06	4.13	4.00	3.75	4.76	3.81	3.22
Mauritania	5.03	6.15	5.29	4.90	4.80	4.88	4.15	3.09
Niger	4.78	5.79	5.01	4.66	4.57	4.64	3.76	2.78
Nigeria	4.93	5.77	5.12	4.83	4.76	4.82	3.36	2.31
Senegal	3.31	3.87	3.44	3.25	3.19	3.23	4.46	3.48
Sierra Leone	3.33	3.92	3.27	3.26	3.21	3.25	2.10	1.57
Togo	3.83	4.38	3.96	3.77	3.72	3.75	2.18	1.48
Upper Volta	3.44	4.05	3.58	3.37	3.31	3.36	2.19	1.62
Cameroon	4.06	5.24	4.33	3.93	3.82	3.90	3.85	3.18
Central African Republic	4.00	5.17	4.37	3.87	3.76	3.84	3.79	3.14
Chad	4.05	5.02	4.27	3.94	3.85	3.92	3.33	2.62
Democratic Rep. Congo	4.30	5.18	4.50	4.20	4.23	4.28	3.21	2.39
Gabon	4.06	5.57	4.40	4.23	3.92	5.19	4.61	4.06
Ethiopia	3.95	4.87	4.16	3.85	3.76	3.82	3.18	2.49
Kenya	4.23	4.95	4.39	4.15	4.08	4.13	2.77	1.95
Madagascar	3.88	4.56	4.04	3.80	3.74	3.79	3.54	1.84
Malawi	3.81	4.26	3.91	3.76	3.72	3.75	1.92	1.22
Rhodesia	4.73	5.34	4.87	4.66	4.61	4.65	2.67	1.69
Tanzania	4.13	4.99	4.33	4.03	3.95	4.01	3.09	2.32

should provide better estimates than those in Columns 1 to 3 since they consider the effect of changing elasticities to some extent. However, in a number of cases where the income of a country is just over $750, the arbitrary use of the low elasticity rates associated with this class of countries appears to have distorted the estimates. The estimates in Column 4 to 6 are much more accurate for countries near the center of the three arbitrary income ranges than for those near the group dividing values. A major example is Japan, which has a per capita income of $803. Because Japan is classed among the high income group, the estimates of its import growth rates given in Columns 4 to 6 are much lower than those in other columns. The elasticity of imports undoubtedly rise at low income levels and then begin to fall at higher income levels at some smooth or regular pattern rather than the choppy and abrupt nature given by these three arbitrary classifications.

The estimates in Columns 7 and 8 take no special consideration of changing elasticities as income levels change, but use instead average elasticity values as is also done in Columns 1 to 3. The power functions estimates in Columns 7 and 8 are generally similar to those in Columns 1 and 3. The similarity of the two types of functions estimates supports the belief that the two separate studies, the cross-section and time-series, agree and support each other. The power functions were derived in the time-series study and the elasticity function elasticity values were derived in the cross-section study. It appears that the power functions place more relative emphasis on the effect

of income growth than the elasticity function which tends to emphasize the effect of population more.

The three types of estimates for food and total agriculture imports have been averaged for each country in Table 5.2 and the countries ranked according to their potential growth rates. It is hoped that averaging the estimates may have helped to eliminate the various over or under emphasis and distortions found in each of the three types of estimates.

In looking at the countries ranked among those most rapidly increasing imports, it can be seen that most of them have incomes nearing $500 and up to approximately $1,000. There are, of course, a few exceptions such as Israel and the United Arab Republic for example. A few indications of Table 5.2 might be stressed here. The Near East, or what is often referred to as the Middle East, appears to be a rapidly expanding market area. Iraq, the United Arab Republic, Israel, Iran, and Jordan all rank among the top twenty nations in agriculture import growth potential. Southern Europe also appears to be a rapidly expanding market area with Greece, Spain, Portugal, Turkey, and Cyprus ranking among the top twenty agriculture import growth nations. The remainder of the top twenty nations is made up primarily of Latin American nations. There is a noticeable absence of African nations. This appears to be due to the fact that per capita income levels are generally very low in Africa and per capita income growth rates are not expected to be very rapid in the near future in most African nations.

TABLE 5.2
PROJECTED POTENTIAL FOOD AND TOTAL AGRICULTURAL IMPORT GROWTH RATES

Country	Food[1] Import Growth	Per[2] Capita Income	Country	Ag[1] Import Growth	Per[2] Capita Income
World	3.89		World	4.56	
Developed Nations	3.10		Developed Nations	3.39	
Developing Nations	4.07		Developing Nations	4.68	
North America	2.85		North America	3.12	
Europe	3.13		Europe	3.41	
Oceania	3.09		Oceania	3.40	
Latin America	4.26		Latin America	4.89	
Africa	3.76		Africa	4.29	
Near East	4.68		Near East	5.32	
Far East	3.84		Far East	4.20	
1 Trindad and Tobago	6.70	682	1 Trindad and Tobago	7.87	682
2 Puerto Rica	5.85	1,086	2 Libya	6.68	740
3 Libya	5.73	740	3 Puerto Rica	6.59	1,086
4 Israel	5.59	1,255	4 Israel	6.31	1,255
5 Jamaica	5.29	463	5 Jamaica	6.16	463
*6 Japan	5.24	803	6 Greece	5.86	595
7 Greece	5.06	595	*7 Japan	5.85	803
8 El Salvador	5.05	252	8 El Salvador	5.82	252
9 Nicaragua	4.95	325	9 Nicaragua	5.71	325
*10 Spain	4.95	636	*10 Spain	5.62	636
*11 United Arab Republic	4.95	165	11 Portugal	5.60	371
12 Jordan	4.92	214	12 Iraq	5.60	283
13 Portugal	4.87	371	*13 United Arab Republic	5.47	165
14 Iraq	4.86	283	14 Jordan	5.45	214
*15 Iran	4.79	242	15 Panama	5.39	478
16 Panama	4.67	478	*16 Iran	5.27	242

[1]Import growth rates are expressed in terms of average percentage growth per year from 1965 to 1985. Source: Compiled from Table 5.1.

[2]Per Capita Income figures are for the year 1965. Source: Statistical Office of the United Nations, Statistical Yearbook, 1968 (New York: United Nations Publishing Service, 1969), p. 576-580.

*Countries population exceeds 10 million.

TABLE 5.2 Continued

Country	Food Import Growth	Per Capita Income	Country	Ag Import Growth	Per Capita Income
*17 Taiwan	4.65	200	*17 Turkey	5.25	257
*18 Turkey	4.56	257	18 Costa Rica	5.12	381
19 Costa Rica	4.46	381	*19 Taiwan	5.11	200
20 Cyprus	4.39	614	20 Cyprus	5.06	614
*21 Brazil	4.35	230	*21 Mexico	4.98	441
*22 Peru	4.35	244	22 Ghana	4.85	256
23 Mauritania	4.34	114	23 Lebanon	4.80	363
*24 Mexico	4.34	441	*24 Brazil	4.78	230
25 Liberia	4.23	272	*25 Peru	4.78	244
26 Ghana	4.23	256	26 Mauritania	4.77	114
*27 Thailand	4.22		27 Gabon	4.73	369
28 Ivory Coast	4.18	219	*28 Thailand	4.64	
29 Lebanon	4.18	363	29 Chile	4.62	493
30 Gabon	4.12	369	30 Guatamala	4.59	277
*31 Philippines	4.12	246	31 Ivory Coast	4.59	219
32 Ecuador	4.11	200	*32 Columbia	4.58	315
33 Dominican Republic	4.07	232	*33 Philippines	4.55	246
34 Niger	4.07	82	34 Ecuador	4.52	200
35 Chile	4.03	493	35 Dominican Republic	4.49	232
*36 Nigeria	4.03	71	36 Niger	4.47	82
*37 Pakistan	4.02	101	*37 Nigeria	4.43	71
38 Guatamala	4.01	277	*38 Pakistan	4.41	101
*39 Columbia	4.00	315	39 Malta	4.35	408
*40 Sudan	3.97	91	*40 Sudan	4.31	91
*41 Burma	3.90	62	*41 South Africa	4.28	522
42 Zambia	3.88	204	*42 Burma	4.27	62
*43 Ceylon	3.80	138	43 Zambia	4.27	204
*44 Korea	3.79	107	44 Liberia	4.23	272
*45 South Africa	3.75	522	*45 Ceylon	4.18	138
*46 Algeria	3.73	203	*46 Korea	4.15	107
47 Bolivia	3.72	153	*47 Algeria	4.09	203
48 Cameroon	3.72	126	48 Rhodesia	4.06	232
49 Malta	3.72	408	49 Bolivia	4.06	153
50 Rhodesia (Central)	3.69	232	50 Cameroon	4.03	126
51 African Rep.	3.67	127	*51 Morocco	4.02	180
*52 Morocco (Dem. Rep.)	3.66	180	52 African Rep. (Democratic)	3.97	127
53 Congo	3.63	87	*53 Rep. Congo	3.96	87
54 Chad	3.54	69	54 Honduras	3.89	209
55 Honduras	3.54	209	*55 India	3.85	97
*56 India	3.53	97	56 Chad	3.84	69

TABLE 5.2 Continued

Country	Food Import Growth	Per Capita Income	Country	Ag Import Growth	Per Capita Income
*57 Tanzania	3.49	68	57 Venezuela	3.81	917
58 Paraquay	3.45	207	*58 Tanzania	3.81	68
59 Kenya	3.44	100	59 Iceland	3.78	2,109
*60 Ethiopia	3.43	47	60 Paraguay	3.77	207
61 Iceland	3.43	2,109	61 Kenya	3.76	100
62 Finland	3.43	1,568	62 Finland	3.75	1,568
63 Venezuela	3.43	917	*63 Ethiopia	3.72	47
64 Denmark	3.38	1,070	64 Senegal	3.71	191
*65 France	3.36	1,626	65 Denmark	3.69	2,070
66 Senegal	3.35	191	*66 France	3.66	1,626
*67 Italy	3.31	974	*67 Italy	3.61	974
68 Tunisia	3.30	191	68 Tunisia	3.59	191
*69 Australia	3.23	1,840	*69 Australia	3.56	1,840
70 Cambodia	3.20	120	70 Cambodia	3.49	120
71 Uganda	3.20	83	71 Uganda	3.47	83
72 Madagascar	3.17	98	72 Madagascar	3.46	98
73 Norway	3.17	1,712	73 Norway	3.45	1,712
*74 Netherlands	3.06	1,394	*74 Netherlands	3.34	1,394
75 Togo	3.03	98	75 Togo	3.30	98
*76 Nepal	3.02	68	*76 Nepal	3.27	68
77 Austria	2.96	1,110	77 New Zealand	3.25	1,867
78 New Zealand	2.95	1,867	*78 Canada	3.20	2,156
79 Sweden	2.94	2,248	79 Malawi	3.19	44
80 Ireland	2.94	818	80 Sweden	3.19	2,248
81 Malawi	2.93	44	81 Austria	3.18	1,110
*82 Canada	2.92	2,156	82 Haiti	3.17	86
83 Haiti	2.92	86	83 Ireland	3.16	818
84 Gambia	2.81	85	84 Uruguay	3.06	562
85 Upper Volta	2.81	44	*85 United States	3.04	3,240
*86 United States	2.78	3,240	86 Upper Volta	3.04	44
*87 Vietnam	2.76	119	87 Gambia	3.02	85
88 Sierra Leone	2.72	142	*88 Vietnam	2.97	119
89 Uruguay	2.71	562	*89 Argentina	2.96	778
*90 Argentina	2.70	778	90 Sierra Leone	2.94	142
91 Belgium - Luxemburg	2.70	1,583	91 Belgium - Luxemburg	2.91	1,583
92 Switzerland	2.68	2,128	92 Switzerland	2.91	2,128
*93 United Kingdom	2.52	1,579	*93 United Kingdom	2.70	1,579
*94 Germany	2.24	1,659	*94 Germany	2.37	1,659

The implications of the country rankings in Table 5.2 and the general relation that developing countries will provide the most rapidly growing agriculture markets in the future is somewhat favorable in relation to the United States' trade position. As stated previously, the United States' competitive position is best in developing country markets. We control 23.4 percent of the market of developing countries as compared to only 12 percent of the market of developed countries.

Our leading customer, Japan, ranks seventh in potential agriculture imports.[67] Other nations which are good customers of the United States and rank high as potentially rapidly growing markets include Israel, Spain, Portugal, Turkey, Taiwan, Mexico, Brazil, Chile, Colombia, Philippines, and Pakistan. These countries rank in the top forty in regard to agriculture growth potential and had on the average from 1960-65 imported over 20 million dollars of agriculture goods from the United States per year. In several of these countries, part of the imports have been on a concessional basis. However, these countries appear to be converting their imports to a cash basis and will become cash customers as more economic growth occurs.

The importance of Japan as a current customer and future customer is very important to the United States. Not only is Japan a rapidly growing market, it is also nearly the largest market among the top forty growing markets. The United States presently has a substantial portion of Japan's market and needs

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[67]A table of the United States leading customers can be found on page 42.

to hold if not expand this position. Spain also could be a very important market since it too is a large and rapidly growing market which the United States currently has a good position in. Other markets which are large and rapidly expanding and have been good customers of the United States in the past include Taiwan, Mexico, Brazil, and Turkey. These countries will hold a large part of the key to the United States' future export growth rate. Three key markets which the United States might do well to expand its influence in are the United Arab Republic, Iran, and Iraq. These countries in the past have not imported substantial amounts of agriculture goods from the United States. This study indicates that they will be relatively large and rapidly growing markets in the future.

It appears that the United States will have a difficult time holding its export growth rate at the past yearly rate of 6 percent and above. Part of this growth was due to the United States gaining larger portions of various nations' markets. This was true of the developing nations' markets particularly. Since the United States presently controls a larger portion of the developing countries' markets than developed countries' markets, our export growth will be more rapid than the world average rate of import growth which is estimated to be 4.56 percent. The developing countries' average rate of imports is estimated to grow at 4.68 percent. Therefore, it appears that the United States' export growth rate may be around 4.6 percent. But with strong growth of the Japanese and Spanish markets which currently make up about one-eighth of our export market, the

United States could have a growth rate of exports approaching 5 percent a year. But without further improvement in control of the market, which would necessitate taking trade away from other nations, it appears unlikely our export growth will reach 6 percent per year. Market expansion or growth in the past has been responsible for nearly half of the United States' agriculture export growth. If the United States had only maintained a constant share of the developed and developing countries' markets, its agriculture export growth rate would have only been about 3.0 to 3.5 percent instead of slightly over 6 percent.

Continued expansion of control of the international agriculture market at past rates could boast United States' export growth rates to about 7 percent which is even faster than past export growth rates. This occurs because basic demand for food in the world appears to be projected to increase faster in the future than in the past.

Whether the United States continues to expand its control of the international agriculture market at past rates is another question and will not be considered. The author is inclined to believe it will be very difficult to continue such an expansion rate. This study has only concerned itself with finding the basic rate of increase in demand for agriculture and food imports. As indicated, the basic growth in demand for food and agriculture imports around the world, indicates that United States' exports of food and agriculture goods will grow at an average of approximately 4.5 to 5.0 percent a year until 1985.

APPENDIX

TABLE A.1

1965 CROSS-SECTION DATA
(Import and Population Data in Millions:
Per Capita Income and Calories Expressed in Standard Units)

Country	Food Imports	Total Ag Imports	Per Capita Income	Population	Calories
Austria	$ 281.0	$ 415.5	$1110	7.3	2950
Belgium-Luxembourg	801.9	1351.0	1583	9.8	3070
Denmark	338.8	608.3	2070	4.8	3300
Finland	164.5	275.0	1568	4.6	2950
France	1909.3	3200.1	1626	48.9	3150
West Germany	3446.2	5483.2	1659	56.8	2870
Greece	158.4	248.0	595	8.6	2910
Iceland	15.4	23.1	2109	.2	
Ireland	173.1	246.2	818	2.9	3440
Italy	1636.9	2853.0	974	51.6	2860
Malta	33.3	37.5	408	.3	---
Netherlands	987.9	1680.5	1394	12.3	2900
Norway	210.3	308.9	1712	3.7	---
Portugal	120.9	253.4	371	9.2	2548
Spain	487.2	769.2	636	19.0	2800
Sweden	495.4	696.6	2248	7.7	2900
Switzerland	570.4	823.9	2128	5.9	3170
United Kingdom	4768.7	7302.3	1579	54.4	3220
Barbados	19.9	22.9	369	.2	---
Canada	743.3	1098.3	2156	19.6	3180
Costa Rica	16.4	17.7	381	1.5	2460
Dominican Republic	33.9	36.5	232	1.5	2460
El Salvador	30.9	36.3	252	2.9	2120
Honduras	13.7	15.2	209	2.3	2240

TABLE A.1 CONTINUED

1965 CROSS-SECTION DATA

Country	Food Imports	Total Ag Imports	Per Capita Income	Population	Calories
Jamaica	$ 63.7	$ 75.7	463	1.8	---
Martinique	22.3	24.7	---	.3	---
Mexico	57.5	127.7	441	42.7	2780
Nicaragua	15.7	17.3	325	1.7	2550
Panama	19.6	22.6	478	1.2	2280
Trindad and Tabago	55.5	61.3	682	1.0	2467
United States	4175.3	6294.2	3240	194.6	3200
Argentina	68.9	186.9	778	22.4	2920
Brazil	266.4	282.4	230	80.8	2860
Chile	120.4	161.1	493	8.6	2760
Colombia	49.8	81.9	315	18.0	2260
Ecuador	15.6	20.8	200	5.2	1830
Peru	113.7	130.2	244	11.7	2290
Venezuela	137.1	180.0	917	8.7	2490
Cambodia	7.5	8.6	120	6.1	---
Ceylon	188.5	198.4	138	11.2	2080
Taiwan	49.5	155.5	200	12.8	2400
Cyprus	25.8	30.1	614	.6	2629
India	723.4	944.7	97	486.8	1810
Iran	115.1	138.3	242	104.9	1890
Iraq	104.1	123.3	283	8.2	2100
Israel	110.1	197.2	1255	2.6	2820
Japan	1508.6	3661.8	803	98.0	2350
Jordan	44.7	52.8	214	2.0	2500
Korea	72.9	167.0	107	28.4	2390

TABLE A.1 CONTINUED

1965 CROSS-SECTION DATA

Country	Food Imports	Total Ag Imports	Per Capita Income	Population	Calories
Lebanon	$ 123.7	$ 171.5	$ 363	2.4	2730
Sarawak	31.6	35.3	205	.8	---
West Malaysia	218.1	263.2	280	8.0	---
Pakistan	180.7	212.0	101	102.9	2960
Philippines	145.1	178.3	246	32.3	2010
Syria	55.4	66.8	192	5.2	2490
Thailand	72.8	97.6	128	30.7	---
Turkey	37.0	66.0	257	31.1	3110
Viet-Nam	68.8	92.2	119	35.1	2017
Cameroon	16.5	18.3	126	5.2	2130
Central Africa	3.3	4.3	127	1.4	---
Chad	3.1	4.7	69	--	---
Ethiopia	9.8	14.9	47	22.6	2040
Gabon	9.6	10.0	369	.5	---
Gambia	2.7	3.8	85	.3	---
Ghana	58.5	61.8	256	7.7	2160
Ivory Coast	44.9	47.5	219	3.8	---
Kenya	30.9	33.8	100	9.4	2120
Liberia	18.5	21.4	272	1.1	---
Libya	52.4	57.0	740	1.6	---
Madagascar	24.2	31.3	98	6.2	2220
Mauritus	26.9	28.4	228	.8	2370
Morocco	149.7	184.0	180	13.3	---
Nigeria	70.2	75.5	71	58.0	2180
Zambia	27.2	30.4	204	3.7	---
Senegal	61.2	66.7	127	3.5	---
Sierra Leone	20.4	22.8	142	2.4	---

TABLE A.1 CONTINUED

1965 CROSS-SECTION DATA

Country	Food Imports	Total Ag Imports	Per Capita Income	Population	Calories
South Africa	$ 132.7	$ 226.8	$ 522	17.9	2820
Sudan	53.5	61.4	91	13.5	1940
Tanganyika	12.0	12.6	67	11.2	2110
Tunisia	42.9	55.4	191	4.4	---
Uganda	7.5	7.9	83	7.6	---
United Arab Republic	269.1	358.4	165	29.6	2810
Australia	140.4	325.2	1840	11.3	3120
New Zealand	76.7	111.8	1867	2.6	3460

Sources: Food and Agriculture Organization, Production Yearbook.
Food and Agriculture Organization, Trade Yearbook.
United Nations Statistical Office, Demographic Yearbook.
United Nations Statistical Office, Statistical Yearbook.

TABLE A.2

TIME SERIES DATA
(Data Expressed as 1965 Index Value
for Time Period 1955-65 with 1955=100)

Country	Per Capita Food Imports	Per Capita Total Imports	Growth of PCI	Per Capita Food Production	Per Capita Total Ag Production	Food Prices	Population Growth
Austria	173.0	158.0	153.0	123.0	123.0	135.0	104.4
Belgium-Luxembourg	167.0	148.0	135.0	103.0	102.0	124.0	106.6
Denmark	142.0	177.0	147.0	112.0	112.0	145.0	107.4
Finland	124.0	143.0	145.0	126.0	127.0	192.0	108.1
France	139.0	140.0	144.0	119.0	119.0	135.0	113.2
West Germany	191.0	183.0	157.0	108.0	107.0	126.0	111.1
Greece	194.0	198.0	168.0	145.0	143.0	121.0	107.2
Iceland	166.0	157.0	126.0	---	---	246.0	121.7
Ireland	193.0	168.0	144.0	118.0	118.0	137.0	100.0
Italy	336.0	261.0	153.0	118.0	116.0	135.0	107.6
Malta	123.0	131.0	139.0	---	---	123.0	101.0
Netherlands	168.0	171.0	135.0	106.0	106.0	142.0	114.4
Norway	133.0	142.0	138.0	90.0	91.0	144.0	108.4
Portugal	203.0	226.0	154.0	109.0	109.0	129.0	105.6
Spain	657.0	403.0	174.0	120.0	123.0	221.0	109.1
Sweden	166.0	162.0	143.0	97.0	94.0	159.0	106.7
United Kingdom	119.0	113.0	123.0	130.0	132.0	116.0	106.5
Canada	138.0	140.0	124.0	108.8	90.9	121.0	124.7
Costa Rica	126.0	127.0	106.0	97.8	99.3	117.0	150.4
Jamaica	230.0	229.0	151.0	---	---	128.0	117.6
Mexico	93.0	117.0	128.0	112.9	113.7	144.0	143.8
Nicaragua	248.0	232.0	128.0	---	---	106.0	133.2
Panama	145.0	153.0	133.0	110.2	112.2	104.0	137.8

TABLE A.2 CONTINUED

TIME SERIES DATA

Country	Per Capita Food Imports	Per Capita Total Imports	Growth of PCI	Per Capita Food Production	Per Capita Total Ag Production	Food Prices	Population Growth
Argentina	84.0	83.0	116.0	97.3	96.0	167.1	116.4
Brazil	107.0	105.0	123.0	112.9	111.6	338.9	139.0
Columbia	80.0	95.0	110.0	100.3	100.4	294.0	143.7
Ecuador	172.0	159.0	113.0	123.0	131.8	119.0	140.3
Cyprus	187.0	164.0	143.0	148.3	143.9	124.0	114.6
India	323.0	196.0	110.0	96.0	95.8	186.0	128.7
Japan	202.0	226.0	227.0	112.2	116.3	149.0	109.8
Thailand	223.0	232.0	154.0	120.9	127.9	135.0	152.3
Turkey	132.0	102.0	129.0	99.3	116.1	251.0	128.7
Ghana	136.0	139.0	117.0	---	---	205.0	172.0
Kenya	222.0	218.0	107.0	---	---	118.0	156.8
Mauritius	162.0	158.0	102.0	---	---	102.0	133.4
Nigeria	146.0	144.0	143.0	---	---	118.0	184.1
Sierra Leone	181.0	188.0	145.0	---	---	101.0	114.4
Tanganyika	158.0	148.0	107.0	---	---	112.0	135.8
Australia	147.0	133.0	124.0	126.0	113.6	128.0	122.4
New Zealand	126.0	120.0	126.0	108.0	111.7	124.0	122.8
United States	127.0	121.0	120.0	103.8	99.4	116.0	117.1
Honduras	228.0	230.0	118.0	108.2	115.9	96.0	138.1
Netherland Antilles	146.0	108.0	83.0	---	---	121.0	113.5
United Arab Republic	349.0	278.0	125.0	103.7	107.5	149.0	128.8

Sources: Food and Agriculture Organization, Production Yearbook.
Food and Agriculture Organization, Trade Yearbook.
United Nations Statistical Office, Demographic Yearbook.
United Nations Statistical Office, Statistical Yearbook.

TABLE A.3
CRITICAL STATISTICAL VALUES

Critical Values of Multiple Correlation Coefficients

N	Significance Levels	Number of Variables 1	3
10	.75	.24	--
	.90	.44	--
	.95	.55	.67
	.99	.72	.78
30	.75	.13	--
	.90	.24	--
	.95	.31	.42
	.99	.42	.51
40	.75	.11	--
	.90	.21	--
	.95	.26	.37
	.99	.37	.45
60	.75	.09	--
	.90	.17	--
	.95	.21	.31
	.99	.30	.38
120	.75	--	--
	.90	--	--
	.95	--	.22
	.99	--	.27

Critical Values for Student's t-Distribution

Number of Observations	Significance Levels .75	.90	.95	.99
10	0.6998	1.3722	1.8125	2.7638
15	0.6921	1.3406	1.7531	2.6025
20	0.6870	1.3253	1.7247	2.5280
25	0.6844	1.3163	1.7081	2.4851
30	0.6828	1.3104	1.6973	2.4573
34	0.6818	1.3070	1.6909	2.4411
38	0.6810	1.3042	1.6860	2.4286
40	0.6807	1.3031	1.6839	2.4233
42	0.6804	1.3020	1.6820	2.4185
44	0.6801	1.3011	1.6802	2.4141
46	0.6799	1.3002	1.6787	2.4120
50	0.6794	1.2987	1.6759	2.4033
60	0.6786	1.2958	1.6706	2.3901
70	0.6780	1.2938	1.6669	2.3808
120	0.6765	1.2886	1.6577	2.3578

TABLE A.3 CONTINUED

CRITICAL STATISTICAL VALUES

Critical Values of the F-Distribution

V_2	Significance Levels	Degrees of Freedom in Numerator, V_1 1	2	3	4
	.50	0.49	0.74	0.85	0.90
	.75	1.49	1.60	1.60	1.59
10	.80	1.88	1.90	1.86	1.83
	.90	3.28	2.92	2.73	2.61
	.95	4.69	4.10	3.71	3.48
	.99	10.04	7.56	6.55	5.99
	.50	0.47	0.72	0.82	0.87
	.75	1.40	1.49	1.48	1.47
20	.80	1.76	1.75	1.70	1.65
	.90	2.97	2.59	2.38	2.25
	.95	4.35	3.49	3.10	2.87
	.99	8.10	5.85	4.94	4.43
	.50	0.47	0.71	0.81	0.86
	.75	1.38	1.45	1.44	1.42
30	.80	1.72	1.70	1.64	1.60
	.90	2.88	2.49	2.28	2.14
	.95	4.17	3.32	2.92	2.69
	.99	7.56	5.39	4.51	4.02
	.50	0.46	0.71	0.80	0.85
	.75	1.36	1.45	1.42	1.39
40	.80	1.70	1.70	1.62	1.57
	.90	2.84	2.49	2.23	2.09
	.95	5.42	3.32	3.46	3.13
	.99	7.31	5.39	4.31	3.83
	.50	0.46	0.70	0.80	0.85
	.75	1.35	1.42	1.41	1.38
60	.80	---	---	---	---
	.90	2.79	2.39	2.18	2.04
	.95	4.00	3.15	2.76	2.53
	.99	7.08	4.98	4.13	3.65

Sources: Donald B. Owen, Handbook of Statistical Tables (Reading, Mass.: Addison-Wesley Publishing Company, 1962), pp. 28-30, 64-87, 510, 514.

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THE FUTURE GROWTH OF WORLD DEMAND FOR AGRICULTURE IMPORTS AND THE IMPLICATIONS FOR UNITED STATES EXPORTS

by

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AN ABSTRACT OF A MASTER'S THESIS

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This study is concerned with determining the effect of income, population and agriculture production growth upon a country's demand for imports of food and agriculture goods. It is felt that growth of income and population are the two major causes of increases in demand for food and other agriculture products. When demand created by income and population growth is not met by increases of agriculture production within a country, then demand for imports is created.

Population growth obviously creates demand for food and other agriculture goods by increasing the number of consumers. However, unless population growth is accompanied by income growth, the demand will not be effective because of a lack of purchasing power. In cases where rapid population growth was occurring, it was found that import growth often was not very rapid. This appeared to occur because rapid population growth prevented per capita income from increasing and creating purchasing power. Because of the fact that declines in the population growth rate are generally associated with increases in per capita income growth, it was found that declining population growth rates are usually conducive to increasing import growth rates on both a per capita and total import basis.

It was found that the average elasticity of per capita income growth in relation to per capita agriculture import growth was 1.10. When agriculture import goods were classified as food and non0food goods, the same elasticity relation was 1.00 and 1.44 respectively. However these elasticities were found to change as per capita income levels increased. At low

levels of per capita income rises in the income level caused small increases in the elasticity values. However as income levels became higher further increases in per capita income caused rapid declines in the elasticity values.

The results of this study indicate countries in a stage of development termed as "transitional" will be increasing their imports of food and agriculture goods the most rapidly in the next twenty years. Transitional countries are those which are in the lower portion of the developed countries income range and upper portion of the developing countries income range. This per capita income range is around $500 to $1,000. These countries are characterised by relatively rapid and rising rates of per capita income growth which are approaching a rate of 4.0 per year. They also have moderate to low population growth rates which are declining.

Based on this study, it appears that continued economic growth of developing countries will cause increased demand for agriculture imports and it would be in the interest of the United States to aid economic growth of these countries in order to improve our agriculture export markets. The most rapid growth of import demand in the future will be in developing and transitional nations and not in high income developed nations.