A MULTI-SECTORAL LINEAR PROGRAMMING APPROACH TO MEASUREMENT OF THE ECONOMIC COSTS OF INCOME REDISTRIBUTION IN GUATEMALA

by

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TABLE OF CONTENTS

CHAPTER I. INTRODUCTION AND PROBLEM STATEMENT

Some Theoretical Issues

In the decades of the fifties and sixties development was generally equated with growth in per capita GDP (gross domestic product) resulting from net capital formation. As recently as the late 1960's one of the major recommendations of the Pearson Report[1] was a goal of 6% rate of growth per annum for the developing countries throughout the 1970's. If, on the other hand, development involves not only growth in GDP but also to a wide spectrum of socio-economic factors relating to quality of life, then it seems obvious that while growth and industrialization (i.e., capital formation) may be a necessary condition for development it is not a sufficient condition. The ultimate goal of the development process should be to increase the quality of life for all of a country's citizens, not just for the richest 5%. While an economist may have no comparative advantage (resulting from his knowledge of economic theory) in prescribing what an increase in the quality of life may be, it is reasonable to expect that part of this increase would have to include an improvement in economic well-being. In other words all citizens should receive a share of the economic gains of growth. Since a high degree of inequality in the distribution of income (and other benefits of progress) is an

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[1]This report, "Partners in Development", was prepared for the international community at the invitation of the World Bank. It had been drawn up the previous year by a distinguished commission of experts chaired by the Right Honorable Lester B. Pearson and has come to be known as the Pearson Report.

outstanding characteristic of most if not all developing nations of the "Third World", development in the 1970's should, therefore, include an improvement in the distribution of income.

At the Columbia University Conference on International Development, which was held in response to recommendations of the Pearson Report, G. K. Helleiner in speaking of growth and structural changes in Africa takes the following view. Even if the extremely poor countries in terms of per capita income such as are found in Africa were to achieve the annual 6% growth rate as recommended, the quality of life within these nations would not be improved unless there is a drastic improvement in distributional equity. He says "distributional equity is a key element in the quality of a nation's life; the more this is so where the poverty trends are extreme" [9].

"Income in the less-developed countries is typically characterized by a high concentration of incomes in the top ranges, with the top decile of income units receiving some 40-50 percent of total income" [3]. It has long been argued that a distributional pattern such as this may be a necessary price to pay in order to achieve a high rate of growth. This argument is based on the assumption that it is the wealthy who are the savers and investors and that "the inequality of income makes possible the accumulation of profits which is a necessary part of economic growth. It is argued that the typical pattern of development of the now developed countries in the nineteenth century could occur precisely because the marked inequality of incomes made possible large profits, which were an incentive to dynamic entrepreneurial activity and productive investment" [3]. Implicit in this argument is the assumption that benefits from a high rate of growth would "trickle" down to the lower income groups through employment and multiplier effects. The rate of dispersement of the benefits of growth would depend in large part upon the labor absorbing effect of industrialization (assuming industrialization was the chief growth strategy). Experience has shown that technology imported from the developed world is highly capital intensive. The employment effect and, therefore, the distributional effect of industrialization has proved to be disappointing in Latin America. According to Thiesenhusen

> ... higher forms of industry are requiring fewer laborers per unit of capital and factories are replacing labor-intensive artisan shops. Thus employment opportunities, and hence income earning possibilities, are now opening more slowly than ever [23].

If a country were to pursue a growth maximizing strategy then redistribute the benefits of growth by some means such as a highly progressive income tax, the "savings effect" would still have to be contended with. The magnitude of the savings effect depends upon the extent to which the marginal propensity to consume falls as income rises. If the marginal propensity to consume (MPC) were constant at all levels of income, redistribution of income would have no effect on total savings. However, if the MPC is smaller for high income people, then a redistribution of income will involve some sacrifice in savings and, therefore, growth. In this case there would exist a trade-off between growth and equity in the distribution of income. The policy problem would then be to weigh the benefits of an improvement in one of these objectives against the resulting sacrifice in the other.

A recent (1970) attempt to measure the potential savings effect of income redistribution in four Latin American countries was made by Cline [4]. In this study the effect on growth of redistributing income in Argentina, Brazil, Mexico, and Venezuela is calculated under two redistribution schemes. The first was a redistribution of income towards the level of equity found in England. The second scheme was a redistribution of income so that the minimum income equaled one half the overall average family income. The results of this study indicate that for either scheme the effect on the growth rate of the countries involved could be substantial. The sacrifice in the rate of growth would be on the order of 1% for Brazil and Mexico and smaller decreases for Argentina and Venezuela. Cline makes the following qualifying statement:

> While one percentage point is a serious growth sacrifice, it might very well be a reasonable price to pay for a country growing at 5% with inequality so extreme that political instability is chronic.

The arguments that have been presented above present improvement in the distribution of income as an alternative to growth or, at best a result of growth in the long run. Arguments up to this point for a more equal distribution of income are based on socio-political-humanitarian grounds and not on economic grounds. However, there are effects other than the effect on savings which should be considered also.

As long ago as 1776 Adam Smith suggested that the growth of an industry is limited by the size of the market for that industry's output. The extreme inequality of income found in most Latin American countries today is represented by a substantial portion of the population being found in a subsistence sector which is for the most part removed from the rest of the economy because of lack of purchasing power. The result is that the "economic" size of one of these countries is much smaller than geographical size or population would indicate. In such a situation extreme inequality in the distribution of income could be a deterrent to growth by limiting the size of the market.

We now have two major effects of a redistribution of income to consider, both working in opposite directions on the rate of growth; the first being the "savings effect" which was discussed earlier and the "market" or "demand" effect which is being introduced now.

Strassman [21] postulated an inverse relationship between economic growth and income inequality. He was concerned with the distribution of income because it affects the distribution of consumption. The reasoning behind this hypothesis is the following. "The low incomes of a large portion of the population and very high incomes of a small minority have discouraged mechanization and a shift to mechanical industries . . . ." It is consumption inequality which causes workers to be channeled away from mass production industries and into luxury handicraft industries and personal services. A high degree of income or consumption inequality tends to keep the marginal efficiency of capital in the mass production industries low so that industrialization is retarded. It seems that the problem can be summed up in the fact that mass production industries need a large market in order to operate efficiently (assuming increasing returns to scale). Extreme inequality in the distribution of income effects both the level and the composition of demand which limit the size of the market for mass produced consumption goods. Strassmann concludes that economic growth depends not only on capital formation and technological progress but also on growing income equality.

More recently (1970) Thiesenhusen [23] proposed a similar thesis. His argument is based on the idea that although ". . . histories of Latin America's industrial progress over the past two or three decades can be filed under import substitution" some Latin American countries are now facing a situation where it is becoming increasingly more difficult to carry out this strategy. Thiesenhusen explains,

> To date, domestic output . . . produced with borrowed methods . . . has substituted for former imports and, in what has been called the 'easy' stage, pre-existing markets have been filled . . . . Because progressively higher steps in manufacturing usually require a larger scale to operate efficiently, many new lines began with a spurt but quickly ran aground.

In summary Thiesenhusen states:

> One possible way to confront the current exhaustion of import substituting industrialization in some Latin American countries might be through policies such as land reform, which would make the pattern of resource and income distribution more egalitarian. This approach would tend to reinvigorate the simple consumer goods subsector since peasants would be able to make more purchases. Subsequently, farm input manufacture would be stimulated as campesinos attempt to add to their incomes. Government policy should be designed to capture increasing shares of rising incomes; these savings can be invested at growth points of the economy and in infrastructure. Eventually, production of intermediate and advanced manufactures will be able to proceed on a more efficient basis than presently.

In response to the argument that private savings would be lost and therefore growth sacrificed he states that

> . . . with a more equal income distribution the added public savings could more than substitute for whatever private savings might be lost.

Guatemala: The Problem

Guatemala is a small Central American country which lies just south of the Yucatan penninsula. It is bounded on the north and west by Mexico, on the east by Belice, to the south and east by Honduras and El Salvadore, and on the southwest by the Pacific Ocean. It is about the size of the state of Louisiana and has a population of about 4.3 million people.

The economy of Guatemala has been characterized as the "prototype" of a dual economy. A dual economy is defined as one where a dynamic modern sector exists alongside a traditional or subsistence sector [7]. The relation between dualism and the distribution of income is illustrated by a recent study which finds that the allocation of income to the poorest 60 percent of the population is related to the extent of dualism. The greater the degree of dualism the smaller is the share of income going to the poorest 60 percent of the population [2].

Dualism is most pronounced in the agricultural sector which is characterized by the continual existence of traditional large land holdings (latifundia) and numerous uneconomically small land holdings (minifundia). This system of latifundia-minifundia is one of the continuing legacies of the old colonial system and subsequent years under dictatorships. The following statement would seem to apply to Guatemala.

> In those regions where the colonial agrarian system took far stronger hold, as in many Latin American countries, and where export industries served mainly to strengthen the position of the powerful urban classes, modern industrial development has in many cases been superimposed on the traditional agrarian structure. The result is a perpetuation of social inequalities which has given a highly distinctive coloring to the resulting patterns of income distribution, which are amongst the most unequal to be found [3].

The traditional sector is made up largely of Indian farmers who make a living by working small plots of land in the highlands and supplement their earnings working on the large plantations or in nonagricultural activities. The term "Indian" is more than a racial designation but a cultural one as well. Indians are defined as those descendants of the precolonial civilizations inhabiting Central America who have not adopted the characteristic features of modern western culture [7]. People although racially would qualify as Indians but who have begun to adopt or have already adopted modern ways in such areas as dress, religion, customs, etc. are classified with the rest of the population as "Ladinos". According to the 1964 census of population, Indians constituted 43.3 percent of the total population, which is an indication of the extent of economic and cultural dualism in Guatemala.

The development problem in Guatemala has both cultural as well as economic dimensions, but the statement that "development in the 1970's must include an improvement in the distribution of income" would apply here. More specifically with almost 50% of the population made up of Indians, who are defined as being outside the main economy and culture and poor ladino farmers who make up the rest of the traditional sector, an improvement in the distribution of income in Guatemala would have to include development of the traditional sector.

The objective of this study is to examine the effects of a more equal distribution of income in Guatemala. More specifically both the "savings" and "demand" effects will be accounted for simultaneously in a multisectoral model. The answers to two major questions are sought. The first question has to do with the gross distribution of income between the traditional sector and the rest of the economy. More specifically "what is the net cost in terms of sacrificed overall GDP or income in the rest of the economy of increasing output in the traditional sector?" Two approaches will be used to answer this question: (1) The effects of lump-sum transfers to the traditional sector at the expense of the rest of the economy will be measured and (2) a "trade-off" curve in terms of income between the traditional sector and the rest of the economy is derived using a linear programming approach. In other words, the objective will be to measure the cost of developing the traditional sector at the expense of the other sectors of the economy. The second question is "what are the net effects in terms of the savings and demand effects of a more equal distribution of income within sectors?" To answer this question, a more equal distribution of income within each sector will be simulated, and the effects of such a change on the endogenous variables of the model are measured.

CHAPTER II. THE DISTRIBUTION OF INCOME IN GUATEMALA

The Size Distribution of Income

Data on the personal distribution of income in Guatemala are scarce. No official data are published by the government of Guatemala, but GAFICA[1] [25] presents some data on the distribution of income which were derived from data collected by the Social Security Institute (IGSS) of Guatemala. These data only include people who are participating in the Social Security System. This would include salaried workers and wage earners working for the government or larger companies. Self employed people who do not choose to participate in the program and many campesinos (peasants) who do not work on the large fincas are excluded. Most likely both very poor people and very rich people would be excluded from this sample. It is, therefore, reasonable to expect that the information derived from this data would underestimate the degree of income inequality. This is because the poor that are excluded would earn a smaller percentage of income than their percentage of the population, and the rich who are excluded would earn a larger share of total income than their share of the total population. Table (2.1) presents percentage per capita income per decile of the population (deciles are ranked from low to high income) and also cumulative percentage figures. According to the figures given, the lowest 50% of the population in terms of per capita income receive only 12.7% of total income while the richest 5% receive 85.2% of the total income.

[1]Group Asesor de la F.A.O. Para La Integracion Economica Centroamericana F.A.O.'s advisory group for the economic integration of Central America.

TABLE 2.1. Distribution of income in Guatemala, 1968.

	GAFICA Data		
Decile of Population	% Income in Decile	Cumulative % of Population	Cumulative % of Income
1	0.5	10	0.5
2	1.5	20	2.0
3	2.5	30	4.5
4	3.0	40	7.5
5	5.2	50	12.7
6	5.3	60	18.0
7	8.0	70	26.0
8	10.5	80	36.5
9	16.0	90	52.5
10	47.5	100	100.0
Top 5%	35.2		

In addition to the data presented by GAFICA it is possible to derive an estimate of the distribution of income in Guatemala from the income expenditure data reported in two budget studies carried out by the Instituto de Investigacioues Economicas Y Sociales of the University of San Carlos in Guatemala. These two studies, one for the rural population [15] and one for the urban population [16], provide the income consumption data for estimating the consumption functions of the model. These studies will be discussed in more detail later.

The income distribution data resulting from compiling the data in these two studies are presented in Table (2.2).

TABLE 2.2. Distribution of income in Guatemala (1966-69).

Derived from budget study data			
% Families (low income to high)	% Income	Cumulative % population	Cumulative % income
34.0	6.2	34.0	6.2
16.3	6.7	50.3	12.9
12.2	8.4	62.5	21.3
9.3	8.9	71.8	30.2
10.7	14.4	82.5	44.6
6.9	13.3	89.4	57.9
5.6	14.8	95.0	72.8
1.9	7.2	96.5	80.0
1.4	6.8	98.3	86.8
1.7	13.2	100.0	100.0

Using data from the budget studies gives very similar results to those derived using IGSS data (used by GAFICA). The poorest 50.3% of the population receives 12.9% of total income while the richest 5% receive 27.2% of total income. The similarity of the results obtained by the two sets of data is even more striking when the income distribution data is represented by Lorenz curves, which are shown in Figure (2.1). The GAFICA data seems to indicate a slightly more unequal distribution

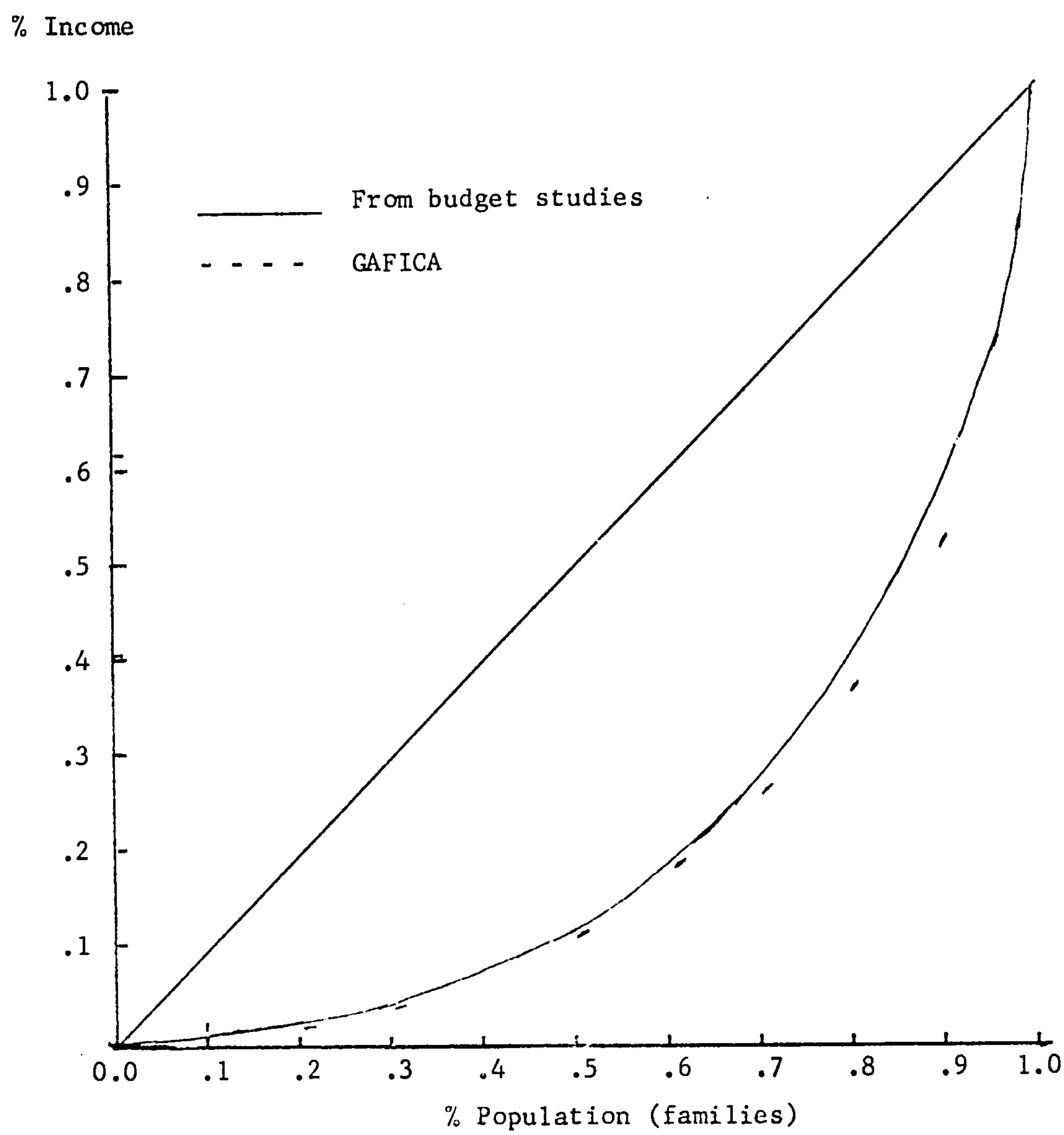

Figure 2.1. Comparison of Lorenz curves derived from GAFICA and budget study data.

of income at higher levels of income than the budget study data. The fact that the methods used to calculate these distributions (i.e., random sampling and analysis of reported wage data) are different but give similar results increases our confidence in these estimates.

The fact that 50% of the families in Guatemala receive only about 13% of total income while the richest 5% of families receive about 30% indicates a high degree of income inequality. This is even more evident when income distribution data from Guatemala is compared with that of other countries. Figure (2.2) shows the Lorenz curves for Guatemala, Great Britain, the United States, Brazil and Mexico. The poorest 50% of families in the United States and Great Britain receive 23.0% and 26% of total income respectively, while the top 5% receive about 18% and 13% respectively.

Another measure of inequality of income, which is related to the Lorenz curve is called the Gini Coefficient. The Gini Coefficient is a summary statistic, which is used to measure the inequality of income distribution, that is calculated by taking the ratio of the area between the Lorenz curve and the 45° line of perfect income equality. The value of this coefficient ranges from 0.0 - 1.0 where a value of 0.0 and 1.0 indicates perfect income equality and perfect inequality respectively. Table (2.3) presents the Gini Coefficients for Guatemala and other countries which gives some basis of comparison.

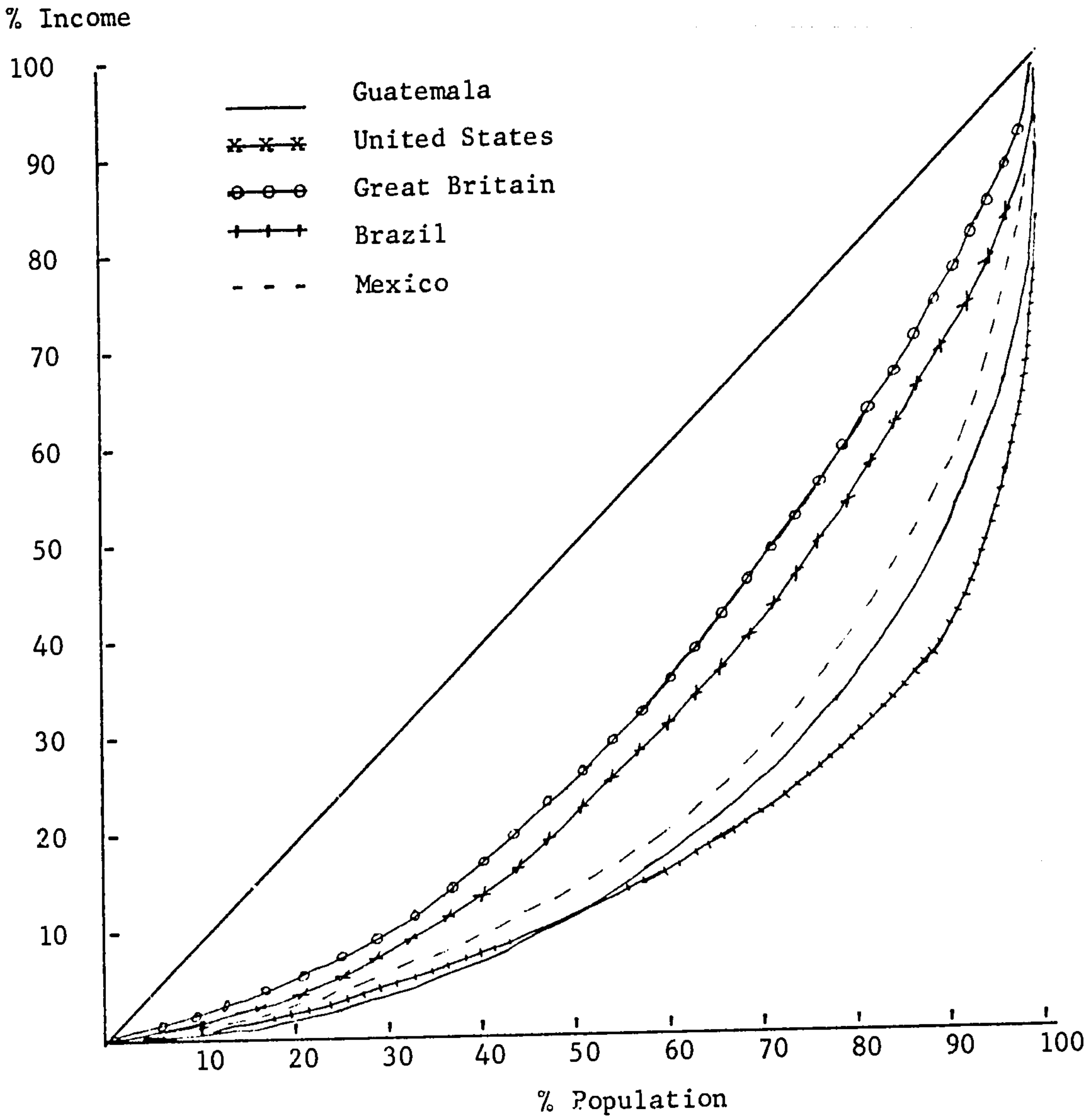

Figure 2.2. Lorenz curves for Guatemala,[a] United States and Great Britain.

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[a]Using GAFICA data

Source: Guatemala: GAFICA [25].
United States: Cline [4].
Great Britain: Cline [4].

TABLE 2.3. Gini coefficients of income concentration by country.

	G
Guatemala	0.58[a]
Mexico	0.53[b]
Brazil	0.57[c]
United Kingdom	0.40[c]
United States	0.40[c]
Norway	0.36[c]

[a]GAFICA [25].
[b]Cline [4].
[c]Thorbecke and Sengupta [24].

The Distribution of Land

Faced with the fact of a high degree of inequality in the distribution of income in Guatemala one turns to the question of what factors influence the distribution of income in Guatemala. This question, of course, would be very difficult to answer completely and indeed could be the subject of another dissertation. However, one outstanding characteristic of Guatemala, which is not unique among Central and Latin American countries should shed considerable light on this question. This characteristic is the highly unequal distribution of land.

Distribution of land becomes even more important in explaining the distribution of income when one considers that 68.2% and 65.4% of the total labor force was employed in agriculture in 1950 and 1964 respectively [5].

Table (2.4) presents the number and size of farms according to the 1964 agricultural census [6].

TABLE 2.4 Guatemala: number and size of farms, 1964.

Farm size class	Number of farms	% of farms	Area	Percent of land	Average size
Less than 0.70 ha[a]	85,083	20.0	32,619.2	0.9	.38
From 0.70 to 6.99 ha	279,797	67.0	607,855.6	17.7	2.17
From 6.99 to 45.13 ha	43,656	10.0	648,900.2	18.8	14.86
45.13 to 902.51 ha	8,420	2.0	1,258,545.2	36.6	149.47
More than 902.51 ha	388	0.9	894,600.4	26.0	2,305.67
Totals	417,344	100.0	3,442,520.6	100.0	8.25

[a]1 ha (hectare) $\cong$ 2.5 acres.

Farm sizes are grouped together in a clarification scheme used in the Agriculture Census and also United Nations reports. This scheme classifies farm size relative to ability to fully employ an average farm family productively during the year. The word productively is important here because obviously an entire family may work on the finca when one man could handle the work alone. In this case the marginal productivity of the other family members would be equal to zero.

According to this scheme any farm less than 6.99 hectares would be classified a subfamily farm, too small to sustain a family (less than two laborers).[1] Farms of size 7 to 45 hectares are classified as family size farms. Farms of size 45.1 to 902.51 and greater than 902.50 hectares are classified medium and large multi-family farms respectively [11].

Subfamily farms, or what will be referred to as the traditional or subsistence sector throughout this paper, account for 87.0% of all farms while accounting for only 18.6% of the land while 388 or 0.9% of the largest fincas possess 26.0% of the land. It is apparent that the distribution of land is even more skewed than the distribution of income.

Economic and Cultural Dualism

The most important economic sector of Guatemala is the export agriculture sector which produces mainly coffee, cotton, and bananas. There is strong evidence that the prime factor influencing investment in Guatemala is the performance of this sector, and has led to Guatemala's economy being classified as an "export led" economy [7]. Most of the

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[1]There are exceptions to this rule. For example, one vegetable farm of one hectare can generally fully employ a family. However, much of the traditional agriculture can be characterized as "milpa" farming, which is growing mainly corn and squash and beans planted in the rows with the corn. Also wheat is grown in many areas and is virtually the only "cash crop" of the highland Indian. These crops are less labor intensive than vegetable farming and much more common so the classification scheme used is probably quite realistic.

export products which are produced come from the large plantation type farms. It is this group which though relatively small in number takes a large share of the land holdings. Over the period of 1950-1966 export crop production grew at a rate of 6.6% while production of domestic consumption crops grew at a rate of 4.1%.

It is the existence of this dynamic modern agricultural subsector existing side by side with the small traditional agricultural subsector which enables Guatemala to be classified as the "prototype" of a dual economy [7]. With approximately 56% of the population in the subsistence agriculture sector and many more extremely poor in the large cities who came from this sector because of lack of employment opportunities one must conclude that the distribution of ownership of land is an extremely important factor influencing the overall distribution of income and wealth. According to Adams "whether one is a subsistence farmer on his own or rented land, an agricultural laborer on a coffee or cotton farm, or an upper-sector entrepreneur looking for a prestigious and profitable investment, land is the base. One of the major problems of access to wealth is simply getting access to land" [1].

As in any capitalist economy the distribution of wealth not only affects the distribution of income directly through the rate of return on wealth but also indirectly through influencing social and cultural factors which have an affect on the distribution of income in the longer run. It was hypothesized (and accepted) by Manger-Cats [10]

> . . . that most power is concentrated in the hands of those who control the land or are intimately connected with this group, and that this results in a social order in which primary producers have no effective opportunities for decision making or for acquiring the capacities for making rational decisions.

He concludes

> . . . that the present land tenure structure of Guatemala is part of a complex matrix of social and cultural factors which tend to obstruct the economic and social development of the country.

In his study Manger-Cats comes to two important conclusions related to the relationship between land ownership and socio-political factors which have long-run effects on income distribution:

> The access to public and private services, including education, technical services, transportation facilities, credit and the like increases with the size of holdings.
>
> The majority of those with low incomes, little education, limited resources and access to few services are politically powerless, or at least inactive, particularly at the national level but even largely so at the local level...[10].

We then have a vicious circle where the distribution of income determines access to more wealth particularly land which in turn influences the distribution of political power and the means of increasing human wealth such as education. Also the access to important factors such as credit and technical assistance are affected. These factors then influence the distribution of income both in the long and short-run.

In light of the above arguments it seems reasonable to conclude that any policy aimed at improving the lives of all Guatemalans and at bringing about a more equitable distribution of income, at least in the long run, will have to come to grips with the problems which are associated with the land tenure system.

CHAPTER III. A METHOD FOR MEASURING THE GROWTH EFFECTS OF A MORE EQUAL DISTRIBUTION OF INCOME IN GUATEMALA

The Method

A three sector linear macroeconomic model is used to measure the effects of a more equal distribution of income. The model is basically Keynesian with no financial variables.[1] All variables are expressed as real values in terms of 1958 prices.

No price adjustment mechanisms are included in the model. There are essentially two types of goods, food and nonfood. It is, therefore, assumed that the own and cross price elasticities between these two types of goods are sufficiently small to warrant the assumption that relative movements of prices will have no effect on the real values of the variables in the model. Allocation of demand for food between the two agricultural subsectors (traditional and commercial) is accomplished in the model using parameters which reflect the present marketing structure in Guatemala (this will be explained later). Also any effects resulting from an increase in the general price level, such as the real balance effect, are not taken into account by the model.

Consumption functions are specified by sector and income level so that the marginal propensity to consume can vary according to sector as well as income level. A linear programming approach will be used to

[1]Not including interest rates in the model should pose no theoretical problems because of the financial system in Guatemala. Interest rates are fixed by the monetary authority and have not been changed in ten years. Therefore, interest rates play no role in discretionary monetary policy. No capital market exists where funds for investment can be raised through the issue of stocks and bonds. Therefore, any model based on a portfolio adjustment mechanism where changes in the money supply affect the relative cost of capital and, therefore, investment would not apply in this case.

allocate investment and, therefore, savings among the sectors. The total amount of savings generated will depend upon government taxation, the consumption functions, and the inflow of foreign capital. Investment in period t will increase capacity of each sector in the same period assuming instantaneous and, therefore, costless adjustment in response to increases in demand.

The objective will be to maximize GDP or a weighted sum of sectoral outputs (different weighting schemes will simulate different policy emphases for the different sectors). Savings and investment will be allocated in such a way as to maximize income while satisfying demand and capacity constraints. Allocation of investment and savings not only will depend upon the incremental output--capital ratios for the sectors but also will depend upon demand for the products produced by the sectors. Changing the distribution of income will effect the total amount of savings available for investment, the total demand for consumption goods, and the composition of consumption demand (at least between food and nonfood goods). In this framework both the savings and demand effects will be working simultaneously and the net effects can be observed.

The trade-off between income in the traditional sector and income in the rest of the economy will be measured by using a slightly modified ofjective function.

Let $W = \delta_1 Y_T^P + \delta_2 Y_R^P$

where:

Y_T^P = production in the traditional sector

Y_R^P = production in the rest of the economy

δ_i = constant weight attached to sector i

also let:

$\Sigma \delta_i = 1$

Optimizing the model at various values of δ_i[1] so that the slope of the objective function ranges from zero to infinity will trace out the transformation surface or feasible region in terms of Y_T^P and Y_R^P . If the slope of this curve is negative, a trade-off exists and the measure of the trade-off will be the slope of the curve or the arc elasticity.

Maximizing GDP and deriving the trade-off curve for some base year will result in what will be referred to as base solutions. The results of simulated changes in the distribution of income will be compared with these base solutions. In order to obtain data for the exogenous variables for the base runs data for the year 1964 was chosen. This can almost be an arbitrary decision because only comparison of results with the base runs is important not the ability to predict actual values of the

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[1] If W can be defined as a total social welfare in Guatemala, then δ_i is the increment to welfare resulting from a one unit increase in production for sector i. Even if the form of the function were correct it would be impossible to determine the value of the δ_i's for the society. What emerges is the implicit welfare function of the people who hold the power, and the weights (δ_i's) are determined by their preferences. Because, peasants have little power or access to power it is likely that the actual values of δ_1 and δ_2 would show that $\delta_2 \geq \delta_1$. This does not necessarily mean that there is a conscious effort to discriminate against the traditional sector, but the structure of the society and the allocation of wealth which have been determined not only by economic forces results in this type of weighting scheme. What is implied is that a concerted effort by policy makers must be made to shift the weighting structure to favor the traditional sector if the gap between income in the traditional sector and in the rest of the economy is to be closed.

endogenous variables. However, it was felt that since the census data was official for 1964, and 1964 was close to the dates of the budget studies and other studies used, it would be a reasonable choice.

In summary, a linear programming model is used to allocate investment and savings in order to maximize GDP and derive a trade-off curve. This is done once with the actual estimates of the parameters to obtain the base solutions. Income redistribution experiments are then carried out by changing the consumption parameters and by simulating lump sum transfers. The effects of these changes and transfers on the optimal GDP and the transformation curves are observed. These changes should then help answer the questions stated in the introduction:

(1) What is the net cost in terms of sacrificed overall GDP or income in the rest of the economy of increasing output in the traditional sector?

(2) What are the net effects in terms of the savings and demand effects of a non-equal distribution of income within sectors?

Identification of the Sectors

The model will include three sectors: traditional agriculture, commercial agriculture, and non-agriculture. A sector will be more than an income and production concept but a cultural one as well. Although the lines between these sectors are not distinct, the two agricultural subsectors can be delineated geographically. The map shown in Figure (3.1) shows five major geographical regions in Guatemala. The north and northeast regions are lowland areas consisting of jungle. The approximate percentage of the total population for this region in 1964 was 3.2.

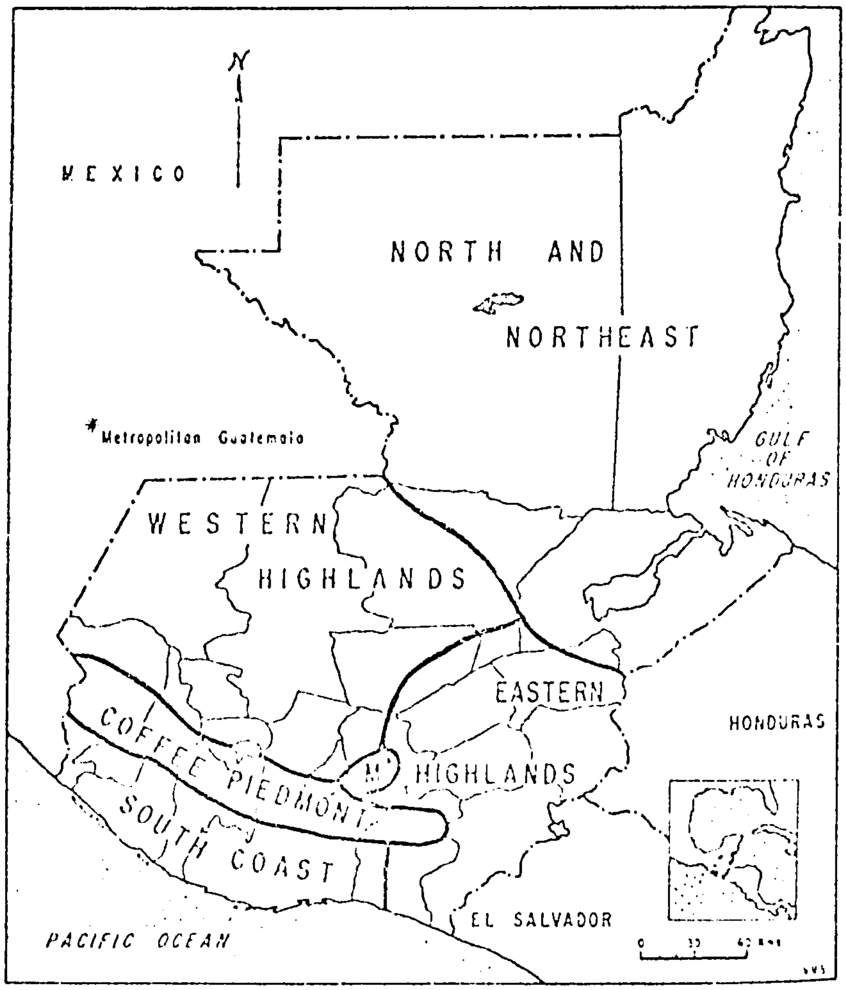

Figure 3.1. Major geographical regions of Guatemala.

Source: Adams [1] .

This region is relatively unimportant as far as agriculture is concerned. The western highlands, which is often called the Indian Highlands, is comprised mainly of small land holdings. The majority of the population is Indian, and indeed several departments in this region have over 90 percent Indian populations. The eastern highlands differ from the western highlands in that the population density is much less. Instead of a predominance of small land holdings, the eastern highlands have a much broader spectrum of small, middle-sized, and large producers. The percentage of Indians in this region is less than 50 percent of the total population in the region. There are, therefore, significant cultural differences between these two regions. The coffee piedmont consists of an area along the south slopes of the mountain range running through the central part of Guatemala. This land is most suited to growing coffee and it is here where most of the large coffee fincas are located. It is to this region that most of the seasonal migration of farm laborers from the western highland occurs. The south coast is tropical sea level land where sugar cane and cotton are most important. The remaining region consists of metropolitan Guatemala, Guatemala City being the capital of the republic [1]. The three sectors of the model will now be rigorously defined. It is necessary to delineate the sectors as rigorously as possible in order to estimate the parameters of the model for these sectors.

The Traditional Sector

The traditional sector is defined as consisting of all families who operate farms classified as subfamily size farms, which account for about 87 percent of all farms in Guatemala (364,879 farms according to the 1964 agricultural census). It will be recalled that subfamily size farms are defined to be those less than 7 hectares in size. Most of these small farms are found in the western highlands of Guatemala. Indeed if one were forced to locate the traditional sector geographically, the western highlands would be the most accurate choice both because of the high concentration of small farms and also because of the high proportion of Indians living in this region. These two factors distinguish the western highlands in both an economic and cultural sense.

In addition to these people another group of families, who have no land but would be of the same cultural class, are included in the traditional sector. These families are officially denoted "trabajadores sin tierra" or workers without land who work principally on the large farms. There were about 68,700 families in this category in 1964.

Obtaining an estimate of income per family for this sector is very difficult. No data is published officially by the government or its agencies so the only information available is from surveys taken by individuals or private groups. Sebald Manger-Cats [10] estimates the average per family income of the minifundista in the western highlands at about Q520.00[1] per year. This includes income both in kind and in specie and also from sources outside the farm. He estimates the income

[1] 1 Q (Quetzal) = $1.00.

per family for traditional farms on the coastal plain to be about Q967.00. Although the average area of the minifundia in the lowlands was nearly twice that of those of the highlands, the value of products is about three times as high on the coastal farms. He attributes this more than proportional difference to better soils and good climatic conditions. However, according to the 1964 census of agriculture there were only about 30,000 subfamily size farms in the south coastal region accounting for about 12% of the total number of subfamily farms. Therefore, taking a weighted average based on these weights gives an average per family income of Q573 for the sector as a whole (taking into account the laborers without land the average would be slightly less). However, another study (IDESAC)[14] presents a less optimistic estimate of Q258.00 per family for highland Indian families. However, the average size of farms in this study was 1.2 hectares while for the former study it was 2.14 hectares (1.82 for highlands and 3.23 for coastal plain). The national average size for subfamily farms was 1.86 hectares. The sample by Manger-Cats seems to be more representative of the actual farm size of this sector. Therefore, with the difference in size of farms in the two studies taken into account the lower figure given in the IDESAC study is probably not inconsistent with the Manger-Cats estimate. For purposes of this study the per family income for the traditional sector will be assumed to be equal to approximately Q500.00.

The traditional sector will be assumed homogenous with respect to the marginal propensity to consume (i.e., marginal propensity to consume will be assumed constant for all levels of income in the traditional sector).

The Commercial Agriculture Sector

The commercial agriculture sector will be divided into three subsectors by farm size or income strata. These three subsectors are: (1) family size farms, 7.1 - 45 hectares; (2) small multi-family farms, 45.1 - 896 hectares and (3) large multi-family farms, greater than 896 hectares. Average per-family income will be assumed to be Q1600.00, Q700.00, and Q30,000 for each group respectively.[1] Also to be included in the income of this sector will be income derived from "produccion pecuaria" which includes such products as eggs, milk, wool, honey, and bees wax. Also income from cattle and other animals will be included. Because of lack of data on the income distribution of these activities we will simply assume that income is distributed from these activities in the same proportion as the income from crops. While it is more difficult to locate this sector geographically it is safe to say that most of the large farms producing export crops are located in the coffee piedmont and south coastal regions.

The Nonagricultural Sector

The nonagricultural sector will be defined as all nonagricultural sectors of the economy including government and services. This sector will be divided into ten income strata in accordance with the urban budget study referred to earlier [16].

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[1]These estimates are consistent with the study by Manger-Cats.

There are three important interactions which take place among these three sectors of the model: (1) seasonal movements of labor from the traditional sector (mainly the western highlands) to the large commercial farms, in the coffee piedmont or south coastal plains, (2) mutual demand for goods produced by each sector, and (3) interregional flows of savings.

Each year more than 200,000 cultivators of small plots supplement their incomes by working on the large farms on a seasonal basis [19]. In addition to the seasonal workers are the permanent workers which are the workers without land and the "mozos colonos". Mozos colonos are permanent workers on the large fincas who have been given small plots of land to work for themselves in addition to working the large finca. Both of these latter groups are included in the traditional sectors.

According to Schmid [19] there is some complementarity between employment in the subsistence sector and in the commercial agriculture sector especially for the coffee harvest. By complementarity it is meant that the seasonal demand for workers by the commercial sector does not conflict with planting or harvesting periods in the traditional sector.

According to Schmid if the average migratory worker has only one hectare of land at his disposal, which was the case in his study, he works about 52 days on his home farm. This would leave about 300 days per year available for nonfarm employment. The workers interviewed in his study worked an average of 101 days on the large farms. This would appear to leave workers with 150 days for which they do not take employment. If this conclusion is correct and if workers are willing to work for longer periods of time at the set wage rate, then an assumption of a perfectly elastic supply of labor (at least over a wide range) in this market seems justified. To quote Schmid:

> . . . to the extent that the hiring of labor from the subsistence farms takes place during the slack season on the farms, the supply of labor, in Guatemala can be considered to be unlimited.

This assumption will be employed in the model.

The mutual demand relationships and interregional flows of savings are of central importance to this study because the distribution of income is both affected by and in turn affects these variables. Unfortunately no data exists for these relationships but it is hoped that the model and results to follow will shed some light on these relationships.

The Model

The variables and parameters specified separately for each region are defined as follows:

<u>Endogenous variables</u>

Y_i = total income for sector i $\qquad$ i = T, A, N

where

T = traditional sector

A = commercial agriculture sector

N = non-agriculture sector

Y_i^P = total production in sector i

Y_T^A = total income received from the commercial agriculture sector by agricultural laborers in the traditional sector

Y_T^N = total income received by the traditional sector from non-agricultural sources

L_T = total number of man days of agricultural labor required by the commercial agriculture sector

C_i^j = total demand of sector j for commodities of type i

C_{RN}^N = portion of expenditures on food by the nonagricultural sector which goes to the nonagricultural sector itself

C_A = total consumption demand for agricultural goods produced by the commercial agricultural sector

C_N = total consumption demand for nonagricultural goods

M_A = imports of agricultural commodities

M_N = imports of nonagricultural consumer goods

I_m^i = imports of investment goods by sector i

y_i = personal disposable income of sector i

C_R^i = total consumption demand by the ith sector for food

I = total investment demand

I_i = total investment demand by sector i

T_n = total net tax revenue

T_i^I = total net indirect taxes collected from sector i

T_i^D = total net direct taxes collected from sector i

S_g = total government savings

S_g^i = total government savings allocated to sector i

$(f_i - f'_i)$ = net flow of savings to sector i

Exogenous or predetermined variables

$\bar{C}^i_q$ = government consumption of goods and services from sector i

$\bar{X}_i$ = exports of goods and services from sector i

$\bar{T}^r_i$ = net government transfers to sector i

$\bar{F}$ = net inflow of foreign capital

$\bar{Q}^i_{t-1}$ = capacity output in period t-1 of sector i

Parameters

w = average wage rate paid to agricultural laborers working in the commercial agriculture sector per man day

e_1 = number of man days of agricultural labor (unskilled) required to produce one dollar (in constant dollars) of output in the traditional sector

e_2 = proportion of total income in the traditional sector which comes from nonagricultural sources

$\alpha^i_{R\ell}$ = autonomous consumption expenditures on food by the ℓth income group of the ith sector

$c^i_{R\ell}$ = marginal propensity to consume food by the ℓth income group

$\alpha^i_{N\ell}$ = autonomous consumption expenditures on nonfood goods and services by the ℓth income group of the ith sector

$c^i_{N\ell}$ = marginal propensity to consume nonfood goods and services by the ℓth income group of the ith sector

$\lambda_{i\ell}$ = proportion of total income of sector i which is in income level ℓ

β = proportion of total demand for food by the commercial agriculture sector which is satisfied by the commercial agriculture sector itself

ϵ = proportion of total demand for food by the nonagriculture sector which is satisfied by the commercial agriculture sector

α = proportion of total expenditures on food by the nonagricultural sector which accrues to the nonagriculture sector itself

m_A = proportion of agricultural goods consumed which are imported

m_N = proportion of nonagricultural consumption goods which are imported

m_I = proportion of investment goods which are imported

t^I = average indirect tax rate

t^D = average direct tax rate

γ_i = incremental output-capital ratio for sector i

The equations

Total income for the traditional sector is the sum of income received from production of crops, from agricultural labor in the commercial agricultural sector, and from nonagricultural activities.

$$Y_T = Y_T^P + Y_T^A + Y_T^N \qquad [1]$$

Income from working as an agricultural laborer is given by equation [2] where w is the average wage rate per man day worked on a commercial farm.

$$Y_T^A = w\, L_T \qquad [2]$$

The total number of man days worked, L_T, is assumed to be a function of production in the commercial agricultural sector and is given by equation [3] where e_1 is the man days required to produce a one dollar of output (in constant 1958 dollars).

$$L_T = e_1 Y_A^P \qquad [3]$$

This (equations [2] and [3]) implies a perfectly elastic supply of labor from the traditional sector to the commercial agriculture sector. This assumption is consistent with the concept of a seasonal labor surplus discussed earlier in the chapter.

Income received from the nonagriculture sector is assumed to be a certain fraction of total income for the traditional sector. This relationship, given in equation [4], is not intended to be a behavioral function but merely an accounting mechanism to account for the fact that a certain percentage of the income of traditional farmers comes from nonagricultural sources. To the extent that these traditional farmers spend their income differently than their urban counterparts at the same level of income, this relationship will make a difference. Otherwise this income could be left in the nonagriculture sector and there would be no net effect on total aggregate demand.

$$Y_T^N = e_2 Y_T \qquad [4]$$

Equations [5] and [6] are accounting relationships to account for the transfer of income from the commercial agriculture and nonagricultural sectors, respectively, resulting from the activities discussed above.

$$Y_A = Y_A^P - Y_T^A \qquad [5]$$

$$Y_N = Y_N^P - Y_T^N \qquad [6]$$

We will now assume that output in the three sectors is constrained by demand for the produce of each sector. Equations [7] through [9] express these relationships.

$$Y_T^P \leq C_T^T + C_T^A + C_T^N + \overline{C}_g^T \qquad [7]$$

$$Y_A^P \leq C_A^T + C_A^A + C_A^N + \overline{C}_g^A + \overline{X}_A - M_A \qquad [8]$$

$$Y_N^P \leq C_N^T + C_N^A + C_N^N + C_{RN}^N + \overline{C}_g^N + I + \overline{X}_N - M_N - I_M^T - I_M^A - I_M^N \qquad [9]$$

Implicit in the above relationships are the assumptions:

(a) The traditional sector does not export any of its output to the rest of the world.

(b) Imports of agricultural goods are assumed to be competing with output produced by the commercial agriculture sector only and not the traditional sector.

(c) All investment goods are produced by the nonagricultural sector.

According to the hypothesis being tested changes in the distribution of income will have their primary effect on consumption. Therefore, the following consumption functions given below are critical to the analysis. These are given by equations [10] through [15]. The form of the above consumption functions is important with respect to the distribution of income. ℓ in each sector designates the income strata of each sector. The traditional sector consists of one income group while the commercial agricultural and nonagricultural sectors have 3 and 10 income strata respectively. To obtain the consumption function for the entire sector the consumption functions for the various income stratum are summed over ℓ. $\lambda_{i\ell}$ is the proportion of total sectoral income found in the $\underline{\ell}$th income strata of sector i, and, therefore, reflects the distribution of income. Therefore, assuming the distribution population fixed for each strata, changing the $\lambda_{i\ell}$'s will be equivalent to assuming a different income distribution. It is through changing the parameters, $\lambda_{i\ell}$, that changes in intrasectoral distribution of income are simulated.

First, it is observed that the traditional sector consumes most of its own output except for some output such as wheat which is sold outside the sector. Let us assume that the traditional sector is self-sufficient in the production of food. Therefore, let C_T^T, the total consumption of food by the traditional sector, be expressed as a residual of total production and sales to the other sectors and government. This is given by equation [10].

$$C_T^T = Y_T^P - C_T^A - C_T^N - \bar{C}_g^T \qquad [10]$$

The remaining consumption equations are given below.

$$C_R^A = \sum_\ell \alpha_{R\ell}^A + \sum_\ell c_{RL}^A \lambda_{A\ell} y_A \qquad \ell = 1, 2, 3 \qquad [11]$$

$$\bar{C}_R^N = \sum_\ell \alpha_{R\ell}^N + \sum_\ell c_{R\ell}^N \lambda_{N\ell} y_N \qquad \ell = 1, 2, \ldots, 10 \qquad [12]$$

$$C_N^T = \sum_\ell \alpha_{N\ell}^T + \sum_\ell c_N^T \lambda_{T\ell} y_T \qquad \ell = 1 \qquad [13]$$

$$C_N^A = \sum_\ell \alpha_{N\ell}^A + \sum_\ell c_{N\ell}^A \lambda_{A\ell} y_A \qquad \ell = 1, 2, 3 \qquad [14]$$

$$C_N^N = \sum_{\ell} \alpha_{N\ell}^N + \sum_{\ell} c_{N\ell}^N \lambda_{N\ell} y_N \qquad \ell = 1, 2, \ldots, 10 \qquad [15]$$

The above consumption functions are for agricultural output in general but do not specify from which agricultural subsector (traditional or commercial) the agricultural output will be purchased (with the exception of the traditional sector where $C_T^T = C_R^T$ and $C_A^T = 0$).

Demand for agricultural output is allocated between the two agricultural sectors by the following equations.

$$C_A^A = \beta\, C_R^A \qquad 0 \le \beta \le 1 \qquad [16]$$

$$C_T^A = (1-\beta)\, C_R^A \qquad [17]$$

$$C_T^N = \epsilon\, C_R^N \qquad 0 \le \epsilon \le 1 \qquad [18]$$

$$C_A^N = (1-\epsilon)\, C_R^N \qquad [19]$$

Another problem which must be dealt with is the problem of translating final demand for agricultural products into actual income to the agricultural sectors. In other words final demand as measured in the data includes value added by the nonagricultural sector from such nonagricultural activities as transportation and retailing. Two simplifying assumptions are made. First, it is assumed that demand measured by expenditures for food products by the agricultural sectors (both traditional and commercial) goes directly to the agricultural sectors themselves. In the case of the traditional sector this is realistic in that the producer (or his family) markets his own produce in the local market places or the food is consumed directly by the family. In the case of commercial agriculture the assumption at least implies that value added to agricultural products if not kept within the same family is at least kept within the sector itself. There is also the implication that rural people eat very little "processed" foods. This may not be true of the owners of the large fincas who may spend all or most of their time in the capital, but they are relatively few in number. Second, it is assumed that final consumption demand by the nonagricultural sector, or basically the urban sector, can be divided into a portion that goes to the nonagricultural sector and a portion that goes back to the agricultural sectors. Equations [20] and [21] allocates urban demand for food to the nonagricultural and agricultural sectors respectively. Equation [20] expresses the portion of demand for food which goes to the nonagricultural sector as a constant proportion of total demand for food, $\overline{C}_R^N$

$$C_{RN}^N = \alpha \overline{C}_R^N \qquad [20]$$

Therefore, we have for urban demand for products produced by the agriculture sector at approximate "farm gate" prices the following relation relation.

$$C_R^N = \overline{C}_R^N - C_{RN}^N \qquad [21]$$

The data used to estimate the consumption functions express family income excluding direct taxes but including indirect taxes. Consumption expenditures include indirect taxes. Therefore y_T, y_A, y_N are equal to gross income minus direct taxes plus transfer payments. This is expressed by equations [22] through [24].

$$y_T = Y_T + \overline{T}_T^r \qquad [22]$$

$$y_A = Y_A - T_A^D + \overline{T}_A^r \qquad [23]$$

$$y_N = Y_N - T_N^D + \overline{T}_N^r \qquad [24]$$

Equation [22] implies that the traditional sector pays no direct taxes. Given the difficulty of collecting the tax from the traditional farmers and also considering the level of their income this seems to be a reasonable assumption.

Total investment demand is the sum of investment in the three sectors. This is given by equation [25].

$$I = I_T + I_A + I_N \qquad [25]$$

To account for imports it is specified that the demand for imports is a constant proportion of consumption and investment expenditures. Further, we will assume that the proportion of total demand for a good that is import demand depends on the type of good. We distinguish between three types of goods: (1) agricultural goods, (2) nonagriculture consumer goods and (3) investment goods.

Assuming that imports of food do not compete with products produced by the traditional sector let

$$C_A = C_A^T + C_A^A + C_A^N \qquad [26]$$

so that

$$M_A = m_A C_A \qquad [27]$$

Let total consumption of nonagricultural goods be given by

$$C_N = C_N^T + C_N^A + C_N^N + C_{RN}^N \qquad [28]$$

so that

$$M_N = m_N C_N \qquad [29]$$

The import functions for investment goods are given by equations [30] through [32].

$$I_M^T = m_I \, I_T \qquad [30]$$

$$I_M^A = m_I \, I_A \qquad [31]$$

$$I_M^N = m_I \, I_N \qquad [32]$$

Indirect taxes and direct taxes are specified by equations [33] to [35] and [36] [37] respectively.

$$T_T^I = t^I \, Y_T \qquad [33]$$

$$T_A^I = t^I \, Y_A \qquad [34]$$

$$T_N^I = t^I \, Y_N \qquad [35]$$

$$T_A^D = t^D \, Y_A \qquad [36]$$

$$T_N^D = t^D \, Y_N \qquad [37]$$

The following identities express total net taxes and government savings respectively.

$$T_n = T_T^I + T_A^I + T_N^I + T_A^b - \bar{T}_T^r - \bar{T}_A^r - \bar{T}_N^r \qquad [38]$$

$$S_g = T_n - \bar{C}_g^T - \bar{C}_g^A - \bar{C}_g^N \qquad [39]$$

Private savings by sector are defined by the following expressions.

$$S_T^P = y_T - T_T^I - C_T^T - C_A^T - C_N^T \qquad [40]$$

$$S_A^P = y_A - T_A^I - C_T^A - C_A^A - C_N^A \qquad [41]$$

$$S_N^P = {}_N - T_N^I - C_T^N - C_A^N - C_N^N - C_{RN}^N \qquad [42]$$

Indirect taxes are subtracted out of each of the equations because y_T, y_A, and y_N were not net of indirect sales taxes.

The programming model allocates total government savings among the three sectors. Therefore, let:

$$S_g^T + S_g^A + S_g^N = S_g \qquad [43]$$

Total gross production in each of the sectors is less than or equal to capacity in each sector. Capacity will be determined by the capacity of the previous period plus any addition to capacity resulting from gross investment in the current period. The increase in capacity resulting from investment will be equal to the incremental output-capital ratio for each sector multiplied by the total amount of gross investment that takes place in that sector. These relationships are expressed by the following inequalities.

$$Y_T^P \leq \bar{Q}_{t-1}^T + \gamma_T I_T \qquad [44]$$

$$Y_A^P \leq \bar{Q}_{t-1}^A + \gamma_A I_A \qquad [45]$$

$$Y_N^P \leq \bar{Q}_{t-1}^N + \gamma_N I_N \qquad [46]$$

Total imports must be less than or equal to the amount of foreign exchange earned by exports plus the net inflow of foreign capital F. This is expressed by [47].

$$M_A + M_N + I_M^T + I_M^A + I_M^N \leq \bar{F} + \bar{X}_A + \bar{X}_N \qquad [47]$$

Foreign capital, $\overline{F}$, and exports, $\overline{X}_A + \overline{X}_N$, are assumed to be exogenously determined and are not determined by the model.

There are three sources of savings for the economy as a whole. These are (a) private savings expressed by equations [38] to [40], (b) public savings given by [37], and (c) net foreign flows of capital $\overline{F}$. For a particular sector the sources of savings are private savings generated within the sector itself, public savings that is allocated to that sector, and net inflows of savings from the other sectors. The sum of these net flows of savings to the different sectors can be greater than zero by the amount of foreign capital inflow. The mechanism by which the model handles intersectoral movements of capital will be discussed later.

Investment in each sector must be less than or equal to the total amount of savings available for that sector. Inequalities [46] to [48] express this relationship.

$$S_T^P + S_g^T + (f_T - f_T') \geq I_T \qquad [48]$$

$$S_A^P + S_{gt}^A + (f_A - f_A') \geq I_A \qquad [49]$$

$$S_N^P + S_g^N + (f_N - f_N') \geq I_N \qquad [50]$$

The term, $f_i - f_i'$, found in each investment constraint requires additional explanation. These terms are important because they allow intersectoral flows of savings. For example $(f_T - f_T')$ is the net flow of savings to the traditional sector from the other sectors, from abroad, or both. If the term, $f_T - f_T'$, is positive, then the net flow of savings to the traditional sector is positive. Likewise, if the term is negative, then the net flow of savings to the traditional sector is negative, or, savings are flowing out of the sector to the rest of the economy. The use of $(f_T - f'_T)$ instead of a composite variable say, f_T which could be either negative or positive is because of the restriction imposed by linear programming that all activities be greater than or equal to zero. Therefore, when the net flow of savings to a sector is negative, the program will choose a positive value of f'_i and f_i will not enter the optimal basis and f' will enter at a positive level making $(f_T - f'_T)$ negative.

The sum of the flows of savings to the various sectors must be equal to zero plus the net flow of foreign capital to the country. This constraint is given by equation [51].

$$(f_T - f'_T) + (f_A - f'_A) + (f_N - f'_N) = \bar{F} \qquad [51]$$

In order to make the model "tight" so that all savings are being utilized and that no excess demand or excess savings exist in any market or sector, the following equality must hold.

$$\sum_i Y_i^P = \sum_j \sum_i C_i^j + \sum_i C_g^i + \sum_i I_i + \sum X_i - \sum_i M_i - \sum_i I_m^i \qquad i = T, A, N \qquad j = T, A, N \qquad [52]$$

This forces total savings (private, public and foreign) to equal total investment. Also, the sum of excess demands for products produced by each of the sectors is equal to zero. We added the additional constraints of making equation [8] an equality. Equation [10] forces [7] to equality. Therefore equation [9] will be an equality because the sum of excess demands must be equal to zero. Further, equations [46] and [47] are forced to be equalities. Therefore, [48] must be an equality making the excess demand for savings in all sectors equal to zero.

The model allocates savings and investment among the various sectors in a way that maximizes the objective function subject to the total level of savings which comes from abroad or is generated by savings behavior and taxation policy within the country itself. Because the marginal propensities to consume are different for each sector and for each level of income within a sector, a change in the distribution of income will affect both the total level of savings and the level of savings within each sector. This in turn will affect both the total amount of investment and also the intersectoral flows of savings required to satisfy investment requirements in each sector. The investment requirement in a sector is a function of excess demand for goods produced by that particular sector. Therefore, a redistribution of income which will change both the total amount and the composition of consumption demand will also affect both total investment requirements and sectoral investment requirements. The model, therefore, captures both the savings and demand effects simultaneously. By comparing the results of running the model under the assumption of a more equal distribution of income to the "base solution" results, it will be possible to measure the net economic effects of a redistribution of income.

Estimation of the Parameters of the Model

Before beginning the discussion of the estimation of the parameters of the model a note regarding the general nature of the problem of estimating the parameters of this particular model seems in order. The data requirements of the model call for fairly disaggregated data in time series form. In general this data does not exist at the level of disaggregation required for some data and at no level of disaggregation for other data. The parameters were estimated using such sources as cross section budget studies for consumption parameters and results of studies done by other people using sample data. The basic problem was to find reasonable estimates for the parameters which are not only reasonable from a "micro" standpoint but, when applied in the model, result in estimates of values of the variables, when aggregated together, are consistent with national income account data. It was impossible to use two stage least squares or other simultaneous estimation techniques using data which is consistent with national income data to begin with and derive estimates of the parameters which would assure that the model be reasonably consistent with the national account data. However, it was possible to derive estimates of the parameters of the model which result in the model giving results which are reasonably in line with the official national account data.

The consumption functions

Data to estimate the consumption functions was obtained from two budget studies carried out by the Instituto de Investigaciones Economicas Y Sociales (IIES) at the University of San Carlos in Guatemala City.

During September 1966 to January 1967 a rural budget study was carried out which had a sample size of 1759 families and consisted of families which were defined as agricultural workers [15]. The study included rural families with incomes from Q100.00 to $3000 per annum. In 1969 a more extensive, in that the sample size was larger and the sampling techniques improved, budget study was carried out by the same institute and under direction of the same man which included urban families from the five largest cities of Guatemala [16], Guatemala City, Quezaltenango, Puerto Barrios, Jutiapa, Esquintla. The study included urban families with incomes that ranged from Q100.00 to more than Q10,000.00 per year.

It was felt that using both of the studies would give a representative sample of people at all levels of income as well as the rural and urban components of the population.

The basic methodology used to estimate the parameters of the consumption functions by sector and level of income is as follows. It was assumed that income in the traditional sector and the bottom sector (family size farms) of the commercial agriculture sector was spent as rural income. Income from the rest of the commercial agricultural sector and the nonagricultural sector was assumed to be spend as urban income. Therefore, the rural and urban budget studies were used to estimate consumption functions for these two basic groups. The budget studies give family consumption expenditures and average income for 23 and 20 income groups for the rural and urban studies respectively. Consumption functions for food and nonfood were estimated using income and consumption data at the different levels of income giving 23 observations for the rural functions and 20 observations for the urban functions. The consumption functions fit were of the form $C = a + by + cy^2$. Since the marginal propensity to consume is given by $b + 2cy$ the sufficient condition for a falling marginal propensity to consume as income rises is that c be negative. However, since the model is linear it was necessary to express the quadratic consumption function as a series of linear segments. This was done by dividing rural and urban income into income groups corresponding to the different levels of income specified for income distribution purposes. The marginal propensity to consume and intercept term was calculated at the mean income for that particular income group. This resulted in the estimates of $c^j_{i\ell}$ and $\alpha^j_{i\ell}$ for all i, j and ℓ.

The original raw data for the budget studies was not available. The consumption and income data were in terms of group averages for each income level. This would not necessarily present a problem but in this case the number of observations in each group is different. Therefore, the model is of the form:

$$\bar{y} = \beta \bar{X} + \bar{U}$$

where:

$\bar{y}$ and $\bar{X}$ are group means of the dependent and independent variables respectively.

$\bar{U}$ is the average error for each group.

Therefore, if $U \sim (0, I\sigma^2)$

then $\bar{U} \sim (0, V\sigma^2)$

where:

$$V = \begin{pmatrix} \frac{1}{n_1} & & & \\ & \frac{1}{n_2} & & \\ & & \ddots & \\ & & & \frac{1}{n_i} \end{pmatrix}$$

When the n_i are not the same, heteroscedasticity results and ordinary least squares will result in biased estimates of the standard errors of the coefficients. To eliminate this problem, weighted least squares was used. The variables of the model were transformed by pre-multiplying by the following diagonal matrix:

$$\begin{pmatrix} \sqrt{n_1} & & & \\ & \sqrt{n_2} & & 0 \\ & & \ddots & \\ & 0 & & \sqrt{n_i} \end{pmatrix}$$

The results of fitting the above polynomial using the rural data for food and nonfood respectively are given below. The standard deviation of the estimate of a coefficient is given in parentheses below the coefficient. The t statistic is reported below the standard deviation.

For total consumption we have:

$$\begin{array}{ccccccc} C & = & 90.36 & + & 0.9279\gamma & - & 0.00014\gamma^2 \\ & & (18.07) & & (.0249) & & (.000011) \\ & & 7.68 & & 19.52 & & -6.40^{1} \end{array}$$

Since the same independent variable appears in both equations the consumption of nonfood goods and services can be found by subtracting

---

[1] Indicates the estimate is significantly different than zero at the 0.01 level.

the values of the parameters of the consumption function for food from the respective parameters in the total consumption function. Therefore:

$$C_N = 12.50 + 0.4416Y - 0.00013Y^2$$

The results of fitting the polynominal consumption function for the urban data are presented below.

For total consumption we have:

$$\begin{array}{ccccc} C = & 46.16 & + 1.0299Y & - & 0.00002Y^2 \\ & (4.53) & (0.1182) & & (0.000008) \\ & 10.18 & 8.71 & & 2.29^1 \end{array}$$

For food we have:

$$\begin{array}{ccccc} C_R = & 278.49 & + 0.2673Y & - & 0.00001Y^2 \\ & (50.27) & (0.0233) & & (0.000001) \\ & 5.54 & 11.49 & & -5.99^1 \end{array}$$

Therefore for nonfood we have:

$$C_N = 232.33 + 0.7626Y - 0.00001Y^2$$

Since the coefficient, c, is significantly different from zero and negative in all cases we reject the hypothesis that c is equal to zero and that the marginal propensity to consume is constant at all levels of income.

Table (3.1) presents the calculated marginal propensities to consume and corresponding intercepts by sectors and income groups within the sectors.

Deriving the marginal propensity to consume food and nonfood goods and services for the rural and urban populations and plotting these on the same graph indicates some interesting differences in consumption behavior between the rural and urban population as well as between groups of people and different income levels. Comparison of rural and urban

TABLE 3.1. Average income, marginal propensity to consume and autonomous consumption expenditure by sector and level of income within each sector for food and nonfood per family.

Sector and income Strata	$\bar{Y}$	MPC at $\bar{Y}$ Food	MPC at $\bar{Y}$ Nonfood	Intercept at $\bar{Y}$[a] Food	Intercept at $\bar{Y}$[a] Nonfood
Traditional sector	400.00	.4279	.3376	89.54	33.30
Commercial agriculture					
Family farms	1,600.00	.2527	.0256	264.74	345.30
Small multi-family	9,700.00	.0733	.5686	1,219.39	708.57
Large multi-family	30.00	0.01[b]	0.0[c]	2,064.72	14,306.64
Nonagricultural sector					
0 - 500	411.50	.2591	.7544	280.17	-230.65
501 - 1000	787.76	.2516	.7469	284.65	-226.17
1001 - 1500	1,249.07	.2424	.7377	293.99	-216.83
1501 - 2000	1,749.77	.2324	.7277	308.93	-201.88
2001 - 3000	2,441.62	.2185	.7138	338.03	-172.80
3001 - 4000	3,458.16	.1982	.6935	397.86	-112.96
4001 - 6000	4,833.14	.1707	.6660	511.78	0.96
6001 - 8000	6,828.66	.1308	.6261	744.29	233.48
8001 - 10,000	8,788.73	.0916	.5869	1,047.25	539.43
10,000 +	13,998.99	0.0[d]	.4827	2,064.72	1,726.27

[a]These represent per family autonomous consumption expenditures. To find the intercept for each level of income the estimated number of families in each income level was multiplied by the above per family intercepts.

[b]MPC = 0 at Y = 13,365.

[c]MPC = 0 at Y = 38,130.

[d]MPC = 0 at Y = 13,365.

total marginal propensities to consume is presented in Figure (3.2). Comparison of rural and urban marginal propensities to consume food and nonfood at various levels of income is presented in Figure (3.3).

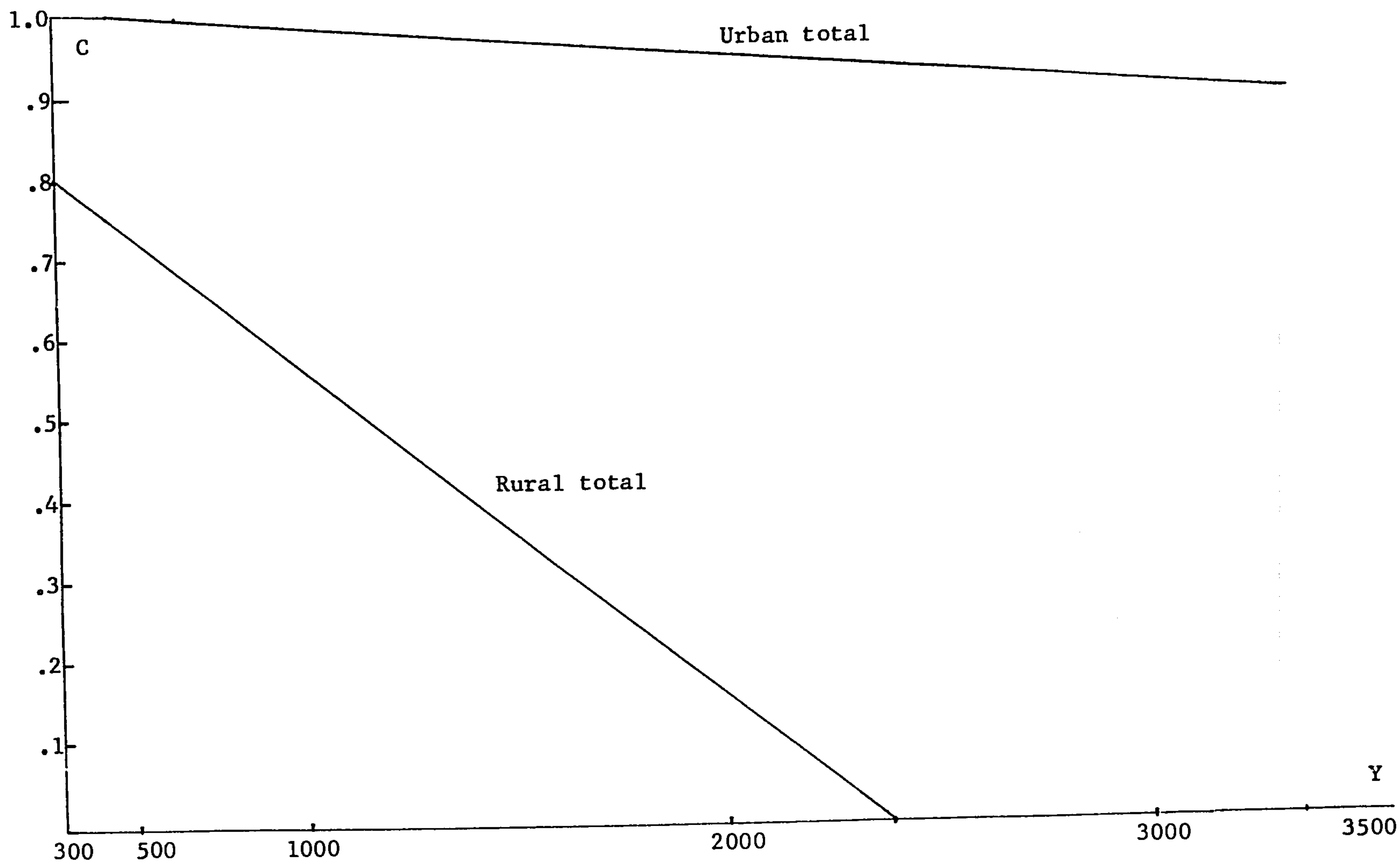

Figure 3.2. Comparison of rural and urban marginal propensities to consume at various levels of income.

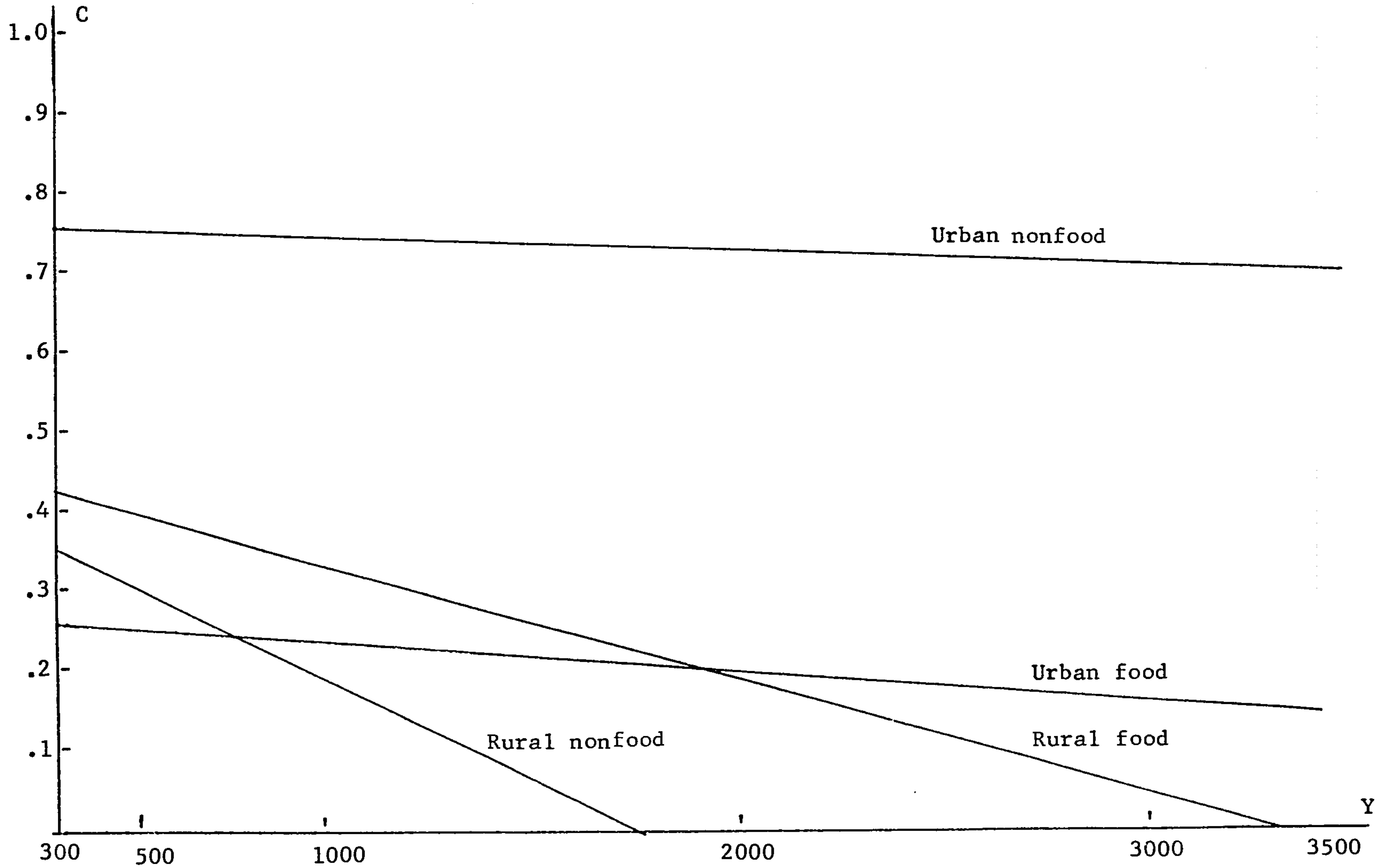

Figure 3.3. Comparison of rural and urban marginal propensities to consume food and nonfood at various levels of income.

From Figure (3.2) it appears that the difference in consumption behavior between rural and urban people is at least as great as the difference in behavior between people at different levels of income. At any given level of income the marginal propensity to consume is higher for urban people than for rural people. A glance at Figure (3.3) indicates that the difference in total marginal propensities to consume for the rural and urban population is mostly made up of the difference in the marginal propensity to consume nonagricultural goods.

To provide a more rigorous test of the hypothesis that the urban marginal propensity to consume is greater than the rural marginal propensity to consume, the urban and rural data were pooled and dummy variables were added to test for a significant difference in b and c between rural and urban populations.

To test for a shift in the parameter, b, the following equation was fit using the pooled urban-rural data.

$$C = a + b\,Y + b'Y' + C\,Y^2$$

where:

$Y' = 0$ for urban observations

$Y' = Y$ for rural observations.

If b' turns out to be significantly greater than zero the null hypothesis that the parameter, b, is not greater for rural income than for urban income will be rejected. Similarly if b' is significantly less than zero, the null hypothesis that the parameter, b, is not less for rural income than for urban income will be rejected. The results of fitting the polynomial consumption function over the pooled rural and urban data are presented below.

a	$=$ 148.53	$t = 3.53$
b	$=$ 0.9905	$t = 36.93$
b'	$=$ -0.2754	$t = -4.97$
c	$=$ -0.000017	$t = -7.73$

b' is significantly less than zero at the 0.001 level of significance with 16 degrees of freedom. We therefore reject the hypothesis that the parameter, b, is not less for rural income.

The same procedure was applied to test for a shift in the parameter, c, between urban and rural income. The following equation was fit.

$$C = a + b\,Y + C\,Y^2 + C' + (Y^2)'$$

where:

$$(Y^2)' = 0 \text{ for urban observations}$$

$$(Y^2)' = Y^2 \text{ for rural observations.}$$

The results of fitting this equation are presented below.

a	$=$ 60.89	$t = 1.82$
b	$=$ 1.0224	$t = 38.75$
c	$=$ -0.000019	$t = -8.64$
c'	$=$ -0.00016	$t = -5.34$

c' is significantly less than zero at the same level of significance leading to the rejection of the hypothesis that the value of c is not less for rural than for urban income.

Since MPC $= b\,Y + 2\,c\,Y$ and b and c seem to be less for rural income, we conclude that the marginal propensity to consume is smaller for rural than for urban people at any given level of income.

There are three factors which alone or in combination may lend credence to this result. The first has to do with the structure of the rural sector itself. Approximately 88% of all farms in Guatemala were classified as subfamily size in 1964 [6]. The distribution of the population should correspond roughly to the distribution of farms. The largest share of this population is made up of highland Indians whose consumption behavior is determined at least partly by tradition. For example, Indian women in the highlands pretty much still wear their traditional costumes. Corn is still the staple as it has been for centuries. Sol Tax in his classic study of a Guatemala indian economy, "Penny Capitalism" [22] makes the observation that while among the Indians the richer Indians live better than the poor, the differences are "strictly limited -- i.e., in degree not proportional to wealth and always within the bounds of the culture". More specifically:

> ... variations among rich and poor (indians) are held strictly within bounds. The richer families could certainly afford to plaster their adobe-brick house; they do not. They could afford windows which they do not have. They could have lime-mortar or even brick floors, but they do not. They could have raised fireplaces (as the Government demands) and do not. And so on. They lack such things not because they are unfamiliar with them - for Ladino homes that they frequent have them - but because they do not want them... it is obvious that so-called "cultural factors", as opposed to economic, are involved [22].

The second factor which may help to account for the lower MPC for the rural sector has to do with what Rogers calls the "Mud Wall Complex" [17]. According to Rogers ". . . when a subsistence farmer achieves a higher level of living than his peers, he consumes his material gains in a non-veblenian style". Rogers quotes G. M. Foster who suggests a reason for mud walls: "People who threaten the community by acquiring or appearing to acquire more than their traditional share are discouraged from persisting in this action by gossip, slander, backbiting, fear of witchcraft, and physical violence or threat of bodily harm" [17]. It is not within the scope of this paper to determine whether this view is accurate in the case of the Guatemala peasant. However, enough evidence (see Rogers [17]) of this attitude has been found in other countries to give the idea some consideration in understanding the consumption behavior of Guatemalan peasants.

These two possible explanations for the observed consumption behavior between rural and urban populations should at the very least indicate the need for an interdisciplinary approach to problems of development in countries with a high proportion of the population engaged in traditional agriculture. In dealing with problems in these areas the economist should look to the sociologists and anthropologists before going ahead and applying received economic theory with its usual assumptions concerning the "rational economic man". The success of development programs such as the one suggested by Thiesenhusen where the size of the domestic market is to be increased by developing the traditional or subsistence sector will depend on knowledge that is specific to the traditional farmer. While this program may be successful in the long run, economic development will lag behind cultural development or change. (It should be noted that while a peasant's desire for a television set may be an indication of cultural change it is not necessarily an indication of cultural development if development implies an improvement.)

The third factor which may be contributing to the observed difference in consumption behavior between the urban and rural population has to do with the availability of goods and knowledge of new products. A look at any Guatemalan map with reasonable detail reveals literally hundreds of towns in the highlands with only a dirt path linking them to the outside world. A peasant who moves to the city is faced with a much greater variety of goods to purchase than perhaps would be found in his home market. The urban dweller is not only faced with a wider selection of goods, but his attitude toward purchasing them may change as a result of a "demonstration effect".

It was mentioned earlier that incom received by owners of multi-family size farms would be assumed to be consumed as urban income. This assumption seems consistent with the factors discussed above. These people have high mobility and many of them live in the city much or all of the time. It seems reasonable to expect that their consumption habits would be better depicted by the urban consumption function rather than the rural consumption data which was derived from interviewing mostly campesinos. Further the range of income of the rural sample only went as high as $3000.00 which would not include the income levels of the owner of the multi-family size farms.

The incremental output-capital ratios

The incremental output-capital ratio, γ_i, for sector i is defined as the increment to output resulting from one unit of investment. It is different from the marginal product of capital in that the latter assumes other factors constant while the incremental output-capital ratio assumes that other factors may be increased along with capital in accordance to least cost combination of resources. In mathematical terminology $\frac{dQ}{dK}$ is the incremental output-capital ratio while the marginal product of capital is given by the partial derivative rather than the total derivative or $\frac{\partial Q}{\partial K}$

The incremental output-capital ratio for the traditional sector was derived using production coefficients estimated by Gollas [8]. Gollas fit Cobb-Douglas production functions to survey data obtained from owners of farms of family size or smaller. The average size of farm was three hectares.

Given $Q = f(K, L, N)$ then:

$$\frac{dQ}{dK} = MPP_K + MPP_L \frac{dL}{dK} + MPP_N \frac{dN}{dK}$$

where:

MPP_K = the marginal productivity of capital

MPP_L = the marginal productivity of land

MPP_N = the marginal productivity of labor.

We will assume that the traditional sector can not increase total land holdings. Therefore, $\frac{dL}{dK} = 0$. According to Gollas "one may observe, on the whole, indications of inefficient use of family labor among Guatemalan highland Indians. The efficiency indexes suggest that too much family labor is being used in farm activities". Given this information we will assume that MPP_N is also equal to zero. Therefore the incremental output-capital ratio for the traditional sector will be assumed to be equal to the marginal productivity of capital. Gollas estimated the marginal productivity of capital to be 0.40. Therefore, $\gamma_T = 0.40$.

The incremental output-capital ratios for the remaining sectors (commercial agriculture and nonagriculture) were estimated by fitting the following equations for each sector.

$$Y_t - Y_{t-1} = \gamma I_{t-1} \qquad i = 0, 1, 2, 3$$

The equation was estimated with investment in the current year as the independent variable and also lagged one, two, and three years. Unfortunately, investment data broken down into investment in agriculture and investment in nonagriculture was only available for nine years giving only eight degrees of freedom. On the basis of t tests and goodness of fit statistics estimates of γ with investment in the current year were chosen. The estimated incremental output-capital ratios for the commercial agriculture and nonagricultural sectors are presented below with their standard errors and t values.

$$\hat{\gamma}_A = \begin{array}{c} 0.747 \\ (0.2612) \\ 2.9 \end{array} \qquad \hat{\gamma}_M = \begin{array}{c} 0.4770 \\ (0.0398) \\ 12.0 \end{array}$$

$\hat{\gamma}_A$ is significantly different from zero at the 0.02 level of significance while $\hat{\gamma}_m$ is significant at the 0.0001 level.

Estimates of w, e_1, and e_2

The average wage rate, w, earned by agricultural laborers working in the commercial agriculture sector was estimated by Schmid for different plantation crops, coffee, sugar cane, and cotton [18]. Taking the weighted average with the weights corresponding to the proportion of the unskilled labor force employed in the production of each crop, an average of Q0.88 per man day was arrived at.

e_1 is the number of man days required to produce one unit of output (measured in constant prices) in the commercial agricultural sector. Using data provided by Schmid, e_1 for export crops was estimated to be approximately 0.43 [18]. Using Table 3.5 of [7] the proportion of export crops to total commercial production was estimated to be 0.57. It was assumed that $e_1 = 0$ for nonexport crops which implies that all seasonal laborers work only on fincas producing export crops. This, of course, is not completely accurate but it is true that the large fincas are almost exclusively export crop oriented, and it is these fincas which hire the great bulk of seasonal labor. This assumption, therefore, is probably not too extreme. At any rate it should be recognized that L may be underestimated because of this factor. The final estimate of e_1 was taken to be the weighted sum of the value of e_1 for export and nonexport crops. The weights were the proportion of export crops and nonexport crops in total commercial agricultural production respectively. The estimated value of e_1 is therefore taken to be 0.2438.

According to Gollas [8] income from employment in nonagricultural activities makes up on the average about 28% of total income of the subsistence farmer. Therefore e_2 was estimated to be equal to 0.28.

<u>Estimates of β, ϵ, α</u>

β is the proportion of total demand for food by the commercial agriculture sector which is satisfied by the commercial agricultural sector itself. We will make the assumption that the commercial agriculture sector is self-sufficient and purchases no food from the traditional sector. Therefore, let $\beta = 0$.

ϵ is the proportion of total demand for food by the nonagricultural sector which is satisfied by the commercial agriculture sector. Wheat is the major cash crop of the traditional sector. Since corn is the main staple of this sector most of the wheat is sold outside of the sector. We will assume that the nonagricultural sector consumes this wheat. According to Table 3.5 of [7] this accounts for 4.5% of total domestic consumption of agricultural products consumed by the nonagricultural sector. We, therefore, let $\epsilon = 0.045$.

α is the proportion of total expenditures on food by the nonagricultural sector which actually accrues to the nonagricultural sector itself. This measures value added by the nonagricultural sector as a proportion of the total value of agricultural production at final demand prices. A crude measure of α is given by taking the ratio of the difference between total agricultural production net of exports and the value of final consumption of food (domestic) and the value of final consumption of food. The estimates for α for the years 1958-1966 ranged from 0.6320 to 0.6423. α was therefore assumed to have a constant value of 0.64.

Estimates of m_A, m_N, m_I

The import parameters were obtained from simple ratio estimates using national account data. Ordinary least squares regression was not used because looking at the estimates for these parameters revealed that they changed over time but were fairly constant for several years at a time. Since the model would not be used for forecasting, it was felt that more realistic estimates would result from choosing the values of the parameters for the years close to the year for which the model simulations would be carried out (in our case 1964).

The estimates for the import parameters are given below.

$$m_A = 0.03 \qquad m_N = 0.27 \qquad m_I = 0.40$$

<u>Estimates of t^I and t^D</u>

The average indirect and direct tax rates were estimated using generalized least squares resulting in the following functions.

$$t^I = \underset{\substack{(0.0027)\\ 26.73}}{0.0727}\, Y \qquad R^2 = 0.9794 \quad d = 1.72$$

$$t^D = \underset{\substack{(0.0024)\\ 8.45}}{0.0206}\, Y \qquad R^2 = 0.8361 \quad d = 1.59$$

where:

t^I = total indirect taxes

t^D = total direct taxes

Y = gross domestic product.

Table (3.2) presents a summary of the parameters and their estimates (excluding the consumption parameters which are presented in Table (3.1)).

TABLE 3.2. Summary of parameters and their estimates.[a]

Parameter	Estimate
γ_T	0.40
γ_A	0.75
γ_N	0.48
w	0.88
e_1	0.24
e_2	0.28
β	0.0
ϵ	0.045
α	0.64
m_A	0.03
m_N	0.27
m_I	0.40
t^I	0.07
t^D	0.02

[a]The distribution parameters, λ, i, ℓ are presented in other sections.

CHAPTER IV. EMPIRICAL RESULTS

The Base Solution: Maximization of GDP

The programming model used can be expressed in the following summary form:

Maximize $C'Y$ subject to

$$AY \leq \bar{X}$$

$$Y \geq 0$$

where:

C = 1 x n row vector of weights used in the objective function

Y = n x 1 vector of endogenous variables defined for the model

$\bar{X}$ = n x 1 vector of constants corresponding to the values of the exogenous variables and constants in the model

A = m x n matrix of constant coefficients corresponding to the parameters of the model.

Maximizing GDP subject to the constraints imposed by the model results in the following values of important endogenous variables. These are presented in Table (4.1).

When possible, base run predictions were compared with actual values for 1964 to check the reasonableness of the estimates. These are compared in Table (4.2).

Given the piece-meal manner in which the parameters of the model were estimated, the agreement between actual and predicted values of the important variables of the model seems to be acceptable.

TABLE 4.1. Values of selected endogenous variables for the base run.

Variable	Maximization of GDP Value for base run (Millions of Q 1958 prices)
GDP	Q 1311.40
y_T	199.96
y_A	250.10
y_N	837.62
C^P	1116.15
C_R^P	232.14
C_N^P	884.21
I	135.11
I_T	0.0
I_A	20.55
I_N	114.56
$f_T - f_T'$	-33.07
$f_A - f_A'$	-56.57
$f_N - f_N'$	109.44

TABLE 4.2. Comparison of selected base run estimates with actual values of the selected variables for 1964.

Variable	Predicted	Actual
C^P	1116.15	1085.25
C_R^P	232.14	244.26
C_N^P	884.21	824.21
I	135.11	157.79
I_A	20.55	20.6[a]
I_N	114.56	107.78[a]
Y_{A+T}^P	398.83	384.76
Y_N^P	912.58	913.75
GDP	1311.40	1298.51

[a]Private investment only.

Two comments concerning the results of the base solution maximization of GDP seem required. First, the model allocates investment among the agricultural and nonagricultural sectors in a way very similar to the actual situation. Second, the interregional flow of savings is from the traditional and commercial agricultural sectors to the nonagricultural sector. Since investment is zero in the traditional sector this implies that all net savings generated within the traditional sector are transferred out of the sector. While this may or may not be realistic it should be remembered that this is an "optimal" solution based on the demand for the output of the traditional sector and the incremental output-capital ratio which is the lowest of all the sectors. The implied average saving rate for the traditional sector is about 16.5 percent while for the economy as a whole it is about 8 percent. If these figures are even close to the actual values, traditional views about savings behavior of peasants seem to be questioned at least in the case of the Guatemalan "minifundista". According to the data collected by Manger-Cats the average savings rate for his sample of families with less than 7 hectares of land corresponding to our classification for the traditional sector was about 15.5 percent [10]. This lends some support to the above results.

This optimal solution also assumes that the financial system is developed to the extent that savings can be readily transferred from one sector to another. While the actual situation in Guatemala at the present time would indicate this to be true for the commercial agriculture and nonagricultural sectors there is some question as to the extent traditional farmers use the banking system. According to Tax the Indians in his village did not use banks. More specifically, "A few wealthy families are known to have considerable cash on hand, kept in chests at home (banks are not used); in two or three cases it might amount, at times, to hundreds of dollars. But the rich seem generally to invest their funds in land, and are rich rather in the value of property owned than in cash" [22].

In order to simulate the case where no savings could flow out of the traditional sector, we repeated the base run under the restriction that $f_T' = 0$. The results of this run are compared with the original results in Table (4.3).

TABLE 4.3. Comparision of solutions under the assumption of free flow of savings from the traditional sector and zero savings flow.

Variable	Values under assumption of free flows	Values under assumption of zero flows
GDP	Q 1311.40	Q 1305.65
Y_T^d	199.96	216.82
Y_A^d	250.10	249.12
Y_N^d	837.62	818.95
C^P	1116.15	1113.16
C_R^P	232.14	239.15
C_N^P	884.21	874.01
I	135.11	131.16
I_T	0.0	34.92
I_A	20.55	11.60
I_N	114.56	84.65
$f_T - f_T'$	-33.07	0.0
$f_A - f_A'$	-56.57	-97.39
$f_N - f_N'$	109.44	117.19

The result of this experiment shows a negligible loss in GDP (0.4%) resulting from forcing the solution away from the original unrestricted optimum. However, income in the traditional sector increased by 8.4% while income in the commercial agriculture and nonagricultural sectors fell by .4% and 2.2% respectively. The loss in savings resulting from the fall in income in the nonagricultural sector has to be made up from the commercial agricultural sector. This is indicated by the fact that net flows of savings to the nonagricultural sectors increased while investment in that sector fell. Also it should be noted that the savings which are generated within the traditional sector are forced into investment in that sector and results in increased income in that sector because of the increased capacity. It is also interesting to note that the increased income in the traditional sector comes mostly at the expense of the nonagricultural sector.

Under the assumptions and estimates of the parameters up to this point, the optimal solution for maximizing GDP shows excess savings being generated in the agricultural sectors and flowing to the nonagricultural sector. There is zero net investment in the traditional sector.

Derivation of the Trade-off Curve

The trade-off curve was derived using the objective function defined in the previous chapter (i.e., $w = \delta_1 Y_T^P + \delta_2 Y_R^P$, where $Y_R^P = Y_A^P + Y_N^P$).[1] Table (4.4) presents the results of each solution corresponding to the particular values of δ_1 and δ_2.

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[1]A distinction between income and production in a sector exists in this model because of the fact that the traditional sector earns income from activities outside the traditional sector. Production was used in the objective function because, while income in the traditional sector could be increased by growth of the commercial agriculture sector through the employment of agricultural labor, a more important concept would be an increase in income in the traditional sector due to increased production in that sector.

If the increment to the slope is sufficiently small, increasing the value of the slope of the objective function from zero to infinity will trace out the feasible region over which the objective function is maximized. The trade-off curve is the portion of the curve defining the boundary of the feasible region which has a negative slope. The results of deriving the base run trade-off curve indicate only two distinct optimal solutions exist for this model. However, any linear combination of these two solutions could be optimal given a nonlinear objective function. The trade-off curves for $Y_T - Y_R$ and $Y_T^P - Y_R^P$ are presented in Figures (4.1a) and (4.1b), respectively. The slope and arc elasticity for the respective curves are also given in the same diagrams.

According to the results presented in Table (4.4) an increase in total income of the traditional sector of about 24 percent will result in a 1.4 percent loss in GDP and a loss of 6.9 percent for the other sectors of the economy combined. In terms of production an increase of 42 percent in Y_T^P will result in a 4.9 percent decrease in production for the other sectors combined. In terms of per-unit change it appears that in order to increase total income in the traditional sector by one Quetzal (1 Quetzal = 1 dollar) GDP would be sacrificed by Q.34 and a one Quetzal increase in Y_T^P will require a sacrifice of Q1.34 in Y_R^P.

A transformation curve was also derived under the restriction that $f_T' = 0$ (i.e., savings were not allowed to flow out of the traditional sector). The results of this exercise are presented in Table (4.4b). Figures (4.2a and (4.2b) permit a comparison between the trade-off curve derived under the two alternative assumptions. The original curves derived with no restriction of f_T' are given by the broken lines.

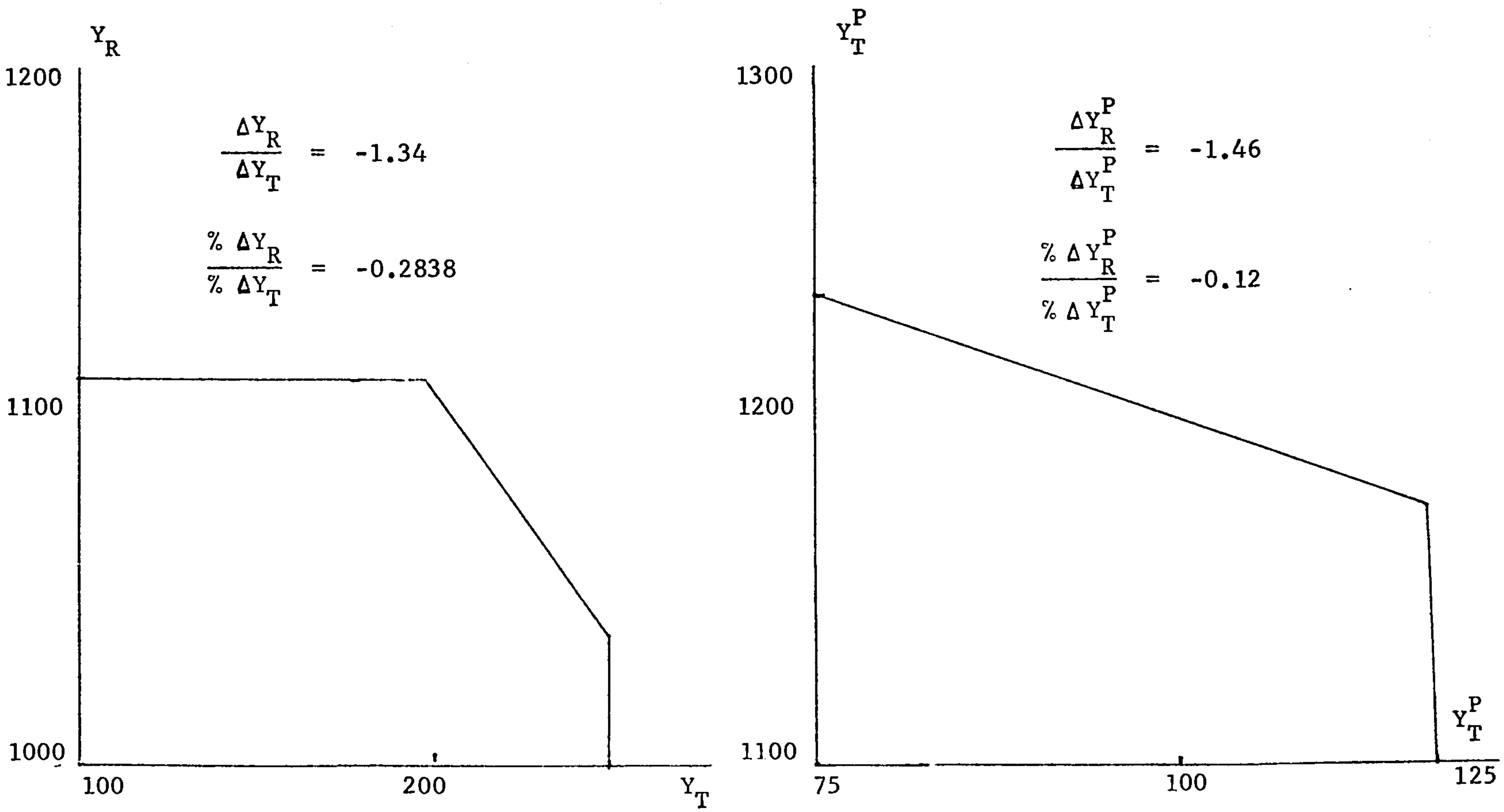

Figure 4.1a and 4.1b. Trade-off curves between the traditional sector and the rest of the economy in terms of total income and total production respectively.

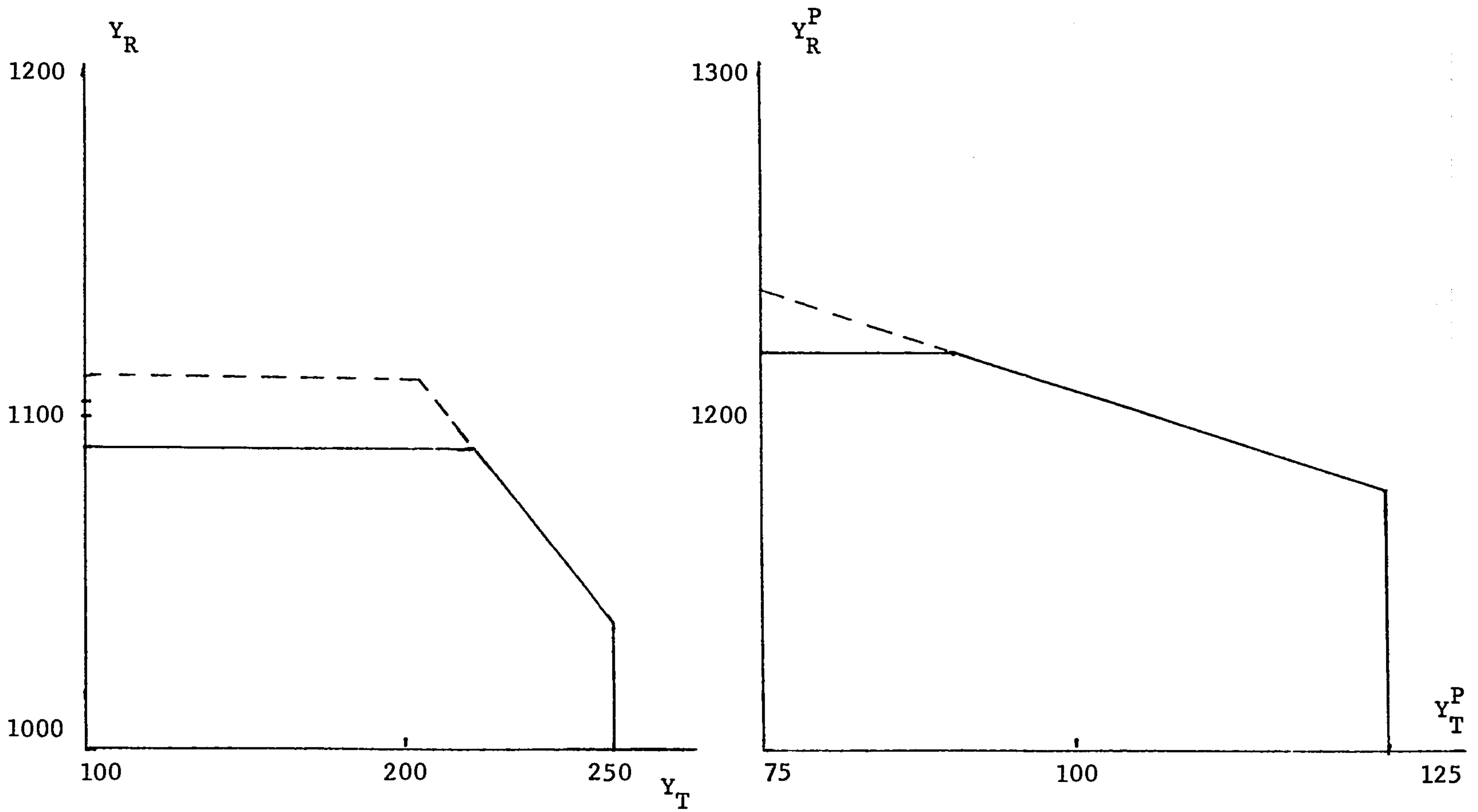

Figure 4.2a and 4.2b. Trade-off curves between the traditional sector and the rest of the economy in terms of total income and total production, respectively: Comparison of assumptions concerning f_T .

TABLE 4.4a. Results defining trade-off curve between the traditional sector and the rest of the economy - Base Run.

Solution	δ_1	δ_2	GDP	Y_T	Y_R	Y_T^P	Y_R^P	I	I_T	I_A	I_N	f_T-f_T'	f_A-f_A'	f_N-f_N'
1	1.0	0.0	1292.68	254.86	1037.81	116.74	1176.54	115.97	101.02	14.95	0.0	74.59	-60.57	5.78
2	0.8	0.2	No change in solution											
3	0.6	0.4	No change in solution											
4.	0.4	0.6	1311.40	199.96	1111.45	75.73	1235.67	135.11	0.0	20.55	114.56	-33.07	-56.57	109.44
5	0.2	0.8	No change in solution											
6	0.0	1.0	No change in solution											

TABLE 4.4b. Results defining trade-off curve between the traditional sector and the rest of the economy - $f_T' = 0$.

Solution	δ_1	δ_2	GDP	Y_T	Y_R	Y_T^P	Y_R^P	I	I_T	I_A	I_N	$f_T - f_T'$	$f_A - f_A'$	$f_N - f_N'$
1	1.0	0.0	1292.68	254.86	1037.81	116.14	1176.54	115.97	101.02	14.95	0.0	74.59	-60.57	5.98
2	0.8	0.2	No change in solution											
3	0.6	0.4	No change in solution											
4	0.4	0.6	1305.65	216.82	1088.83	88.14	1217.51	129.23	31.03	18.83	79.38	0.0	-57.80	77.60
5	0.2	0.8	No change in solution											
6	0.0	1.0	No change in solution											

It can be seen from the figures that forcing all savings generated in the traditional sector to that sector limits the size of the feasible region and places a lower limit on growth of the economy outside the traditional sector but does not change the slope of the trade-off curve.

The Redistribution Experiments

Having obtained the base run results we now are ready to proceed with the redistribution experiments.

Experiment No. 1

The first experiment will consist of lump sum transfers to the traditional sector at the expense of the remaining sectors. The net sum of the transfers will be equal to zero, and the amount taken from the commercial agriculture and nonagricultural sectors will be proportional to the respective share of Y_A and Y_N in Y_R. Two sizes of lump-sum transfers will be assumed in order to see if the results are proportional or non-proportional to the size of the income transfer. It was estimated that to increase family income by Q100.00 in the traditional sector would require a transfer of approximately Q43.4 million.

Therefore, for experiment No. 1A let:

$$\Delta T_T^r = 43.40$$

$$\Delta T_A^r = -9.94$$

$$\Delta T_N^r = -33.46$$

It was also estimated that to double per-family income in the traditional sector would require a transfer of about Q200.00 million. Therefore for experiment No. 1B let:

$$\Delta T_T^R = 200.00$$

$$\Delta T_A^R = -45.80$$

$$\Delta T_N^R = -154.20$$

The results of these two experiments are presented in Table (4.5).

TABLE 4.5. Results of experiments 1A and 1B compared with the Base Run.

	Maximization of GDP		
Variable	Base Run	Experiment 1A	Experiment 1B
GDP	1311.40	1319.20	1347.34
Y_T^d	199.96	242.51	396.05
Y_A^d	250.10	237.95	194.11
Y_N^d	837.62	814.76	732.26
C^P	1116.15	1105.66	1067.54
C_R^P	232.14	229.03	218.27
C_N^P	884.21	876.63	849.27
I	135.11	153.47	219.72
I_T	0.0	0.0	0.0
I_A	20.55	16.64	2.54
I_N	114.56	136.82	217.18
$f_T - f_T'$	-33.07	-62.36	-168.05
$f_A - f_A'$	-56.57	-90.09	-82.38
$f_N - f_N'$	109.44	172.24	270.23
Y_N^P	912.58	923.26	961.83

Experiments 1A and 1B produce some interesting results. According to the results presented in Table (4.5) a lump sum transfer of Q43.4 and Q200.00 million from the nontraditional sectors to the traditional sector will increase GDP by 0.6% and 2.7% respectively. Total private consumption fell by 0.9% and 4.4% respectively. Total investment, however, increases but only in the nonagricultural sector where investment increases by more than the fall in investment in commercial agriculture. This is due to a total increase in available savings. Total production in the nonagricultural increases due to increased investment in that sector. Since the demand constraint of nonagricultural production is binding and consumption demand for nonagricultural goods falls, investment demand is the stimulus to growth in this sector under this type of redistribution scheme in spite of the high import content of investment goods. It seems clear that the gainers from a lump sum transfer to the traditional sector would be the traditional farmers in terms of increased disposable income and the nonagricultural sector both in terms of increased capacity due to the investment in that sector but also from the increased investment demand.

Results of repeating experiments 1A and 1B under the restriction that no savings are allowed to flow out of the traditional sector, are presented in Table (4.6).

Lump sum transfers of Q43.4 and Q200.00 million to the traditional sector under the restriction of $f_T' = 0$ result in an increase of GDP of 0.4% and 0.8% respectively. This is in contrast to 0.6% and 2.7% respectively for the unrestricted runs. Total private consumption demand fell by 1.2% and 4.8% in contrast to 0.9% and 4.4% for the

TABLE 4.6. Results of experiments 1A and 1B compared with Base Run under the restriction $f_T{}' = 0$.

Variable	Base Run (Under restriction)	Experiment 1A	Experiment 1B
GDP	1305.65	1310.27	1316.43
Y_T^d	216.82	276.97	484.34
Y_A^d	249.12	236.08	188.97
Y_N^d	816.66	774.54	621.78
C^P	1116.34	1102.98	1062.51
C_R^P	243.10	251.83	276.34
C_N^P	873.24	851.15	786.17
I	129.23	147.21	193.85
I_T	31.03	63.32	162.46
I_A	18.83	13.34	0.0
I_N	79.38	70.55	31.39
$f_T - f_T{}'$	0.0	0.0	0.0
$f_A - f_A{}'$	-57.80	-90.52	-76.60
$f_N - f_N{}'$	77.60	110.32	96.40
Y_N^P	895.69	891.45	872.66

unrestricted runs. The fall in consumption came at the expense of demand for nonagricultural goods because the demand for food increased owing to the fact that increased output resulting from investment in the traditional sector allowed an increase of food consumption in that sector. (It should be remembered that the traditional sector was assumed to be self sufficient in food and that no food would be purchased from the commercial agricultural sector).

While the results of the experiments do not change qualitatively with the additional assumption of $f_T' = 0$, the net effect on GDP is less while the demand effect (consumption) is about the same. This implies that the restriction effects the optimal flow of savings and, therefore, the savings effect.

Conclusion

The combined demand and savings effects of a lump sum transfer of income from the rest of the economy to the traditional sector is to increase GDP while total private consumption falls and savings and, therefore, investment increases. Keeping all savings in the traditional sector doesn't change the slope of the trade-off curve but limits the size of the feasible region.

Experiment No. 2

Experiment No. 2 consisted of simulating an improvement in the distribution of income within each sector such that the distribution within each sector corresponded to the income distribution of England. This involved changing the vector of $\lambda_{i\ell}$'s in the consumption functions for each sector. $\lambda_{i\ell}$ is the proportion of total income found in income level ℓ of sector i. If we assume that the distribution of families remains constant the increasing $\lambda_{i\ell}$ for one income level and decreasing it for another will represent a distribution from the latter level to the former.

Table (4.7) presents the results of experiment 2 in comparison with the Base Run.

Improving the distribution of income within sectors increases total consumption demand by about 1.3% while total investment falls from Q135.11 million to Q121.70 million or by about 10%. The net effect on GDP is negligible (an increase of 0.07%).

The trade-off curve was also derived using this distribution. Figure (4.3) shows the trade-off curve for the base run and the trade-off curve [illegible] under the assumptions of experiment 2. Comparison of the [illegible] in figure (4.3) indicates that the effect of imposing a more equal distribution of income on each sector has little or no effect on the slope of the trade-off curve but limits the size of the feasible region due to the fall in available savings.

<u>Conclusion</u>

Redistribution of income within sectors increases total private consumption and decreases investment. The net effect on GDP is negligible indicating that the savings and demand effects net out. The slope of the trade-off curve is unaffected but the size of the feasible region is diminished.

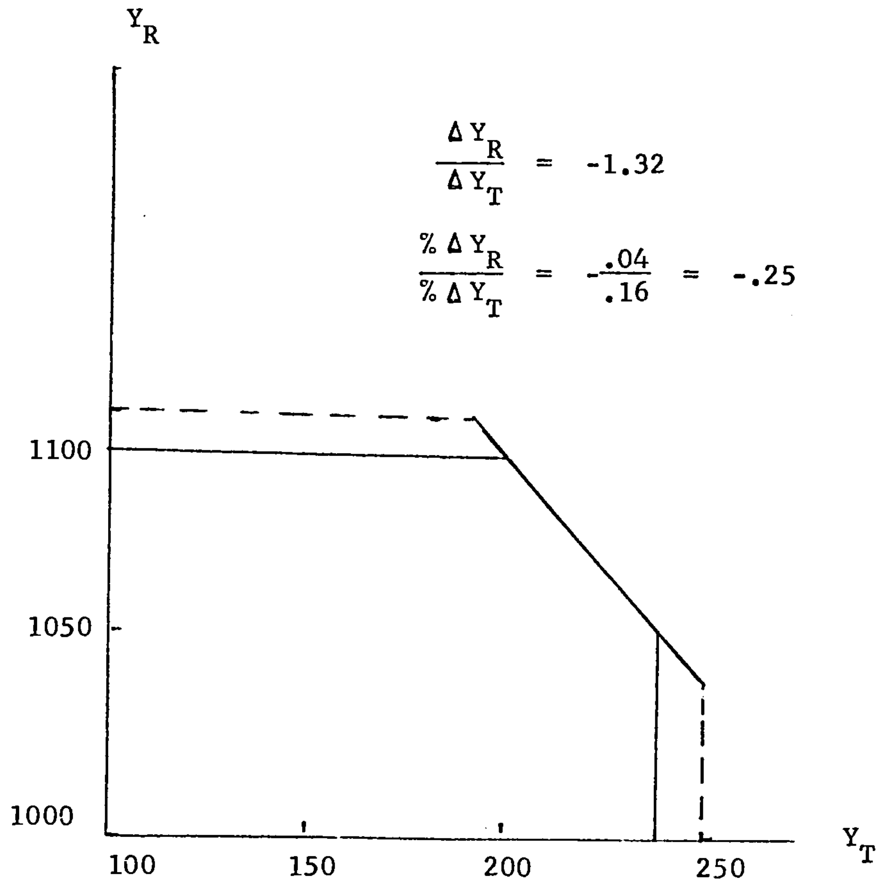

Figure 4.3. Trade-off curves for Base Run (broken lines) and for experiment 2.

TABLE 4.7. Results of experiment No. 2 and Base Run compared.

Variable	Base Run	English Distribution
GDP	1311.40	1312.36
Y_T^d	199.96	206.13
Y_A^d	250.10	266.20
Y_N^d	837.62	816.47
C^P	1116.15	1130.58
C_R^P	232.14	253.70
C_N^P	884.21	876.88
I	135.11	121.70
I_T	0.0	0.0
I_A	20.55	48.98
I_N	114.56	72.72
$f_T - f_T'$	-33.07	-37.12
$f_A - f_A'$	-56.57	-49.06
$f_N - f_N'$	109.44	105.98

Experiment No. 3

Experiment 3 consisted of simulating the combined effects of a redistribution of income between sectors and within sectors. More specifically a lump sum transfer of Q43.4 million will be carried out while the English distribution of income is imposed on the individual sectors. The results of this experiment are given in Table (4.8).

TABLE 4.8. Results of experiment 3 and Base Run compared.

Variable	Base Run	Experiment 3
GDP	1311.40	1319.78
Y_T^d	199.96	248.42
Y_A^d	250.10	253.36
Y_N^d	837.62	794.19
C^P	1116.15	1119.77
C_R^P	232.14	249.79
C_N^P	884.21	869.98
I	135.11	139.94
I_T	0.0	0.0
I_A	20.55	43.86
I_N	114.56	96.09
$f_T - f_T'$	-33.07	-66.24
$f_A - f_A'$	-56.57	-82.71
$f_N - f_N'$	109.44	168.75

The results of experiment 4 show that the net effect of both a intersectoral and a intrasectoral redistribution of income along the lines specified is a .6% increase in GDP, a .3% increase in consumption and an increase in investment of about 3.5%.

Conclusion

The effects of a lump sum transfer to the traditional sector and a redistribution of income within sectors are in opposite directions with the transfer of income between sectors having the greatest net effect. This of course depends on the size of the lump sum transfer, but it is clear that the differences in consumption and saving behavior are greater between the traditional sector and the rest of the economy than those differences in consumption behavior within sectors due to different levels of income.

Experiment No. 4

In this experiment the effect of an autonomous increase in total savings in the form of a transfer from abroad is examined. A trade-off curve is derived under the assumption of a Q30.0 million increase in foreign capital inflow, F. The results of this experiment are presented in Table (4.9). The trade-off curves for this experiment are shown in Figure (4.4). The results indicate that an autonomous increase in capital from abroad shifts the trade-off curve up and to the right such that the slope of the curves remain constant. With an increase in foreign capital GDP will increase, but the range over which output and income for a sector may increase at the expense of other sectors will also increase. However, the rate at which this trade-off occurs will not change.

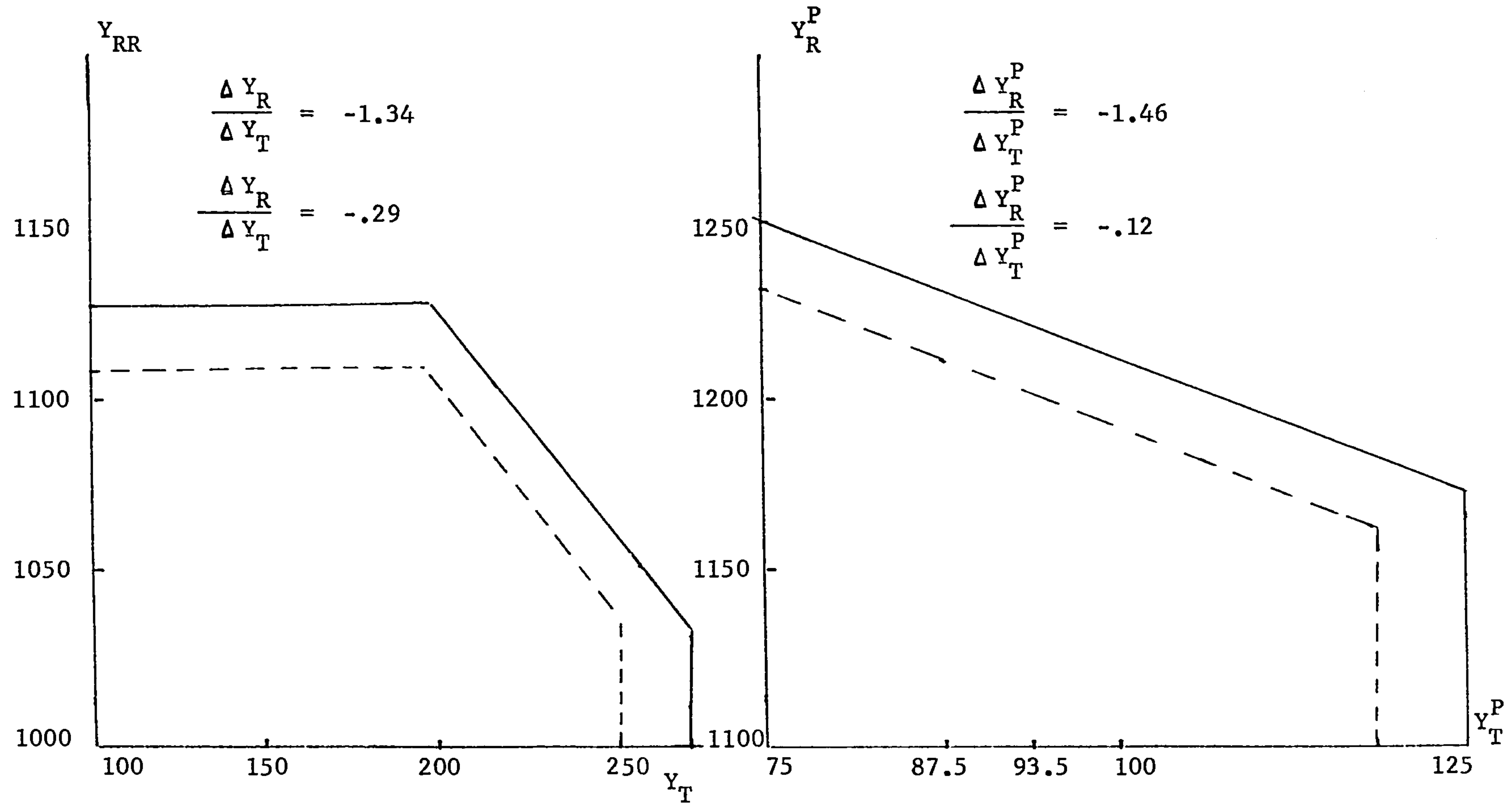

Figure 4.4. Trade-off curves for Base Run (broken lines) and for experiment 4.

TABLE 4.9. Trade-off curve derived from experiment 4.

Solution	δ_1	δ_2	Y_T	Y_R	Y_T^P	Y_R^P	I	I_T	I_A	I_N	f_T-f_T'	f_A-f_A'	f_N-f_N'
1	1.0	0.0	273.56	1032.33	129.67	1176.23	149.37	134.84	14.53	0.0	105.30	-60.87	5.57
2	0.8	0.2	No change in solution										
3	0.6	0.4	No change in solution										
4	0.4	0.6	200.27	1130.62	75.73	1255.16	174.92	0.0	22.00	152.92	-38.40	-55.53	143.93
5	0.2	0.8	No change in solution										
6[a]	0.0	1.0	102.30	1163.53	4.80	1251.04	185.80	0.0	24.51	161.29	-48.83	-53.74	152.57

[a]This solution called for excess capacity in the traditional sector. We will restrict the sectors to produce at full capacity. Therefore, this solution was eliminated.

Experiment No. 5

Up to this point it has been assumed that the traditional sector is self sufficient and does not purchase food from the commercial agriculture sector. This implies that a transfer of income to the traditional sector will not increase consumption of food. While it is reasonable to expect that the marginal propensity to consume food would be low once the traditional farmer reached a certain level because their diet is prescribed largely by tradition [5], it would be interesting to see what the result would be if the traditional sector were allowed to consume more food than they produce. To employ this assumption equation [10] of the model is replaced by [10a] and [10b] which are given below.

$$C_R^T = C_T^T \pm C_A^T \quad [10a]$$

$$C_R^T = \sum_{\ell} \alpha_R^T + \sum_{\ell} C_{R\ell}^T \lambda \, r \, \ell \, Y_T \quad [10b]$$

The estimates for the consumption function given in [10b] are presented in Table (3.1).

Both GDP maximization and derivation of the trade-off curves are repeated under these new assumptions. Also both a lump sum transfer and imposing the English distribution of income within sectors were carried out and the results were compared with both the original base run and the base run derived under the new assumption. The results of this experiment are presented in Tables (4.10) and (4.11). The trade-off curves derived with and without the new assumption are presented in Figure (4.5).

The result of imposing this consumption function for food upon the traditional sector is an increase in GDP of Q91.0 million, an increase in total private consumption demand of about Q35.0 million, and a decrease

TABLE 4.10. Original Base Run and results of experiment 5.

Experiment	GDP	Y_T^d	Y_A^d	Y_N^d	C^P	C_R^P
Original base run	1130.40	199.96	250.10	837.62	1116.15	232.14
Base run under new assumption	1322.01	218.88	299.47	780.17	1151.77	296.55
Lump-sum transfer of Q43.4 million	1323.58	263.06	291.55	745.47	1152.18	311.75
English distribution of income	1297.99	212.15	281.91	780.97	1161.19	312.96

TABLE 4.11. Results defining trade-off curve under the new assumption, experiment 5.

Solution	δ_1	δ_2	Y_T	Y_R	Y_T^P	Y_R^P
1	1.0	0.0	220.32	1101.06	76.92	1244.46
2	0.8	0.2	No change in solution			
3	0.6	0.4	218.88	1103.12	75.73	1246.28
4	0.4	0.6	No change in solution			
5	0.2	0.8	No change in solution			
6	0.0	1.0	No change in solution			

C_N^P	I	I_T	I_A	I_N	f_T-f_T'	f_A-f_A'	f_N-f_N'
884.21	135.11	0.0	20.55	114.56	-33.07	-56.57	109.44
855.32	109.97	0.0	107.75	2.22	11.26	5.73	2.82
840.43	111.32	0.0	111.32	0.0	-.84	-22.27	42.91
848.27	76.73	0.0	76.73	0.0	12.64	-29.99	37.15

I	I_T	I_A	I_N	f_T-f_T'	f_A-f_A'	f_N-f_N'
109.71	2.99	106.72	0.0	13.95	4.99	.86
No change in solution						
109.96	0.0	107.75	2.21	11.26	5.73	2.82
No change in solution						
No change in solution						
No change in solution						

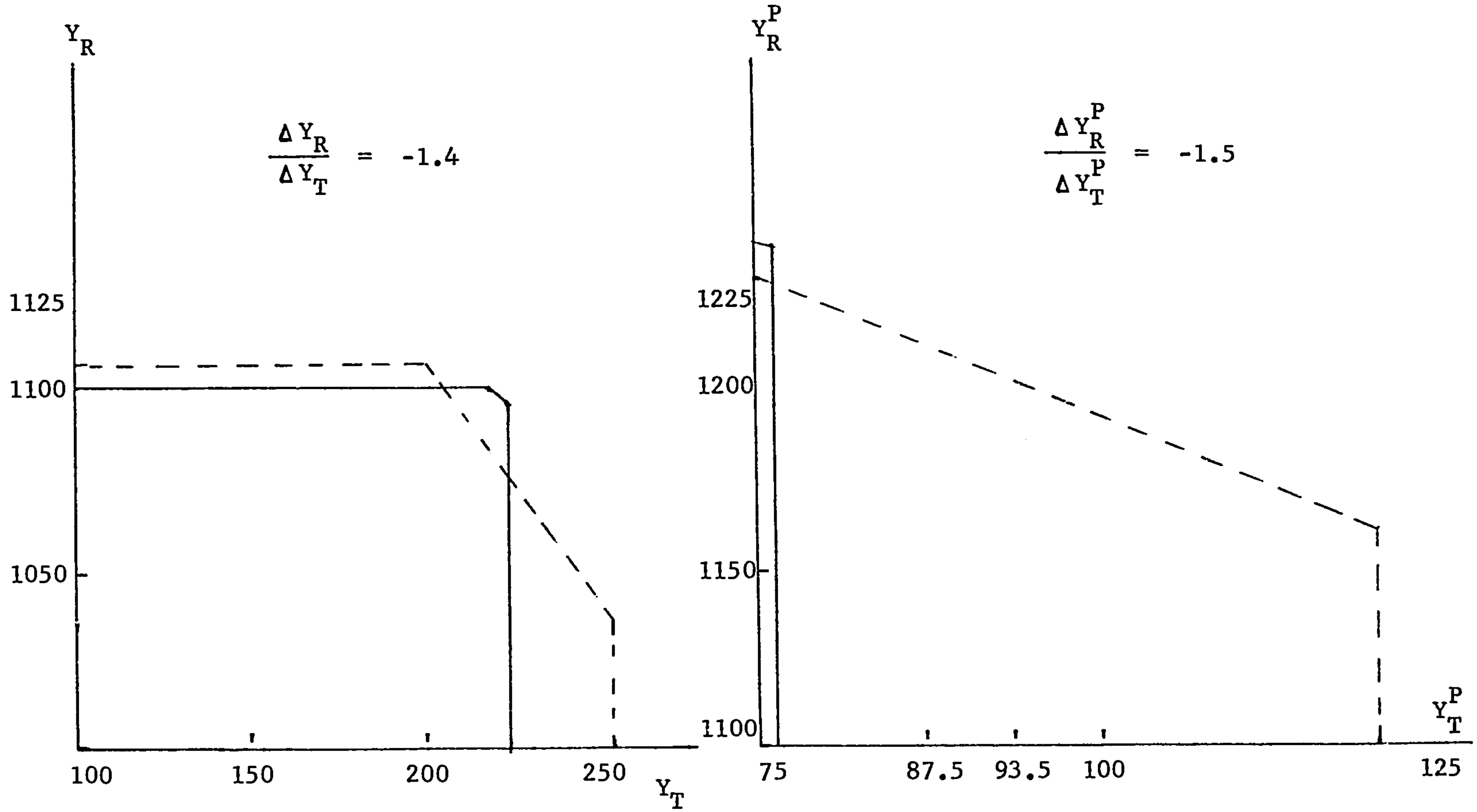

Figure 4.5. Trade-off curve for original Base Run (broken line) and for experiment 5.

of total investment of about Q25.0 million. Total consumption of food increased while demand for nonagricultural consumer goods fell. The major result is that savings have decreased to the point that there are no excess savings generated in any sector so no interregional transfer of capital occurs.

The results of the income redistribution experiments are somewhat different than before. While a lump-sum transfer of income from the rest of the economy to the traditional sector caused a net increase in GDP, which was the result obtained before, a more equal distribution of income within sectors causes GDP to fall, where GDP rose under the same experiment before. The composition of demand is much different. In this case the demand for food is much higher relative to the demand for nonfood goods and services. The critical difference in this case is that savings are allocated to the traditional sector, not for investment purposes but for consumption purposes. The combined effect of the savings and demand effect is to decrease GDP by 1.8 percent.

A look at the trade-off curves derived in this experiment reveal that savings are limited to the extent that essentially only one optimal feasible solution exists. This is because there are limited savings to transfer from one sector to the others and, therefore, no way to increase income in one sector at the expense of the other sectors.

Conclusion

This experiment indicates the importance of the estimates of consumption parameters and the assumptions concerning the consumption behavior of the traditional sector. In the former experiments it was indicated that the traditional sector was a source of savings, and given the right incentives and help these savings could be used to develop that sector or could be used in the rest of the economy (if savings could be transferred out of the traditional sector). In this case (experiment 6) the traditional sector requires credit or savings from the rest of the economy to meet the consumption demand in that sector. In the former case the development problem was one of efficient use of available resources (savings), while in the latter case it is one of the total availability of resources (savings).

Summary of Results

The results of this study can be divided into two categories; those that have to do with the trade-off between income in the traditional sector and in the rest of the economy and their results coming from the redistribution experiments. The results show that a policy designed to favor the traditional sector by channeling savings into that sector at the expense of the rest of the economy will cost Q0.34 in terms of GDP for every Q1.00 increase in income in the traditional sector. In terms of income in the rest of the economy the cost of a Q1.00 increase in income in the traditional sector is Q1.34. In percentage terms a one percent increase in income for the traditional sector will cost 0.06 percent and 0.28 percent in terms of GDP and income in the rest of the economy respectively. The effect of simulating a more equal distribution of income both through lump-sum transfers and improving the distribution of income within the sectors is solely on the total amount of savings which would be available for investment purposes and not upon the slope of the trade-off curve.

The effect of a lump-sum redistribution of income from the rest of the economy to the traditional sector is to increase GDP while total private consumption falls and savings and investment increase. The net effect on GDP of a redistribution of income within sectors so that the distribution of income corresponds to the English distribution of income is negligible but total private consumption does increase while savings and investment fall.

CHAPTER V. CONCLUSIONS, POLICY IMPLICATIONS, ISSUES AND AREAS FOR ADDITIONAL RESEARCH

Summary and Implications for Policy

The results of this study indicate that traditional farmers in Guatemala are savers and that their marginal propensity to consume is less than the MPC or urban dwellers. The view that peasants will spend almost all of an increase in income on consumer goods appears to be false in the case of Guatemala. This conclusion is particularly relevant with respect to "national market" arguments such as the one espoused by Thiesenhusen [23]. It is true that in a country where approximately 50 percent of the population does not participate in the money economy to any great extent increasing income for those people will increase the size of the market for nonagricultural products. However, it should be realized that this effect may be smaller or at least require a longer time to develop than expected.

The results also indicate that a cost is attached to diverting savings to the traditional sector for the purpose of increasing production through investment. Of course there is no way to tell how significant this cost is. It may be that this is a reasonable price to pay to develop the traditional sector. At any rate, policy makers should be aware of the potential cost of diverting resources (savings) to the traditional sector. It should be pointed out that the cost in terms of GDP of using savings in the traditional sector rather than in the rest of the economy results from the fact that savings are being diverted from sectors with relatively higher incremental output-capital ratios than the traditional sector. Savings are, therefore, less efficient in terms of increasing capacity in the traditional sector than in the other sectors of the economy. However, it should be remembered that the incremental output-capital ratio for the traditional sector was calculated using production functions derived from data which embodied the present traditional level of technology. This point was made by Schultz [20] whose hypothesis is that the rate of investment is low in the traditional agricultural sector because the level of technology is so primitive that the return to investment is low. If new technology is applied to traditional agriculture which is specific[1] to this type of agriculture, then it is conceivable that investment can be as productive in the traditional sector as in the commercial agricultural sector.

The effects on the trade-off curve of increasing the incremental output-capital ratio for the traditional sector to make it equal to the incremental output-capital ratio for the commercial agricultural sector were measured using the model. The results are compared with the original base solution in Figure (5.1). The trade-off curve for the original base solution is represented by the dashed lines.

Increasing the productivity of investment in the traditional sector yields two important results. First, the slope of the trade-off curve in terms of income or production is significantly less than for the original solution. This means that the economic costs of diverting savings to the traditional sector are less in terms of the effects on the rest of

[1]It is obvious that taking the technology which is used on the large coffee or cotton farms and applying it directly to the small plots in the highlands would result in failure.

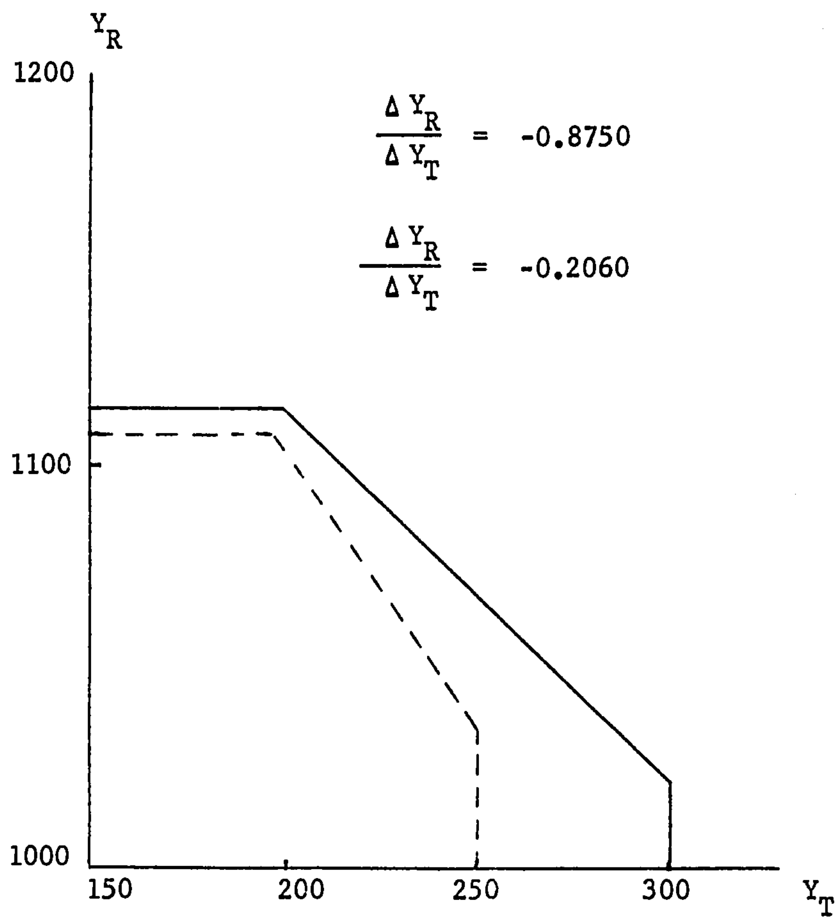

Figure 5.1. Trade-off curves where $\gamma_T = \gamma_A$.

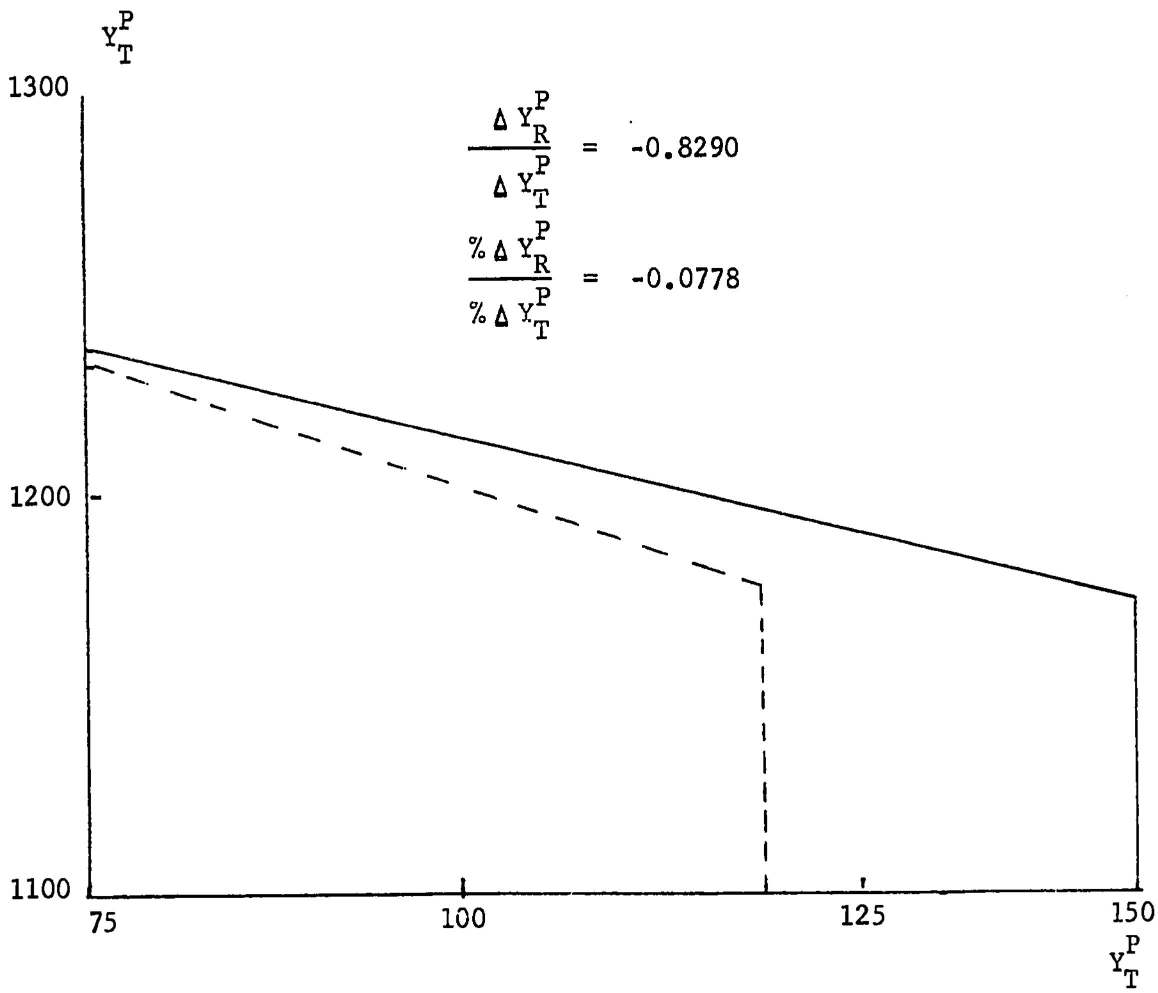

Figure 5.1. Continued.

the economy. With respect to GDP the results are dramatically different. In this case GDP rises as savings are diverted to the traditional sector from the rest of the economy. The second result is that savings are more efficient in the traditional sector while not being less in the other sectors.

The overall effect is the same as when the overall supply of savings increases (i.e., the curve shifts out away from the origin). The range over which income can be increased in the traditional sector at the expense of the other sectors, therefore, increases.

The economic cost of any policy aimed at improving the distribution of income with respect to the traditional sector versus the rest of the economy is a function of the relative levels of technology. In other words merely making credit available to the traditional farmers without a corresponding program to increase productivity may result in economic costs which are unacceptable to the policy makers.

It has been implicitly assumed that increasing productivity in the traditional sector is a technical problem and that the farmers would be able to market their produce if they increased their production. At the present time traditional farmers bring their produce to the local market on their backs and in many cases only dirt paths connect him to the market place. This type of marketing system is bound to limit growth of income in the traditional sector. The implication for policy is that the government should take an active part in improving the marketing system in the highlands. This can include everything from building new roads to encouraging or setting up marketing cooperatives.

Some Important Issues and Areas for Further Research

An extremely important assumption which has been made throughout the study is that traditional farmers will respond to economic incentives and adopt new technology to increase output. The success of any program for development of the traditional sector depends on a knowledge of the motivations, values, and attitudes of the traditional farmers in Guatemala. It has been the experience in other countries that action programs designed to stimulate development among subsistence farmers have frequently failed because of limited knowledge about them [26]. Because we are dealing with a "subculture of peasantry" an interdisciplinary approach to this problem should be taken. Economists, sociologists, and anthropologists can all make important contributions in developing policies and programs for development of the traditional sector. One such important contribution has been made by Sol Tax [22]. Tax made a detailed study of one village in the highlands of Guatemala during the years 1936 to 1941. Although the study is old, one who is familiar with the village or other parts of the highlands is struck by the appearance that there has been so little cultural change. Also Schultz in his important book, "Transforming Traditional Agriculture" [20], (published in 1964), uses Tax's work as one of two case studies to test his hypotheses. Tax named his book "penny capitalism" because this title best characterized the economy of the village which was studied. Tax's well documented thesis is that the highland Indians in this village are capitalists, but on a microscopic scale. His contention is that given the state of technology on these small farms the Indian farmer is allocating his resources in such a way as to maximize output. To put it in Tax's words:

> The Indian is perhaps above all else an entrepreneur, a businessman, always looking for new means of turning a penny. If he has land enough to earn a good living by agriculture as such, he is on the lookout for new and better seeds, fertilizers, ways of planting; and always new markets.

He observes that vendors know exactly how much they can sell an item for in order not to take a loss and also the maximum price which can be expected to receive on a particular day in a particular market. He notes that the difference in price of a given product between two spatially distinct markets was seldom more than the cost of transportation between the markets. Indeed anyone who has bargained with an Indian lady for vegetables or handicrafts would be very slow to conclude that these people do not have "business minds". Tax even documents a conversation where knowledge of the concept of "comparative advantage" is implied. Several men were discussing the fact that another town was considered to have superior onion seeds. One man in the group suggested that they write to the minister of agriculture and ask him to stop the other town from growing onions. Another man argued that the people in the other town would do the same and ask that the Panajachenos, people from (Tax's village) plant no more cucumbers (in which they had an advantage).

> . . . he added his views that business and farming are free, so that what a town plants is not a matter for laws, and that a town has more of a certain crop than others because it produces better there.

It is possible to hear a similar conversation among businessmen in the United States today.

In summary, the import of Tax's (and Schultz's) thesis is that traditional farmers will respond to incentives and will adopt new methods of production. This implies an optimistic outlook with respect to the possibilities for development of the traditional sector.

However, it is only fair to point out that the Guatemalan case may be an exception to the rule with respect to this optimistic picture of the Guatemalan minifundista. Rogers [17] attempts to "synthesize what is presently known about the motivations, values, and attitudes of subsistence farmers". His review of the literature reveals a pessimistic picture of peasants. He suggests several characteristics which appear to be fundamental to the subculture of peasantry. All of these if true of the Guatemalan peasant would be constraints on development. Following is a list of ten central elements in Rogers subculture of peasantry.

1. Mutual distrust in interpersonal relations.
2. A lack of innovativeness.
3. Fatalism.
4. Low aspirational levels.
5. A lack of deferred gratification.
6. Limited time perspective.
7. Familism.
8. Dependency upon government authority.
9. Localiteness.
10. A lack of empathy.

No attempt will be made to go into each one of these elements but two of these have particular relevance to the question of whether or not peasants will respond to economic incentives and adopt new techniques if given the opportunity. First, is the element second on the list, "a lack of innovativeness". According to Rogers, peasants generally lack innovativeness in their reaction to new ideas. One reason for this is that they avoid risk. One can say that the lack of innovativeness among peasants is due to lack of scarce economic resources. Peasants are poor and cannot afford to adopt new technology which requires a cash outlay. This, however, does not explain (according to Rogers) why peasants are also reluctant to adopt innovations which are economically costless but potentially profitable. Rogers contends that Tax's penny capitalists are exceptions in the subculture of peasantry. The second important element is a "lack of deferred gratification". The import of this element is that peasants are not savers but prefer to consume in the present rather than save for the future. The evidence he cites to support this contention is the great amount of alcohol consumed by peasants. This evidence indicates that peasants are typified by impulse gratification rather than the deferred gratification pattern.

It is clear from the implications of these two views (Tax and Rogers) that a resolution of these questions concerning the attitudes and motivations of peasants is necessary for any development program in the highlands to be successful. Because the Rogers study is an attempt to generalize and the Tax study--is specific to Guatemala the balance would have to be in favor of the more optimistic picture of Guatemalan peasants presented by Tax. Also the results of this study with respect to the marginal propensity to consume do not support Rogers' conclusions that peasants are not savers. An example of the importance of knowing the attitude and motivations of people affected by a policy can be given in the area of credit policy. The IDESAC Study [14] presents the results of a sample of 264 peasant families concerning use of credit. Eighty-two percent of the families interviewed did not obtain credit. When asked why they did not obtain credit 5.5 percent of those who did not obtain credit reported that they did not do so because the interest rate was too high; 13.4 percent did not have the necessary collateral while 81.1 percent of all those who did not obtain credit did not do so because they said they did not know what role credit could play in increasing production and they were not willing to take the risk. They stated that a good harvest not only depended on the man but also on the weather and other factors outside their control. The avoidance of risk would appear to support Rogers. However, not wanting to take a risk when it is not known how much is to be gained does not seem to be uneconomic behavior and indeed would be the rational behavior of a risk averter. The implication for credit policy is that for such a policy to succeed attention must be given to an area of educating the farmer to the uses of credit and how best to use it to increase production. Also, and not of lesser importance, risk must be minimized for the peasant farmer. This would not only include reasonable rates of interest and payments but also collateral requirements which if the harvest fails will not wipe out the farmer's assets. For example, no peasant is likely to risk his land because once he has lost his land he has no more means of support except working for other peasants at extremely low wages or on the large plantations, which would probably mean his having to leave the highlands. This means that the government would probably have to bear if not all, most of the risk in making credit available to the traditional sector. This would need to be done whether the credit came from private sources or from the government itself.

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