INCREASING AGRICULTURAL PRODUCTIVITY AND INDUSTRIALIZATION

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This is to certify that the

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ABSTRACT

INCREASING AGRICULTURAL PRODUCTIVITY
AND INDUSTRIALIZATION

by Martin Taggart Pond

Increases of per capita income in the early stages of economic development result in large increases in the quantity of food demanded. If agricultural prices are not to rise rapidly, the supply of food must be increased. However, some have argued that increasing the supply of food will increase real farm income, increase the industrial wage required to induce agricultural labor into industrial production, reduce industrial investment and, thereby, reduce the rate of industrialization.

The purpose of this study is to establish the likelihood of an increased food supply reducing the rate of industrialization. The analysis is developed by employing offer curves. The shape and position of these curves are first established from assumed sector indifference maps. From the shape and position of these curves price and income elasticities are determined. Because of the difficulties encountered in establishing sector indifference maps, the empirical data are in the form of elasticities. The shape and position of the offer curves are then established to accord with these elasticities.

The results of the analysis, on the basis of very limited empirical evidence, did not support the above conclusion. An agricultural productivity increase is likely to turn the terms of trade against agriculture enough to reduce its purchasing power. If it is

assumed that the industrial wage is determined by the per capita income of the agricultural sector, it is very improbable, therefore, that the wage industry must pay to acquire agricultural labor will rise. Since a greater part of profits than of wages is saved, the rate of industrial investment will, therefore, not decline and thereby reduce the rate of industrialization.

The study concludes by considering some of the implications of the analysis results.

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by

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As Subsistence is, in the nature of things, prior to conveniency and luxury, so the industry which procures the former, must necessarily be prior to that which ministers the latter. The cultivation and improvement of the country, therefore, which affords subsistence, must, necessarily, be prior to the increase of the town, which furnishes only the means of conveniency and luxury.

Adam Smith, Wealth of Nations.

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CHAPTER I

INTRODUCTION

Statement of the Problem

Two groups within the family of nations stand in stark contrast to each other. A small wealthy core is at one end of the continuum. At the other extreme, there is a much larger group of primarily newly independent nations whose real income is only a tiny fraction of that possessed by the wealthy members. Because of this vast disparity of relative incomes, the developing nations are desperately seeking means by which they can increase their rate of development until it equals or surpasses that of the wealthy.[1]

One very appealing means is rapid industrialization. According to Brzezinski:[2]

> The leadership and the intellectuals of these countries . . . viewing the past with distaste, deeply conscious of their economic and social backwardness, fully aware that both the USSR and the West are far ahead of them in power, prestige and, in the case of the latter, standard of living, the intellectuals tend to see one factor as paramount in causing this state of inequality: the technological revolution of industrialization . . . Industrialization has thus become a sort of panacea -- a key to the future.

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[1] For the purposes of this thesis, the rate of development is synonomous with the rate of increase in product per capita.

[2] Zbigniew Brzezinski, "The Politics of Underdevelopment," World Politics, Vol. IX (October 1956), p. 58.

The enchantment with industrialization has oriented the thinking and actions of the developing countries' leadership toward the developed countries. Malenbaum[3] contends that, despite the vast apparatus of the sample survey, the Indian economist has relatively little knowledge about the Indian economy. They are great admirers of the more developed countries and although they insist on doing things "their own way" they have difficulties conceiving of doing it differently than the admired ways of the richer countries. Malenbaum maintains that very little analysis was made of the Indian economy's performance during the First Five Year Plan; rather the arguments concerning capital/output ratios, employment effects of investment, interdependence of the sectors of the economy, the sources of domestic savings for investment, etc., proceeded from drawing upon the experiences of the Soviet Union, Europe, and the United States with little questioning of the differences which may have existed between these and the Indian economy.

The developed countries, for the most part, possess responsive, highly productive agricultural sectors, and/or they possess the ability to import their agricultural needs. Also, throughout their histories of industrial expansion, each country's agriculture was capable of satisfying the demands industrialization made upon it.[4]

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[3] Wilfred Malenbaum, "Who Does the Planning?" see Park and Tinker, Leadership and Political Institutions in India, Princeton University Press, pp. 301-313.

[4] William H. Nicholls, "The Place of Agriculture in Economic Development," a paper presented at a round table on Economic Development, Gamagori, Japan, 1960.

Problems can arise in the developing countries of today if industry is energetically promoted while agriculture, having difficulties supplying its own needs, remains stagnant. Specifically, if heavy investment outlays are made to expand industrial plants and equipment, those providing the goods and services for this construction experience an increase of income. With the low per capita income possessed by most of the developing countries, a large part of the increased income is spent on food. If some provision has not been made for the agricultural sector to provide the additional food demanded, the importance of food for life and vitality drives the price of the existing supplies up rapidly. Income accrues to the agricultural sector, and agriculture's per capita income rises. Industry, in order to attract agricultural labor to operate the new equipment, is forced to pay a higher wage. The new equipment increases the productivity of industrial labor, but a large part or all the increase can be required to pay the higher wage. This tends to reduce the quantity of industrial investment, for the major source of savings is profits rather than wages.[5]

The obvious solution to such a siphon on industrial expansion appears to be an increase in the productivity of food by the agricultural sector. Yet some authors have argued that any attempt to expand agricultural output will only increase the per capita income of agriculture and thereby increase the wage the industrial sector must pay to obtain agricultural labor.

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[5] W. Arthur Lewis, "Economic Development with Unlimited Supplies of Labor," Manchester School, Vol. XXII (May 1954), p. 157.

Does an increase in agricultural productivity require an increase in the wage paid by the industrial sector? The objective of this thesis is to answer this question. The position taken is that the interrelationships between agriculture and industry are such that increases of agricultural productivity will not require an increase of the industrial wage.

Chapter II reviews both the important empirical and theoretical works concerned with the interrelationships between the two sectors. From these works the important variables are determined. Chapter III develops a comparative statics, general equilibrium model in which the important variables are related to each other. The model is then presented in graphic form so that the effects of increased agricultural productivity on the industrial wage can be obtained directly. Chapter IV begins with a model application for the United States. From the United States example, generalizations are made with respect to other nations. At the conclusion of the chapter, the empirical results are related to the problem posited above: first, with all the assumptions of the model, and, then, the likely results when some of the important assumptions are relaxed. Chapter V discusses some of the implications for development policy, along with a brief summary of the thesis.

CHAPTER II

REVIEW OF LITERATURE

Introduction

All-out industrialization, so appealing to the indigenous leadership of the developing nations, has been challenged, at least so far as the short-run is concerned, by economists interested in examining the role of agriculture in the industrialization process. The consensus is beginning to emerge among these economists, particularly those of the developed countries, that industrial progress must await establishment of a firm expanding domestic agricultural base or a solid base for imports through exports.

The importance of such an agricultural surplus as a requirement for industrialization was described by Adam Smith.[6] His general theme was that when the countryside can produce more than its own requirements, it exchanges this excess production for the products of industry. Industry acquires the agricultural goods required for subsistence and the countryside adds to its consumption the products of industry. Before industry can expand then, agricultural production must be great enough not only to supply agriculture's needs but also to provide for increasing industrial subsistence requirements at the same time agriculture provides an expanding market for industrial output. In other words, an expanding agricultural excess in

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[6] Adam Smith, An Inquiry into the Nature and Causes of the Wealth of Nations, The Modern Library 1937, Book III, Chapter I.

the countryside increases the demand for industrial production and at the same time provides a larger subsistence base upon which industry can expand.

Present knowledge of price elasticities of less than unity for many agricultural products makes it less certain that an increasing production in agriculture also creates a larger rural market for the products of industry.

The tendency of central planning agencies in the underdeveloped countries to disregard what seemed rather obvious to Adam Smith has aided in stimulating a renewed interest on the part of many present-day economists in examining agriculture's role in economic growth. Contributions by these economists tend to fall into two broad groups, empirical observations and theoretical formulations. Each of these will be discussed in turn.

Empirical Observation

Industrial Structure and Development

Kuznets analyzed the change in industrial structure in terms of both labor force and national product. These changes were observed from two different points of view. First, countries were grouped by the level of per capita income each possessed during a five year period in the 1950's. The groups were then arrayed from those with relatively low incomes to those whose incomes were relatively high. The corresponding industrial structure pattern was then observed by comparing the structures displayed by the various income groups. Secondly, various countries were analyzed over long periods to observe the changes in industrial structure that occurred in the course of their economic development.

Kuznets found by both approaches that as per capita income increased, the share of the labor force and the national product in the agricultural sector declined. He also found, in general, that the rise in product per worker as per capita income rose was greater for agricultural labor than for non-agricultural labor. From these observations, he concluded:[7]

> At the danger of stressing the obvious, one may claim that an agricultural revolution -- a marked rise in productivity per worker in agriculture -- is a pre-condition of the industrial revolution for any sizeable region in the world...

Dovring,[8] using much the same approach as the second used by Kuznets, analyzed the change in industrial structure in terms of the labor force. He arrived at much the same results as did Kuznets with respect to the decline of agriculture's share of the total labor force as the presently developed nations increased their income in the course of economic growth. However, he differentiates between two different types of decline, relative and absolute. If population were to remain constant, there would be no relative decline; for as the non-agricultural sector's share of the total labor force expanded, the absolute number employed in the agricultural sector would of necessity decline. On the other hand, if population increased, it is possible for the share of the total force employed by the agricultural sector to decline although the total number it employs increases. This he terms a relative decline.

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[7] Simon Kuznets, Six Lectures on Economic Growth, Free Press, 1959, pp. 59, 60.

[8] F. Dovring, "The Share of Agriculture in a Growing Population," Monthly Bulletin of Agricultural Economics and Statistics, Vol. VIII, (August/September 1959), pp. 1-11.

Planning agencies, committed to rapid industrialization and faced with widespread under-employment in the agricultural sector, tend to think in terms of shifting labor from relatively unproductive agricultural under-employment to more productive industrial occupations. However, an absolute decline in agriculture's share of the labor force depends on the rate of population increase, the rate of increase in non-agricultural employment, and the share of the total labor force employed by the non-agricultural sector. The greater the share of the total labor force employed in the non-agricultural sector, the greater the rate of increase in non-agricultural employment; and the smaller the rate of population increases, the greater will be the possibility of an absolute decline in agriculture's share of the total labor force.

Dovring found that an absolute decline in the share of the labor force employed in agriculture did not occur until late in the development process of most of the presently developed countries. He also indicated that their rate of population increase was much lower during their early economic growth than is now the case with developing countries. Also, the absolute decline occurred, with few exceptions, only after agriculture no longer employed the major part of the total labor force.

Given the high rates of population increase, and the high percentage of the total labor force employed by agriculture in most of today's developing nations, an absolute decline in agriculture's share of the labor force would require an extremely rapid expansion of non-agricultural employment.

In light of the above, it appears that at low levels of per capita income a significant part of income increases is spent on agricultural products, and labor productivity is such that a large proportion of the total labor force is required to satisfy this demand. As per capita income increases, the proportion of income spent on agricultural products declines. Agricultural output, therefore, constitutes a smaller proportion of total output. Also, as per capita income increases, if domestic agriculture is to meet the rising demand for food and fiber, the productivity of agricultural labor must increase if the increased demand is to be satisfied, at first with a relative, and later an absolute, decline in the proportion of the total labor force employed in the production of agricultural products.

Theoretical Formulations

Industrial Expansion

Lewis[9] published one of the first and most significant formulations of the two sector model. It is also controversial. Although his distinction between the capitalist and subsistence sectors is based on the use and non-use, respectively, of reproducible capital, most of the agricultural land, initially at least, will be in the subsistence sector, and all industrial output will be produced by the capitalist sector. The capitalist sector satisfies its demand for labor by drawing on an unlimited source in the subsistence sector. The price the capitalist sector must pay for this labor is

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[9] W. Arthur Lewis, op. cit., pp. 139-191.

determined[10] by the subsistence wage that prevails in the subsistence sector. Since the capitalist sector's labor is fructified with capital, the product per worker will be greater than his wage. The quantity of product above the industrial wage is assumed to be saved and invested to increase the stock of capital. When the stock of capital increases, the productivity of industrial labor increases together with the capitalist sector's demand for labor. Since there is a surplus of labor that can be drawn from subsistence agriculture, additional labor can be acquired at the same subsistence wage. A large part of the increased industrial productivity brought about by the greater capital stock is then available for further expansion of the capital stock. Thus, under these conditions, the capitalist sector will continue to expand.

The rate of increase in the growth of the capitalist sector can be impeded by an increase in the price the sector must pay for labor. With an unlimited supply of labor in the subsistence sector, the price of labor to the capitalist sector will rise only when the income in the subsistence sector rises.

If the capitalist sector depends on the subsistence sector for its food supply and/or raw materials, it can be faced with a dilemma. If no attempt is made to increase agricultural output, the expansion of the capitalist sector will increase the demand for the agricultural product, increase its price, and turn the terms of trade against the capitalist sector. In this situation, if the industrial

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[10] The term "determined" has been used, since the industrial wage can be greater than agricultural earnings without causing labor to migrate. Lewis has suggested a differential of 30 per cent or more.

sector is to draw labor from agriculture, the industrial wage in terms of industrial goods must rise by more than the increased price of agricultural products. On the other hand, if agricultural output is expanded, the income of the agricultural sector in terms of agricultural goods can increase because there is a greater quantity of product to be distributed among the sector's population. Again, assuming that terms of trade remain constant between the two sectors, the industrial wage in terms of industrial goods must rise by more than the increased income of the agricultural sector if labor is to be acquired from agriculture. Hence, conceptually, there are circumstances such that regardless of whether agricultural output is or is not expanded, the industrial wage in terms of industrial product must rise, reducing the rate of increase of the capitalist sector.

The possibility of this dilemma occurring depends on the change in the terms of trade brought about by an increase in agricultural output. If the terms of trade move against agriculture enough to offset its increased output -- i.e., the increased income of the agricultural sector in terms of agricultural goods does not represent an increased income in terms of industrial goods -- the industrial wage in terms of industrial goods need not rise. On the other hand, if the terms of trade move against agriculture less than enough to compensate for its increased output, the industrial wage must rise in order to offset the rise in agricultural income in terms of industrial goods and attract labor to industrial employment. The important consideration then for determining the wage the industrial sector must pay for labor (that, in turn, affects the rate of growth

of the industrial sector) is the resulting terms of trade brought about by an increase in agricultural productivity.

Industrial and Agricultural Interrelationships

Ranis-Fei[11] attempted to expand upon the Lewis model by incorporating his ideas with other prevalent ideas found in the current economic development literature. They used Lewis' formulation of the industrial sector but explicitly related it to the agricultural sector.

According to Ranis-Fei, the industrial wage does not increase as more agricultural labor is drawn into industrial employment because there is a redundant supply of agricultural labor in the agricultural sector. From the point at which all labor is located in agriculture, the "breakout" point, until enough agricultural labor has been drawn into industry to make the marginal product of those who remain greater than zero, Ranis-Fei term phase one. Phase two, beginning at the end of phase one, continues as more labor leaves agriculture until the marginal product rises to the "institutional wage." During this phase the industrial wage rises, for, as more labor with a positive marginal product is drawn from agriculture, the supply of agricultural products is reduced. This turns the terms of trade in favor of agriculture, and industry must pay a higher wage to maintain the same purchasing power. During phase three the "institutional wage" is no longer applicable. Agricultural labor is paid its marginal product which throughout phase three is greater than the "institutional wage."

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[11] Gustav Ranis and John C. H. Fei, "A Theory of Economic Development," American Economic Review, Vol. LI. (September 1961), pp. 535-565.

The Ranis-Fei formulation set the "institutional wage" at the "breakout" point equal to the average product. The industrial sector draws off labor from the agricultural sector during phase one by paying a wage equal to or a required differential above this "institutional wage."

For some non-economic reasons, the "institutional wage" prevailing in the agricultural sector is assumed to remain constant although, as workers migrate from the agricultural sector, the quantity of product available to those who remain increases. The workers remaining in the agricultural sector are not permitted to consume the increased quantities of output, according to Ranis-Fei, because of (1) the investment activities of the landlord class, and/or (2) government tax policy. Later in the analysis, when introducing increases in agricultural productivity, Ranis-Fei continue to assume the same "institutional wage." The assumption of a constant "institutional wage," when the per capita output available to the workers in the agricultural sector is increased, either because there are fewer of them or there is an increase in their productivity, appears to be somewhat unrealistic.

If the agricultural economy is composed predominantly of landlords hiring agricultural labor, why should they, in terms of the model, pay more than the marginal product of labor? There is at least one economic exception. As Leibenstein[12] points out, if there is a relationship between the supply of labor, the wage paid,

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[12] Harvey Leibenstein, "The Theory of Underdevelopment in Backward Economies," Journal of Political Economy, Vol. 65, No. 2 (April 1957), pp. 91-103.

and productivity such that the cost of increasing the wage is more than offset by increases in productivity, the landlords can increase their total revenue by paying a wage greater than the marginal product. However, this exception appears to be the second reason given by Ranis-Fei (footnote 10, page 542) as a possible explanation for a rise of the "institutional wage" rather than an explanation for its existence.

On the other hand, if the subsistence agricultural economy is primarily made up of small owner-operators, it is quite possible for the wage to be greater than the marginal product. It is quite probable that the more productive members of the family (in terms of marginal analysis rather than inherent productivity) will share equally with the other members of the family. However, one would not expect the stability of the "institutional wage" assumed by Ranis-Fei throughout their phase one and two. Barring a government tax program, one would expect the wage to remain approximately equal to the average product of the sector throughout phase one and two rather than limited only to the "breakout" point as postulated by Ranis-Fei. Thus, if, because of migration or increased productivity, output increases in the agricultural sector, the average product for the sector would increase and, hence, income in terms of agricultural goods.

The wage the industrial sector must pay to entice agricultural labor into industrial employment will depend on the change in the terms of trade between the two sectors brought about by the increased availability of agricultural output in the agricultural sector. This is precisely the same point reached by the Lewis model above.

Consumption Characteristics of Agriculture

Nicholls[13] is much more explicit than Ranis-Fei in establishing the type of land tenure system that is being considered for the agricultural sector. Possibly as an outgrowth of his criticism of theorists who have failed to incorporate the production side of agriculture into their models, he depicts the difference in the quantity of "agricultural surplus" between small owner-operators attempting to maximize the returns to their land and labor, and landlords interested in maximizing the returns to their land. However, his "agricultural surplus" is not a function of production, but rather it is the difference between the quantity of agricultural product the agricultural sector produces and the quantity it consumes. His assumptions with respect to the consumption behavior of the sector appear to be somewhat questionable.

Unlike Ranis-Fei, he does permit agricultural incomes in terms of agricultural goods to rise as labor migrates from the sector and/or the sector experiences an increase in productivity. However, the quantity of agricultural goods consumed per capita by the agricultural population is assumed to remain constant. In other words, he is assuming a zero income elasticity of demand for agricultural goods by the agricultural sector. Such an assumption may not be too unrealistic if most of the land is held by a few landlords hiring agricultural laborers to cultivate their holdings. If there tends to be "overpopulation" of the sector in the sense that the wage for

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[13] William H. Nicholls, "An 'Agricultural Surplus' as a Factor in Economic Development," Journal of Political Economy, Vol. 71, No. 1 (February 1963), pp. 1-29.

labor has been driven to the biological subsistence level, more agricultural labor is likely to be employed if productivity increases. The wage for labor, however, will remain at the subsistence level. Under these circumstances, there is little possibility for agricultural labor to exchange part of their agricultural wage for industrial goods and thus contribute to the "agricultural surplus." Landlords, on the other hand, would obtain all the increased productivity of their previous employees and would be required to pay only the subsistence wage to the new workers entering the agricultural labor force. Thus, their income in terms of agricultural goods would rise rapidly. However, given an initial high level of income and a low income elasticity of demand for agricultural goods, their increased consumption of agricultural goods probably would be insignificant. For all practical purposes then, all the increase in the landlord's income would be added directly to the sector's "agricultural surplus." Such behavior on the part of agricultural labor and landlords would justify the assumptions laid down by Nicholls. However, if the sector is "underpopulated," the wage would rise as more agricultural laborers were brought into the sector's labor force -- the supply curve for labor would slope upward. As the wage rose, the agricultural laborer's income would increase. An increase in the income of agricultural labor, with much lower initial levels of income and a higher income elasticity of demand for agricultural goods than possessed by landlords, would appreciably increase the consumption of agricultural goods. Thus, average _per capita_ consumption of agricultural goods in the agricultural sector would increase when its income increased rather than remain constant as

assumed by Nicholls. This increase in consumption, in turn, would reduce the size of the Nicholl's surplus.

Much the same result as the latter occurs if the land is cultivated by small owner-operators. Although their income in terms of agricultural goods is determined by the sector's average productivity rather than a wage paid by landlords, their average level of income and income elasticity of demand for agricultural goods are likely to be such that income increases brought about by migration and/or greater productivity raise the per capita consumption of agricultural goods. One would also suspect that if the sector is "overpopulated," the income elasticity of demand for agricultural goods will be greater than if the sector is "underpopulated."

On the basis of the foregoing, it appears that under some circumstances a model is required which will more fully account for the consumption behavior of the agricultural sector than the one offered by Nicholls.

Terms of Trade Between the Sectors

An analysis made by Gutman[14] and Enke[15] permits the assumption of the agricultural sector's income elasticity for agricultural goods to be something other than zero. However, they go further than this in that they relate the consumption behavior of the

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[14] C. C. Gutman, "A Note on Economic Development with Subsistence Agriculture," Oxford Economic Papers, Vol. 9, No. 3 (October 1957), pp. 323-329.

[15] Stephen Enke, "Industrialization Through Greater Productivity in Agriculture," The Review of Economics and Statistics, Vol. 44, No. 1 (February 1962), pp. 88-91.

agricultural sector to that of the industrial. When each sector is specializing in the production of one product, the agricultural in agricultural production and the industrial in the production of industrial goods, and each sector possesses a given factor endowment, it is the degree and nature of the consumption relationships between the two sectors that determine the terms of trade. In other words, their analysis is capable of determining the changes in the terms of trade between the two sectors when agricultural productivity is expanded. This analysis makes it possible to extend that made by Lewis and Ranis-Fei.

Gutman and Enke, addressing themselves to the same issue -- the contribution of increased agricultural productivity to industrial development -- arrive at different conclusions. Gutman maintains that increasing the productivity of subsistence agriculture may be inimical to industrial growth. Enke, on the other hand, takes a strong stand that industrial development is likely to be fostered.

Both authors appear to analyze a closed economy in terms of comparative statics. Enke, through offer curves, establishes an initial equilibrium price at which the quantity of product supplied by one sector is demanded by the other. He then introduces an increase in the productivity of the rural sector. On the basis of his assumptions he concludes that the new equilibrium terms of trade will turn against agriculture enough to reduce the value of the increased output of the agricultural sector in terms of industrial output. Gutman, although he relies on a dynamic model of differential equations presented in an appendix to his article, appears to use, throughout most of his narrative, much the same

comparative statics as employed by Enke. For example, from a differential equation for determining the difference between the rate of change of the real wage in the agricultural and industrial sectors when agricultural productivity has increased, he establishes a relationship between the same variables as used by Enke. Gutman, using certain assumed values for these variables, determines whether the value of the equation is positive or negative, i.e., whether the real wage of the agricultural sector is, respectively, greater or less than that of the industrial sector. He is, then, not interested in determining the magnitude of the difference between the rate of change of the two wages through time, but in which wage rate change at any given point in time is the greater.

With both authors using much the same type of analysis, the explanation for their different conclusions appears to be in the particular values each assumes for the variables employed. Enke assumes the rural families' income elasticity of demand for their own output to be unity or less. Further, he assumes the price elasticity of demand of the rural families for industrial output as well as the price elasticity of demand of urban families for agricultural products to be less than unity. He also assumes that rural and urban families consume agricultural and industrial products in the same proportions. Gutman, on the other hand, conceives of the income elasticity of demand of rural families, in general, to be unity and above. He makes much the same assumption with respect to price elasticities of demand as does Enke. However, unlike Enke, he assumes the proportion of agricultural consumers' incomes spent on industrial goods to be low, while the proportion of industrial

consumers' incomes spent on industrial goods is assumed to be substantially higher.

The importance of the assumptions in determining the different conclusions can be illustrated by the income elasticity of demand for agricultural products by the agricultural sector. If both authors had assumed the same values for the variables with the exception of the above-mentioned income elasticity, then as agricultural output increased, the amount of agricultural output offered by the agricultural sector to the industrial sector would be smaller the greater the income elasticity of the agricultural sector for its own output. The less it offered, the less the terms of trade would turn against it and, thus, the more valuable would be the sector's increased output of agricultural products in terms of industrial products. If the terms of trade did not move against the agricultural sector enough to offset its increased output, the sector's per capita income in terms of industrial goods would increase. In this case the industrial wage would have to be increased to attract agricultural labor and, thereby, the level of savings available for industrial investment would be reduced.

A selection of the appropriate assumptions can be made only by resorting to empirical data obtained from developing economies. Only in this manner can "realistic" assumptions be determined and, thus, better insight be gained as to the actual income distribution brought about by increased agricultural output.

This will be done after a diagrammatic relationship of the variables is developed in the next chapter.

CHAPTER III

THE MODEL

Introduction

The objective of this chapter is to depict carefully the central focus of the thesis in diagrammatic form. The diagrams will be essentially those used by Lewis, Ranis and Fei, and Enke. Lewis has depicted the industrial sector; Ranis and Fei, the allocation of labor between the industrial and agricultural sectors; and Enke, the terms of trade between the two sectors. Some aspects of their diagrams have been altered when it was felt appropriate to do so. These changes will not be discussed but can be determined by comparing their presentations with that which follows.

The Model

The economy is closed. Total population is constant as well as the distribution of the population between the two sectors. Each sector is specializing in the production of one product -- the industrial sector, (In), in the production of the industrial product, (I), and the agricultural sector, (Ag), in the production of the agricultural product, (A). Part of the relationship between the two sectors is depicted in Fig. 1.

The (a) part of Fig. 1 represents the industrial sector; the (b) part is the agricultural. The total population is allocated between the two sectors with the quantity OL in Fig. 1 (a) in the industrial, and the quantity OL' in Fig. 1 (b) in the agricultural

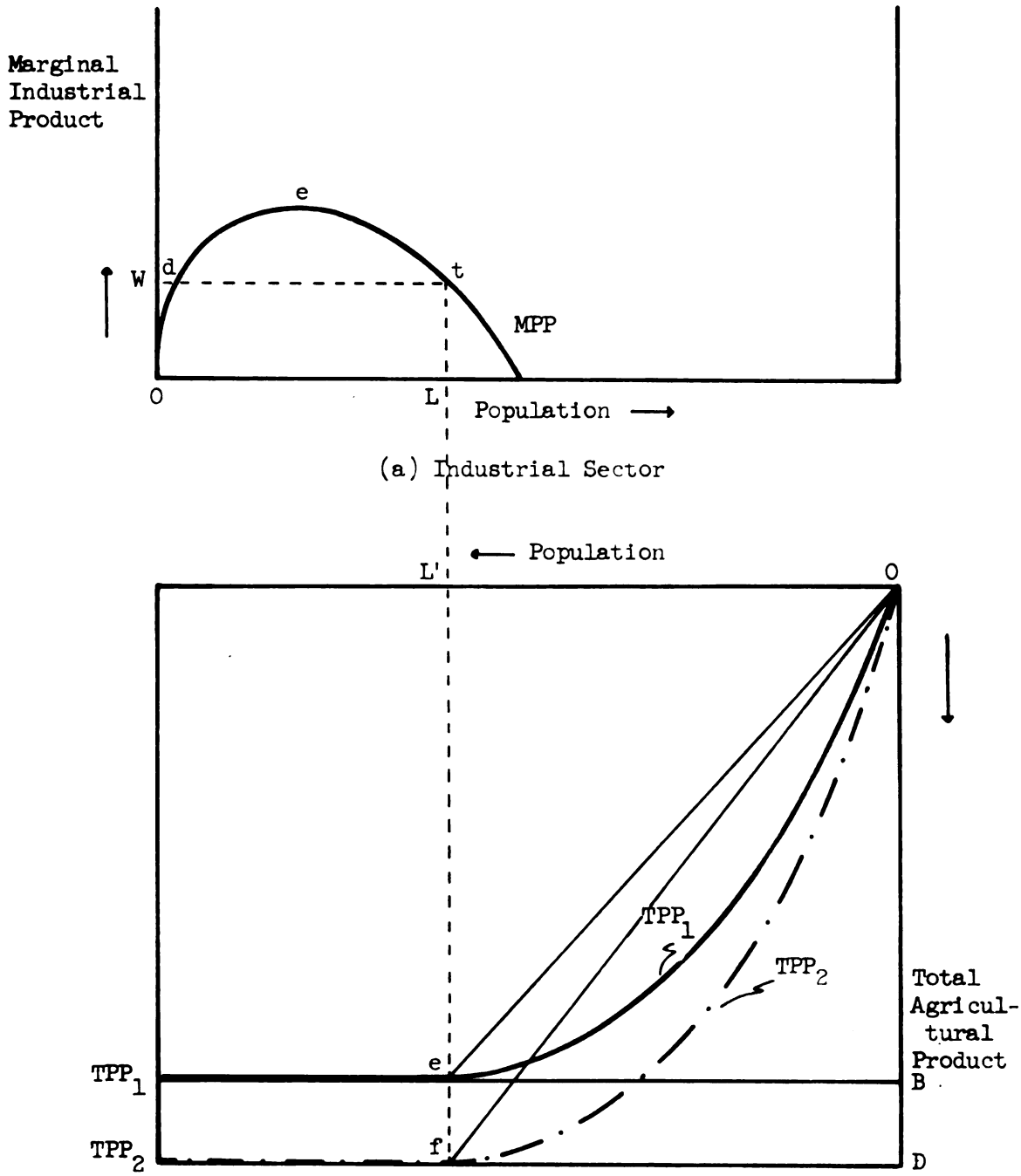

Fig. 1. The Distribution of Output and Labor between the Industrial and Agricultural Sectors

sector. The marginal physical product curve for industrial labor is shown in Fig. 1 (a). Since the total physical product of labor is equal to the sum of the marginal physical product of each unit of labor, the total output of I is given by the area CdetL. The curves of Fig. 1 (b) are total physical product curves. The total output of A is thus given by the distance CB for the curve marked TPP_1.

An autonomous increase of agricultural productivity is introduced by a shift of the sector's total product curve from TPP_1 to TPP_2. The quantity OL' of agricultural labor can now produce OD of A rather than OB, an increase of BD in the output of A. Assuming that the real return to agricultural labor is in terms of average physical product rather than the marginal physical product, the real per capita income of the agricultural sector in terms of A increases with increased output, i.e., in terms of Fig. 1 (b) $\frac{OB}{OL'} < \frac{OD}{OL'}$. It is further assumed that at the initial agricultural output the two sectors are in equilibrium, i.e., $\frac{CB}{CL'} = k(OW)$ where k is the equilibrium differential of per capita income between the two sectors and OW is the industrial wage shown in Fig. 1 (a). If the relative prices of A and I remain unchanged with the increased output of A, then $\frac{OD}{OL'} \neq k(OW)$. To restore equilibrium between the two sectors, the industrial wage must increase. This, in turn, reduces the size of the area det minus the area OWd in Fig. 1 (a), the quantity of I accruing to entrepreneurs after wage costs have been met, which in turn reduces industrial investment.

The assumption that the relative prices of A and I will remain unchanged is not too realistic. The object of the analysis that

follows is to determine the result when this assumption is relaxed.

Terms of Trade

The combination of A and I that each sector consumes depends upon the shape and location of the sector's community indifference curves.[16] The position and shape of these curves also determine the changes in the quantity of A and I consumed by each sector when agricultural output is increased.

Industrial Sector. It is assumed that the industrial sector is almost completely located in an urban environment and displays a high degree of modernity. Members of this sector have had the greatest contact with the advanced nations and are thus most prone to imitate their consumption patterns. Both the requirements of increasing urbanization and attempts to imitate high-income consumption tend to increase the preference for I. Therefore, for a specific point in time the sector's indifference curves tend to "flatten out" along the A axis (see Fig. 2).

In Fig. 2 the total quantity of I produced by the industrial sector is represented by the distance OR. This is the same value given in Fig. 1 (a) by the area OdetL. Although the industrial sector specializes in the production of I it wishes to consume some A. In a closed system, it obtains A by exchanging part of its I for

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[16] The concept of a community indifference curve is used solely for a theoretical rather than empirical construct. Theoretically, offer curves will be constructed from community indifference maps and their elasticity determined. Empirically, the elasticity will be given, then offer curves will be constructed to accord with these elasticities.

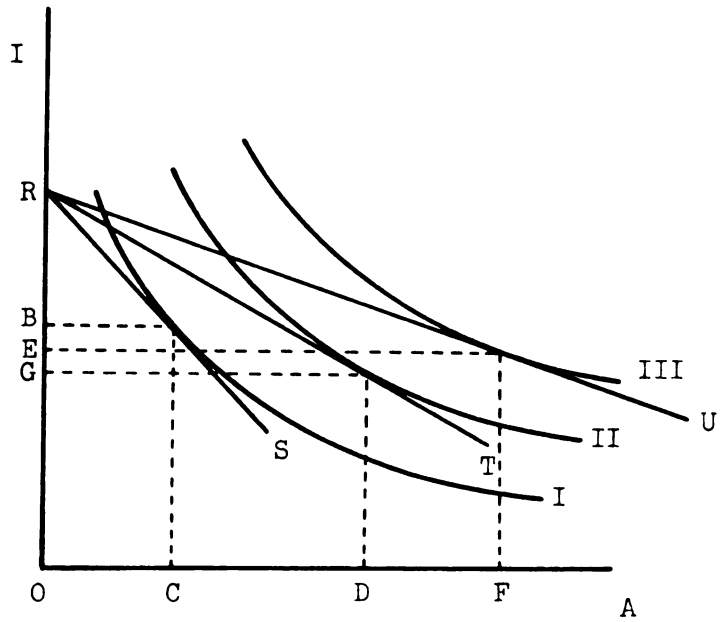


Fig. 2. The Industrial Sector's Indifference Map

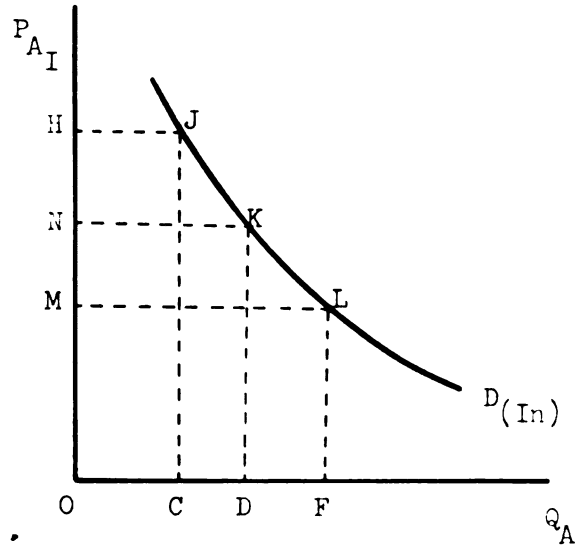
quantities of A produced by the agricultural sector. The quantity of A demanded and the quantity of I supplied depends on the price the industrial sector must pay for A in terms of the quantity of I it must sacrifice. With a price of A in terms of I in Fig. 2 as given by the slope of the line RS, the sector wishes to consume OB of I and OC of A. Since it does not produce A it exchanges the quantity of I it does not consume, RB, for the quantity OC of A. As the price of A in terms of I declines to the slope of the line RT, the sector is willing to supply more I, RG, to obtain more of the relatively cheaper A. As the price of A falls further, represented by the slope of the line RU, more of the relatively cheaper A is demanded, but there is a strong inclination to consume I -- i.e., the marginal rate of substitution of I for A is very small and with I becoming relatively more valuable, the sector is willing to supply less I. Therefore, the quantity of I supplied drops from RG to RE although the quantity of A demanded increases from OD to OF.

It can be observed from Fig. 2 that as the quantity of A a given unit of I can command increases, the higher is the well-being of the sector. Well-being is defined in terms of the level of indifference, i.e., the sector is better off if it can attain the indifference curve marked III than if it can only attain II. Similarly, the curve marked II represents a higher level of well-being than I.

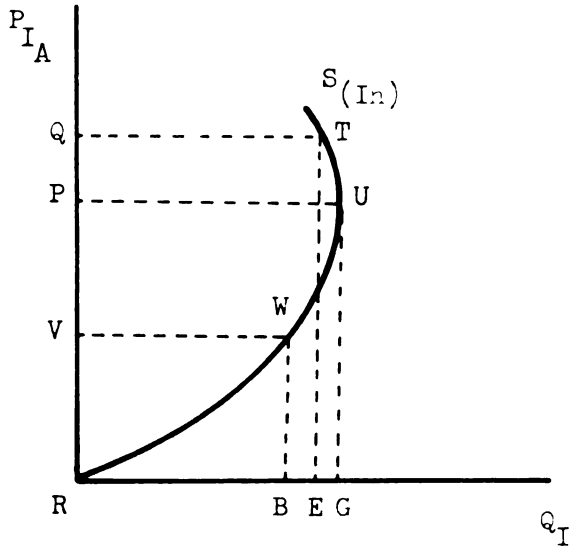
It is possible to derive a demand curve for A and an excess supply curve of I for the industrial sector from Fig. 2 (Fig. 3).

If the price line in Fig. 2 labeled RT is expressed as the price of A in terms of I, P_{A_I}, its value is shown in Fig. 3 (a) by the distance CN. At this price the quantity of A demanded will be CD as is obtained from the horizontal axis of Fig. 2. The price of A in terms of I represented by the price line RU in Fig. 2, is represented in Fig. 3 (a) by the distance CM. At this price the quantity of A demanded is equal to the distance CF. The series of points such as J, K and L in Fig. 3 (a) obtained for all possible prices of A in terms of I forms the industrial sector's demand curve for A.

The excess supply curve can be constructed in the same fashion. It is called an excess supply curve, for it gives the quantity of the sector's total output of I, at various prices, that is not consumed by the sector but is exchanged to obtain A. The price line RT in Fig. 2 can be expressed as the price of I in terms of A, P_{I_A}. Its value is shown in Fig. 3 (b) by the distance RP. The quantity of I the industrial sector is willing to supply at this price is given by the distance RG in Fig. 3 (b). This quantity of I is shown on the vertical axis of Fig. 2. The price line RU in Fig. 2 when expressed as the price of I in terms of A is the distance RQ in



(a) Demand Curve



(b) Excess Supply Curve

Fig. 3. The Industrial Sector's Demand and Excess Supply Curves

Fig. 3 (b). Even though this price increase represents more favorable terms of trade, the industrial sector is willing to supply only RE of I. The series of points such as T, U and W in Fig. 3 (b), obtained for all possible prices of I in terms of A, forms the industrial sector's excess supply curve.

It can be observed that the sector's excess supply curve becomes negatively sloped at the higher prices of I in terms of A. This results from the strong preference for I, and from the fact that each unit of I is becoming more valuable in terms of A. As the price of A declines relative to I, the industrial sector as a consumer substitutes the relatively cheaper A for the more expensive I. However, the sector is also the supplier of I. As the price of I rises relative to that of A, the sector becomes better off. Since neither good is inferior, when the sector becomes better off it will not only consume more A but more I as well. The sector's excess supply curve thus turns back at high prices of I because the positive income effect generated by an increase in the price of I is stronger than the negative substitution effect.

Another useful curve can be derived from Fig. 2, an offer curve for the industrial sector (Fig. 4).

The curve is obtained by determining the total quantities of the sector's output of I that it is willing to offer in exchange for total quantities of A at various prices. For example, at a price represented by the price line RT in Fig. 2, the industrial sector will exchange the quantity RG of I for the quantity OD of A. The price line RT of Fig. 2 is shown in Fig. 4 as the straight line OT with the quantity RG of I shown on the vertical axis as OG and the

quantity OD of A shown on the horizontal axis. If the price line RU of Fig. 2 prevails, the sector will exchange the quantity RE of I for the quantity OF of A. These, too, are shown on the vertical and horizontal axes, respectively, of Fig. 4. The series of points such as J, K and L in Fig. 4 for all possible price lines forms the sector's offer curve.

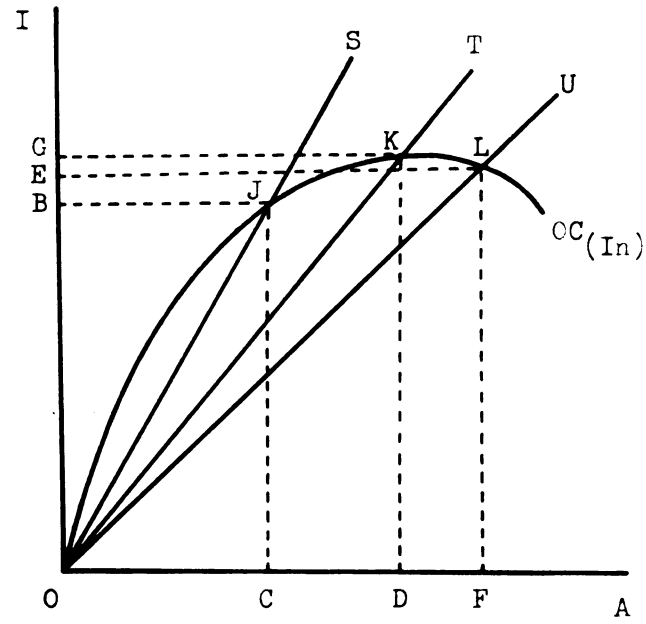


Fig. 4. The Industrial Sector's Offer Curve

It can be observed that the price lines in Fig. 4 have a positive rather than a negative slope as in Fig. 2. This is created by the manner in which Fig. 4 is constructed. Since the interest is in the quantity of I the sector is willing to supply at various prices rather than the quantities it consumes, the origin of Fig. 4 with respect to I is the point R in Fig. 2. The price lines, then, possess the same relationship with respect to the I axis in Fig. 4 as they did in Fig. 2. The relationship of the A axis to the price

lines has been altered by sliding the A axis of Fig. 2 up the I axis until it is perpendicular to the I axis at the point R.

Since Fig. 3 (a), 3 (b), and 4 are all obtained from Fig. 2, Fig. 3 (a) and 3 (b) are implicit in Fig. 4. The curves of Fig. 3 are average curves and that of Fig. 4 is a total curve. For example, at a price of RT in Fig. 2, the sector demands OD of A. It pays ON of I for each unit of A as is shown in Fig. 3 (a). The total quantity of I exchanged for OD of A can be obtained from Fig. 3 (a) by multiplying the price, ON, by OD units of A. The area ONKD of Fig. 3 (a) is the same quantity of I as the distance OG on the I axis of Fig. 4. On the other hand, the quantity of A it must receive in exchange for each unit of its I, at the price represented by RT in Fig. 2, is given by the distance RP in Fig. 3 (b). The total return of A, the product of RP and RG or the area RPUG in Fig. 3 (b), to the sector in exchange for its RG of I can be obtained from Fig. 4 by the distance OD on the A axis.

From Fig. 3 (a) and Fig. 4 price elasticities of demand can be derived, and price elasticities of excess supply can be derived from Fig. 3 (b). The price lines are arbitrarily selected to reveal the full range of elasticities of unitary, greater than unity, and less than unity.

Given an infinitesimal change in the price represented by RT in Fig. 2, the slope of the line representing the new price will be infinitesimally less than the price line OT in Fig. 4. The outlay of I that the industrial sector makes to obtain more A remains constant; the quantity of I measured on the I axis of Fig. 4 remains constant, or, in terms of Fig. 3 (a), the new rectangle that is

formed by the product of the lower price or A in terms of I and the greater quantity of A has the same area as the rectangle ONKD. Given the relationship between price changes, elasticity of demand, and the total quantity spent for a commodity, the price elasticity of demand for A by the industrial sector at point K in Fig. 3 (a) and Fig. 4 is unitary.

A discrete fall in the price of A, represented in Fig. 4 by the decline in the slope of the line OS to that of OT, would increase the outlay of I from OB to OG. The elasticity of the demand curve in Fig. 3 (a) and the offer curve in Fig. 4 between the points J and K is, therefore, elastic.

A discrete fall in the price of A in Fig. 4 from the slope of the line OT to that of OU would reduce the outlay of I from OG to OE. Therefore, the elasticity of the demand curve in Fig. 3 (a) and the offer curve in Fig. 4 between points K and L is inelastic.

Thus, when the slope of the industrial offer curve is zero, the industrial sector's price elasticity of demand for A is unitary; when the slope of the offer curve is positive, its elasticity is elastic; and when it is negative, it is inelastic.

The same phenomenon can be viewed in terms of the excess supply of I rather than in terms of the demand for A. With a price of I in terms of A as given by the line OT in Fig. 4, the quantity of I supplied will be OG as indicated in Fig. 4, or RG as given in Fig. 3 (b). An infinitesimal increase in the price of I does not increase the quantity of I offered. The quantity of I would remain at OG in Fig. 4. The elasticity of excess supply would be zero at point U in Fig. 3 (b).

A discrete increase in the price of I from the inverse slope of the line OS to that of OT in Fig. 4 would increase the quantity of I offered from OB to OG or, in terms of Fig. 3 (b), from RB to RG. With the price of I increasing and the quantity of I also increasing, the elasticity of the excess supply of I with respect to the price of I will be positive between the points W and U on the excess supply curve shown in Fig. 3 (b).

A discrete increase in the price of I from the inverse slope of the line OT to that of OU in Fig. 4 would reduce the quantity of I offered from OG to OE. With the price of I increasing and the quantity of I decreasing, the elasticity of the excess supply curve in Fig. 3 (b) between the points U and T is negative.

If the industrial sector's price elasticity of demand for A is compared with its price elasticity of excess supply, the following relationships can be observed: When the sector's price elasticity of demand for A is unitary, the elasticity of its excess supply curve of I is zero; when the sector's price elasticity of demand is elastic, the elasticity of its excess supply curve is positive; and when its price elasticity of demand is inelastic, the elasticity of its excess supply curve is negative.

Agricultural Sector. The agricultural sector is assumed to be completely comprised of owner-operator, subsistence farmers located in villages. These villages have been relatively untouched by the modernizing influences of urbanization and mass communication. Thus, custom and religious tradition strongly influence patterns of expenditure. The resulting tastes and preferences together with a low per capita income give the sector, as a whole, a strong inclination to

consume the A product. In other words, the marginal rate of substitution of A for I tends to be much greater for the agricultural sector for a given quantity of A than it is for the industrial, i.e., the quantity of I required to compensate for the loss of a unit of A is higher for the agricultural than for the industrial sector.

The total quantity of A produced by the agricultural sector is shown in Fig. 5 by the distance OE on the A axis. This is equal to the quantity OB of A in Fig. 1 (b). The changes in the quantity of I demanded and of A supplied are given for three different prices.

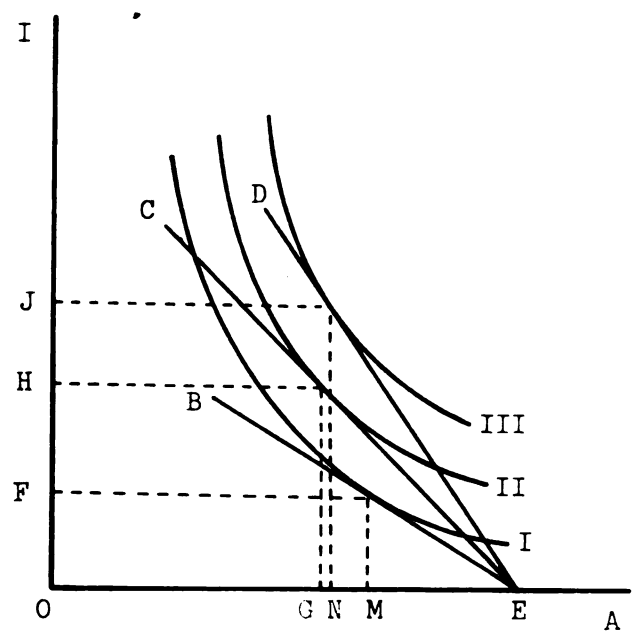
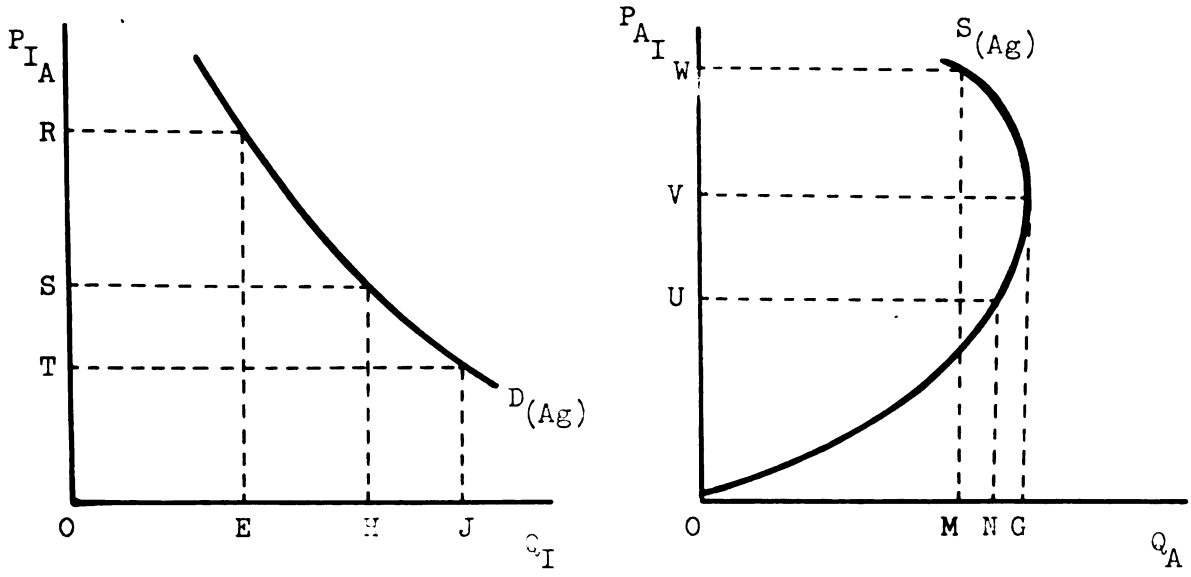


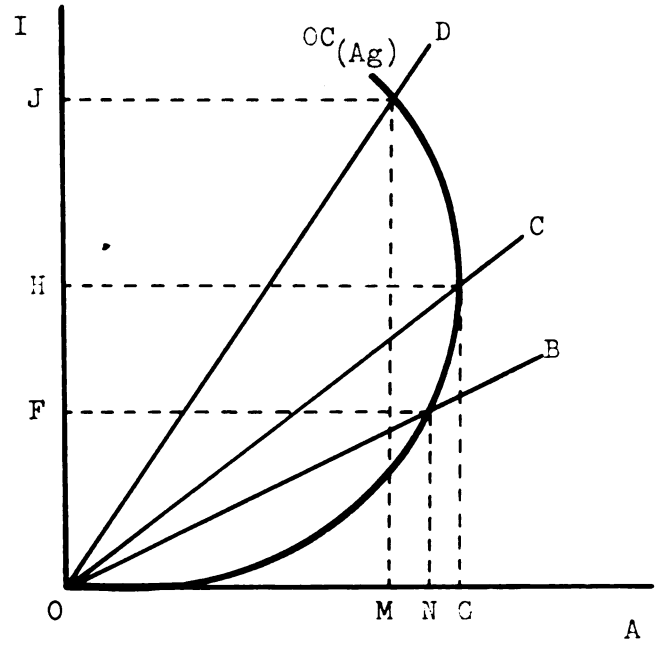
Fig. 5. The Agricultural Sector's Indifference Map

As was done for the industrial sector above, a demand curve, an excess supply curve, and an offer curve are derived from Fig. 5 and shown in Fig. 6. Given the assumption that the agricultural sector strongly prefers the good that it produces over the good that must be obtained through exchange in the market, the same assumption that



(a) Demand Curve

(b) Excess Supply Curve



(c) Offer Curve

Fig. 6. The Agricultural Sector's Demand, Excess Supply, and Offer Curves

was made with respect to the industrial sector, the demand, excess supply, and offer curve of the agricultural sector have much the same appearance as those of the industrial sector. It should be observed, however, that whereas the industrial sector demanded A and supplied I, the agricultural sector supplies A and demands I. The elasticity conditions stated for the industrial sector also hold for the agricultural sector. There is, however, one exception. The price elasticity of demand of agriculture for I is unitary when the slope of the agricultural sector's offer curve is infinite.

In the current development literature, the agricultural sector's excess supply curve has received considerable attention. Although some[17] have objected to the terminology, it is usually called a "marketable surplus" curve. It is commonly conceived as representing the quantity of foodgrains produced by subsistence farmers that is not consumed at the farm but offered on the market.

Several arguments are advanced to explain the curve's negative elasticity. The usual one is that subsistence farmers tend to have rigid cash requirements. As the price of foodgrains rises, these requirements can be met with smaller quantities of grain. Therefore, with a given output, a rise in the price of foodgrains increases the quantity of grain consumed on the farm and reduces the quantity offered on the market.

General Equilibrium between Industry and Agriculture. It is now possible to bring the two sectors together. The combination of

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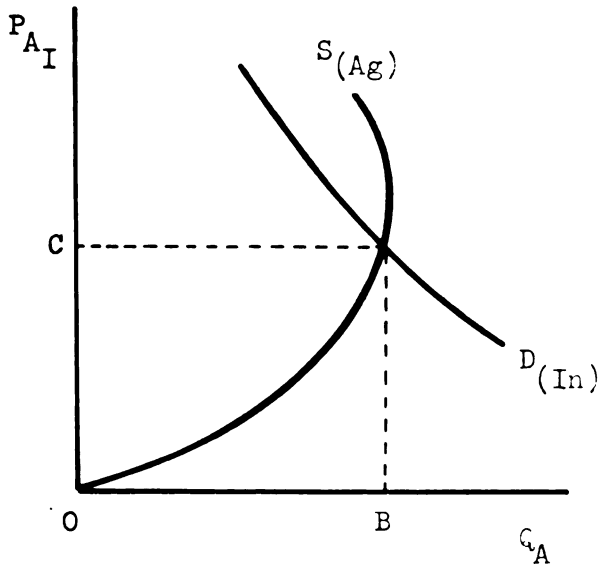
[17] P. N. Mathur and Kannan Ezekiel, "Marketable Surplus of Food and Price Fluctuations in a Developing Economy," Kyklos, Vol. XIV, 1961, Facs. 3, p. 397.

of Fig. 3 (a) and 6 (b) appears in Fig. 7 (a). Fig. 3 (b) and 6 (a) are brought together in Fig. 7 (b). Fig. 4 and 6 (c) are combined in Fig. 7 (c).

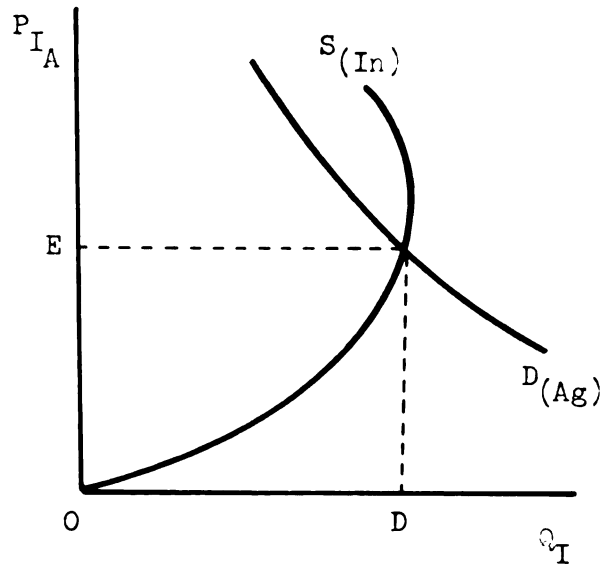
The point at which the two offer curves, $OC_{(Ag)}$ and $OC_{(In)}$, intersect in Fig. 7 (c) provides the equilibrium price solution between the two sectors. This is clearly demonstrated in Fig. 7 (a) and (b). When the price line CF in Fig. 7 (c) is expressed as the price of A in terms of I, OC in Fig. 7 (a), the quantity of A demanded by the industrial sector, OB in Fig. 7 (a), is equal to the quantity of A the agricultural sector is willing to provide at the price of OC. The distance CB of A in Fig. 7 (a) is the same CB as indicated on the horizontal axis of Fig. 7 (c). When the price line OF is expressed as the price of I in terms of A, CE in Fig. 7 (b), the quantity of I demanded by the agricultural sector is equal to the supply offered by the industrial sector at the price of CE. The distance OD in Fig. 7 (b) is the same as the distance CD on the vertical axis of Fig. 7 (c).

An Agricultural Productivity Increase. The above equilibrium position of the model is for a specific duration of time. For the same duration the increase of agricultural output as shown in Fig. 1 (b) by the distance BD is introduced, and a new equilibrium position between the two sectors is determined. Although the initial and new equilibrium positions are in terms of the same duration, these durations are at two different points in time. The analysis then becomes a form of comparative statics.

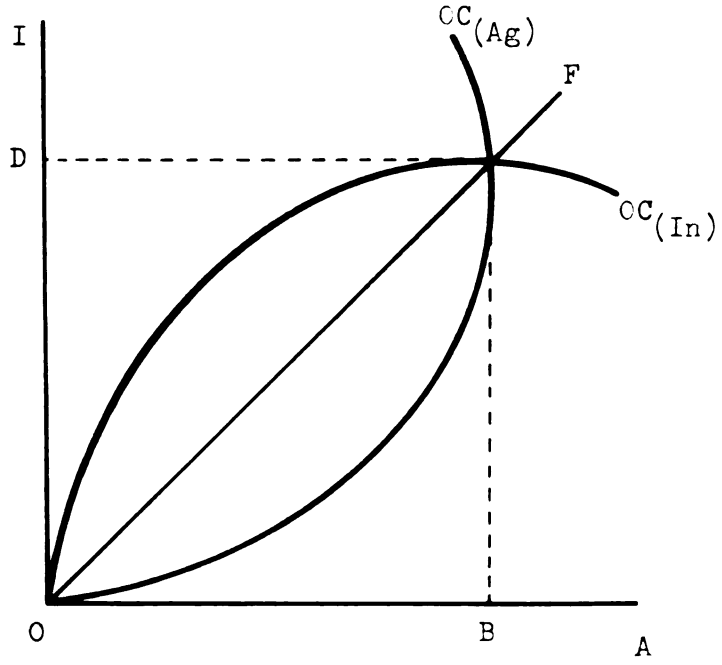
The increased output of A is shown in Fig. 8 by the distance BD, the same BD as shown in Fig. 1.



(a) Industrial Demand and Agricultural Supply



(b) Agricultural Demand and Industrial Supply



(c) Industrial and Agricultural Offer Curves

Fig. 7. The Equilibrium Price between the Industrial and Agricultural Sectors

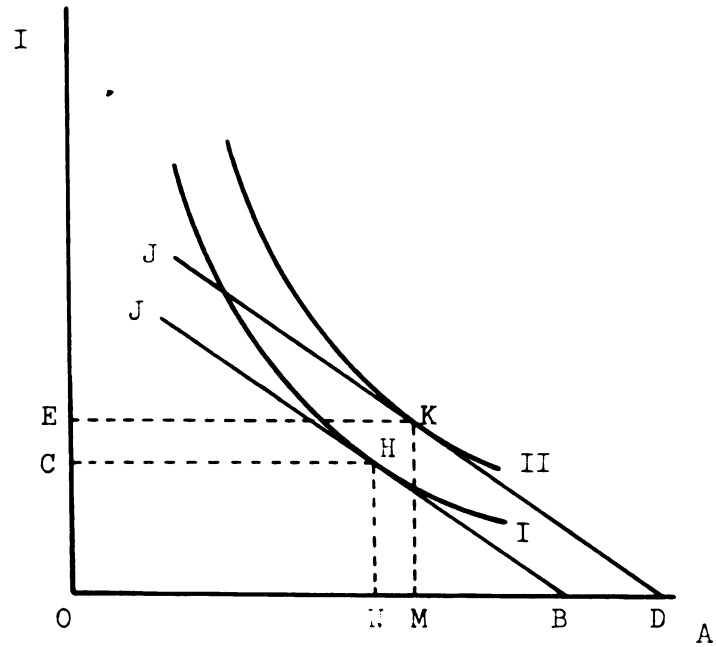
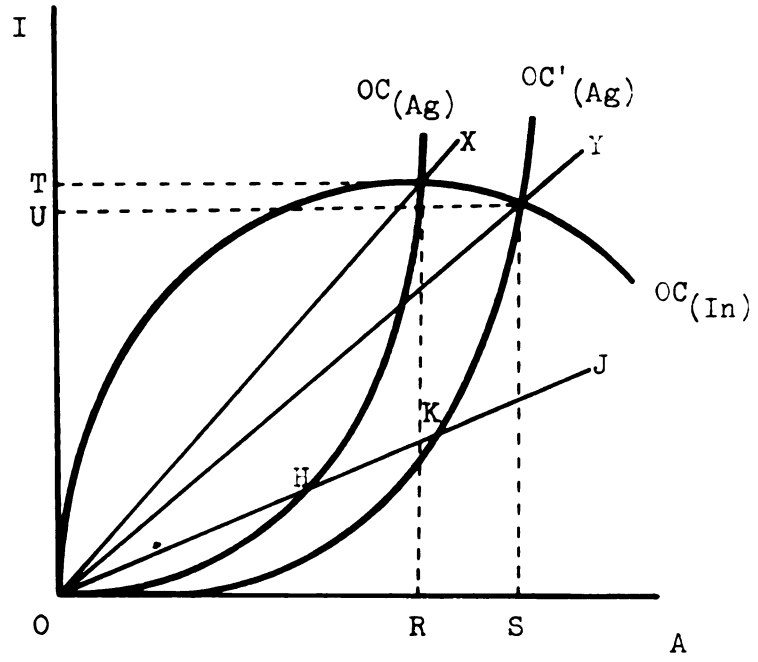


Fig. 8. An Agricultural Productivity Increase

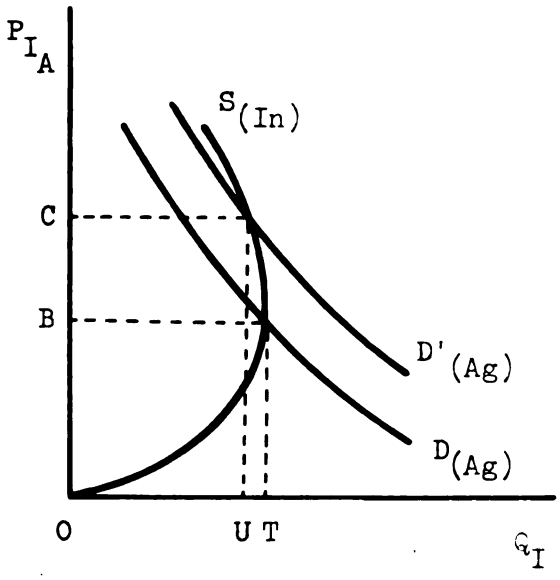
The period of time considered is short enough that the increased output of A does not alter the shape or position of the sector's indifference curves. The effect of the increased output on the sector's demand for I and supply of A is shown in Fig. 8.

At the price of A in terms of I given by the slope of the price lines BJ and DJ (both lines have the same slope), the quantity of I demanded has increased from OC to OE, and the quantity of A supplied from BN to DM. The quantity of A supplied has increased because the quantity NM of A, the increased quantity of A consumed by the agricultural sector, is less than the quantity BD of A, the increased quantity of A available.

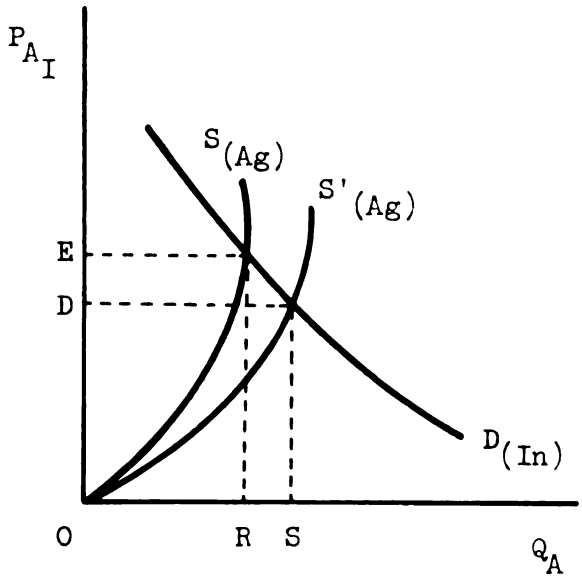
As has been done previously, Fig. 9 (a), (b), and (c) are derived from Fig. 8. The price lines BJ and DJ of Fig. 8 are given in Fig. 9 (a) by the price line CJ. The quantity OC of I in Fig. 8 is



(a) Industrial and Agricultural Offer Curves



(b) Agricultural Demand and Industrial Supply Curves



(c) Industrial Demand and Agricultural Supply Curves

Fig. 9. The Equilibrium Price Change between the Agricultural and Industrial Sectors

equal to the I coordinate at point H in Fig. 9 (a), and the quantity OE in Fig. 8 is equal to the I coordinate at point K in Fig. 9 (a). The quantity BN of A supplied by the agricultural sector to the industrial sector in Fig. 8 is equal to the A coordinate of the point H in Fig. 9 (a), and the quantity DM of A in Fig. 8 is equal to the A coordinate of point K in Fig. 9 (a). When all possible prices of A in terms of I are considered, a new offer curve for the agricultural sector is determined, the curve labeled $OC'_{(Ag)}$ in Fig. 9 (a). The industrial offer curve remains unchanged.

The equilibrium price between the two sectors has turned against agriculture by moving from OX to OY in Fig. 9 (a). (The initial equilibrium price, OX, was arbitrarily drawn to intersect the industrial offer curve at the point its slope is zero.) The price of I in terms of A has increased from OB to OC as shown in Fig. 9 (b). The price of A in terms of I has fallen from OE to OD in Fig. 9 (c). In other words, according to Fig. 9 (b) the agricultural sector must now pay OC of A for each unit of I. Previously, it was paying only OB. Observing the same thing in terms of the quantity of I received from trading A, Fig. 9 (c) indicates that previously the agricultural sector received OE of I for each unit of A; it now receives only OD. Observing the change in total quantities given in Fig. 9 (a), the agricultural sector is exchanging RS more of A but obtaining TU less of I. In other words, the total return in terms of I to the agricultural sector has declined with the increase in the output of A. This agrees with the elasticity analysis made above, for the industrial offer curve of Fig. 9 (a) has a negative slope between the points the initial and new agricultural offer curves intersect

it -- the elasticity of demand for A by the industrial sector is inelastic.

Total Agricultural Output in Terms of I. The preceding analysis provides a means for evaluating the quantity of A traded in terms of I, but it does not evaluate that portion of A consumed on the farm. In subsistence economies this portion can be sizeable. If the quantity of A consumed on the farm is valued at the market price, a total evaluation of A in terms of I can be made by combining Fig. 5 and Fig. 2 into Fig. 10.

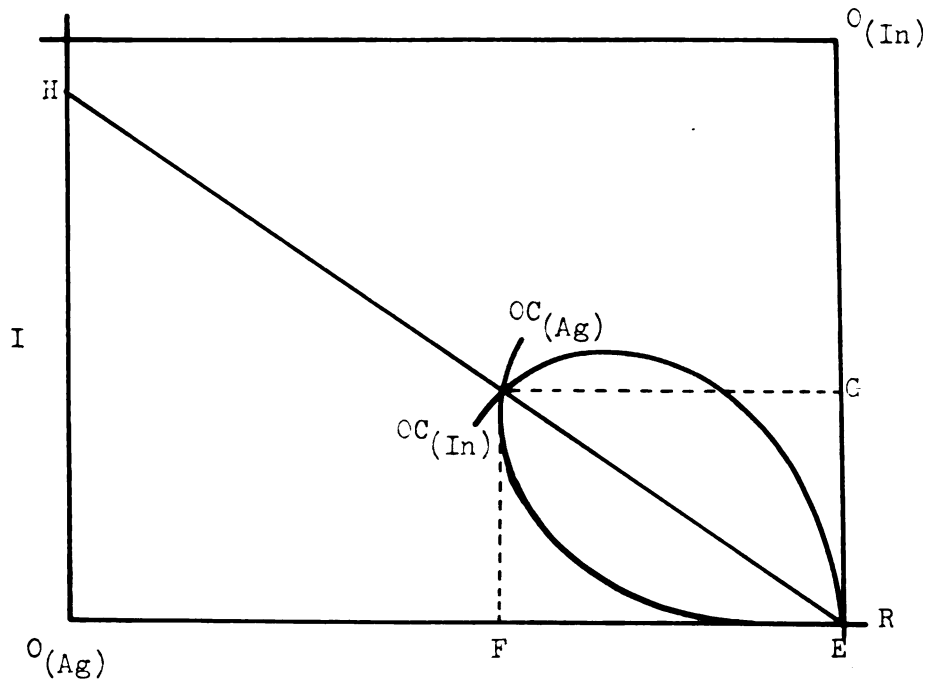


Fig. 10. The Evaluation of Total Agricultural Output

The position of Fig. 5 remains unchanged. Fig. 2 is rotated 180 degrees and placed on top of Fig. 5 so that in Fig. 10 the upper right-hand corner of the rectangle is the industrial sector's

origin. The quantity of I produced by the industrial sector, $O_{(In)}R$, is the length of the vertical sides of the rectangle. The quantity of A produced by the agricultural sector, $O_{(Ag)}E$, is given by the length of the horizontal sides of the rectangle. The offer curves, $OC_{(Ag)}$ and $OC_{(In)}$, are formed by connecting the points that separate the sector's output into that part that it consumes itself and that part it exchanges for industrial product at all possible prices. The equilibrium price between the two sectors is the line beginning at the common point of R and E and passing through the point at which the two offer curves intersect. The agricultural sector consumes $O_{(Ag)}F$ of A and trades the remainder of its production of A, FE, for RG of I. The value of the quantity FE of A in terms of I is RG. Evaluating the quantity of A consumed by the agricultural sector on the basis of the market or equilibrium price, the total quantity of A, $O_{(Ag)}E$, is equal to $O_{(Ag)}H$ of I. The agricultural sector's total income is thus equal to $O_{(Ag)}E$ of A when expressed in terms of A, and $O_{(Ag)}H$ of I when expressed in terms of I.

The increased output of A is shown in Fig. 11 by shifting the agricultural sector's origin in Fig. 10 to the left. The new equilibrium price begins at the common point of R, B, and D and passes through the point at which the new agricultural offer curve, $OC'_{(Ag)}$, intersects the industrial offer curve, $OC_{(In)}$. The increased quantity of A, $O'_{(Ag)}D$, is equal to $O'_{(Ag)}L$ of I. The increase of the agricultural sector's output of A has reduced the sector's total income in terms of I, i.e., the distance $O'_{(Ag)}L$ is less than the distance $O_{(Ag)}H = O'_{(Ag)}H'$. If the terms of trade had remained unchanged by the increased output of the agricultural sector, the

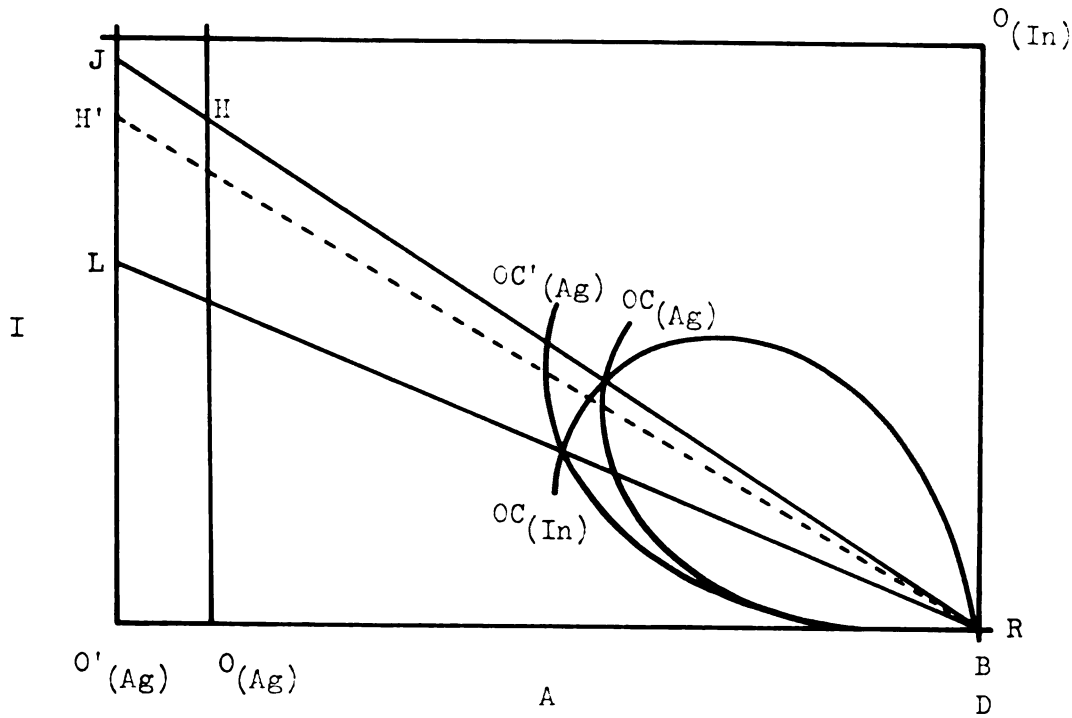


Fig. 11. The Evaluation of Increased Agricultural Output

elasticity of demand of the industrial sector for A being perfectly elastic, the agricultural sector's total income in terms of I would have increased by the distance H'J in Fig. 11. A new equilibrium price line with a slope less than that touching the I axis at J and greater than that touching at H' will increase the agricultural sector's total income in terms of I. An equilibrium price less than that touching the I axis at H' will reduce the agricultural sector's total income in terms of I. With a fall in the agricultural sector's total income in terms of I and a constant population, the agricultural sector's per capita income in terms of I would fall. The industrial sector will thus not be forced to increase the industrial wage because of the increased productivity of the agricultural sector. If, on the other hand, the agricultural sector's per capita

income in terms of I increases, population in the agricultural sector remaining constant, the industrial wage must rise if industry is to obtain labor from agriculture.

Conclusion

The foregoing analysis has made it possible to relate the output changes of Fig. 1 (b) to the wage value in Fig. 1 (a). It is the magnitude of change in the terms of trade, assuming a constant population, that determines the result of the relationship.

On the basis of this analysis, the amount the terms of trade will change with increased agricultural output can be generalized for various values of the relevant variables.

First, the greater the increased quantity of A consumed by the agricultural sector at given prices, the smaller will be the quantity of A offered to the industrial sector. Therefore, the less the agricultural sector's offer curve will shift to the right. This is shown in Fig. 12 by the shift of the agricultural sector's offer curve from OC to OC' rather than from OC to OC", for the slope of the line OE is greater than that of OF. Therefore, the greater the agricultural sector's income elasticity to consume its own output, the less the terms of trade will turn against it. There is, however, one exception. If the industrial offer curve were perfectly elastic, the terms of trade would remain unchanged regardless of the agricultural sector's income elasticity of demand for A.

Second, in Fig. 13 the industrial offer curve labeled $OC_{(In)}$ has a price elasticity of less than unity between the points at which it intersects the initial and the new agricultural offer curves. On the other hand, the industrial offer curve labeled

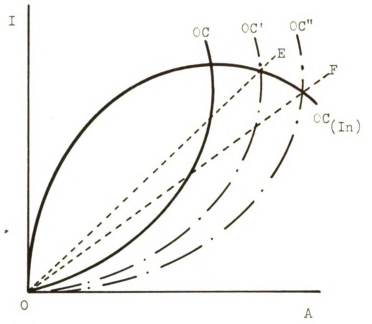


Fig. 12. The Result of Varying the Agricultural Sector's Income Elasticity

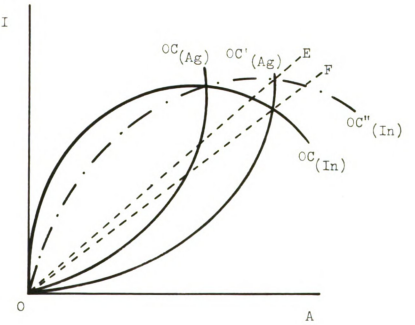


Fig. 13. The Result of Varying the Industrial Sector's Price Elasticity

$OC''_{(In)}$ has a unitary elasticity between the points it intersects the initial and new agricultural offer curves. Observing the relevant price lines, it follows that the less inelastic the industrial sector's price elasticity of demand for A is, the less the terms of trade will turn against agriculture. The result is unchanged if $OC_{(Ag)}$ intersected $OC_{(In)}$ while it was increasing. Again this generalization holds only if the new agricultural offer curve is not perfectly elastic.

Third, the difference between the I coordinates of points H and J in Fig. 14 gives the increase in the quantity of I demanded by the agricultural sector after its output is increased at the initial equilibrium price. Two sets of agricultural offer curves are shown.

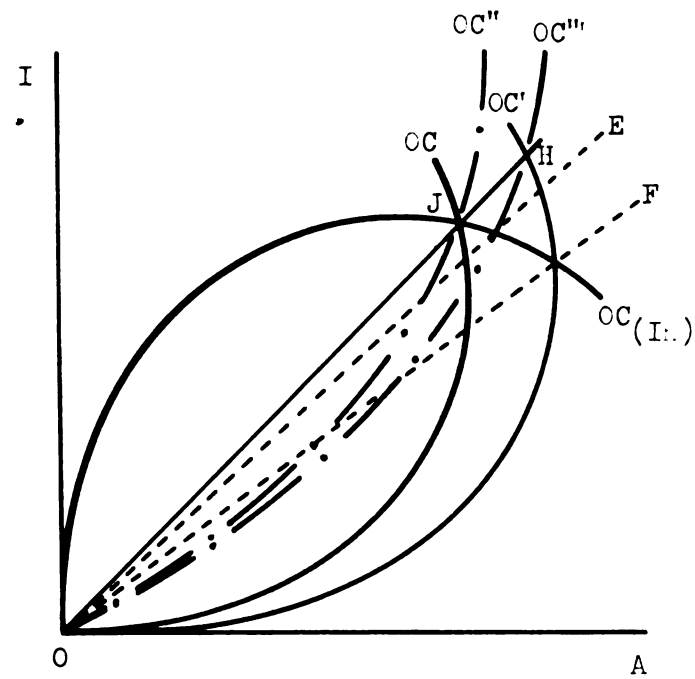


Fig. 14. The Result of Varying the Agricultural Sector's Price Elasticity

The two initial ones, OC and OC", pass through the point J. The two new ones, OC' and OC"', pass through the point H. The offer curve labeled OC"' is elastic between point H and the point it intersects the industrial offer curve. The offer curve labeled OC' is inelastic between point H and the point it intersects the industrial offer curve. Therefore, the more elastic the agricultural sector's price elasticity of demand is for industrial products, the less the terms of trade will turn against agriculture, provided the industrial offer curve is not perfectly elastic.

Lastly, as long as the agricultural sector's income elasticity of demand for A is less than unity, the smaller the proportion of the total output of A it consumes, the less the terms of trade will turn against it. This follows from the relationship that the larger the initial quantity of A offered, the larger will be the base on which the percentage increase in the quantity of A offered is computed. Therefore, the smaller will be the percentage increase in the quantity of A offered to the industrial sector. The smaller the proportional increase of A offered, the less the terms of trade will turn against agriculture.

It is the objective of the next chapter to determine the terms of trade when the likely "real world" values of the above variables are employed.

CHAPTER IV

EMPIRICAL ORIENTATION OF THE MODEL

Introduction

In Chapter III an increased agricultural output was allocated into that part consumed by the agricultural sector and that part which the sector exchanged to obtain more industrial product, i.e., the agricultural sector's income elasticity for consuming its own product. Chapter III also discussed the changes in the quantities of agricultural and industrial goods consumed by both sectors when the relative price of the two products was altered, i.e., the price elasticity of industry for the agricultural product and of agriculture for the industrial product. These results were displayed by appropriate offer curves which were derived from the shape and position of each sector's community indifference curves.

There are some major problems in deriving empirical community indifference curves.[18] Despite this, several studies have been undertaken to estimate income and price elasticities for national economies as well as their various sub-parts. The purpose of this chapter is to draw upon these studies to determine the shape and position of the relevant offer curves. In other words, rather than obtaining a range of income and price elasticities from offer curves

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[18] See Paul A. Samuelson, "Social Indifference Curves," Quarterly Journal of Economics, Vol. LXX (February 1956), pp. 1-22, and Tibor deScitovszky, "A Reconsideration of the Theory of Tariffs," Review of Economic Studies, Vol. IX (Summer 1942), pp. 89-110.

as was done in Chapter III, this chapter arrives at the shape and position of the offer curves from the various estimated elasticities.

In the analysis that follows, the United States case is first examined. Next, attention will be turned to such estimates and data as have been developed for other parts of the world. This will provide a basis for generalization as to the probable empirical ranges within which the variables under consideration may actually fluctuate.

United States

The average value of all food products at the farm level in the United States for 1954-56 was estimated to be 26.8 billion dollars.[19] The agricultural sector's personal income from this production was approximately 49.3 per cent of the total, or 13.2 billion dollars.[20]

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[19] USDA, Supplement for 1959 to Measuring the Supply and Utilization of Farm Commodities, Supplement for 1959 to Agricultural Handbook No. 91, September 1960, p. 22.

[20] Only those inputs obtained outside the agricultural sector were used in determining the cost of production. The return to inputs obtained by interfarm transactions were considered as changes in the distribution of income within the agricultural sector. The cost of non-farm inputs was obtained from data gathered by Ralph Loomis, Agricultural Economist, Farm Economics Research Division, USDA, in which he tabulated price aggregates of purchased and non-purchased agricultural inputs.

Although the data of gross farm income and total production expenses obtained from the Farm Income Situation, ERS, USDA, did not provide breakdowns for food and non-food categories, Wylie D. Goodsell's "Production Costs on 23 Important Types of Farms," The Farm Cost Situation, ARS, USDA, May 1956, pp. 21-27, indicated that the proportion of production expenses to gross farm income varied only slightly when cotton and tobacco farms were excluded. There was a variation from 61.6 to 62.2 per cent. It was also noted that the proportion of non-farm goods and services of total cash expenditures also varied little when cotton and tobacco farms were not included. The proportion varied from 60.5 to 62.0 per cent. The proportion of food was thus assumed to be of the same magnitude as the proportion of non-farm purchased inputs to gross income obtained from the production of all agricultural products.

Disposable income was approximately 70 per cent of personal income, or 9.2 billion dollars. According to the Household Food Consumption Survey of 1955, rural farm families were spending 53.3 per cent of their income on food. Some 40.3 per cent of this food was obtained without direct expense for use at home.[21] In other words, the agricultural sector spent 4.9 billion dollars for food of which 2.0 billion dollars was home supplied. The remaining 2.9 billion dollars of food consumed by farm households was pruchased in the market. Fifty-nine per cent of the value of purchased food accrued to the industrial sector in the form of marketing costs.[22] The value of food products purchased by farm households, valued at the farm price level, was then 1.2 billion dollars. The agricultural sector was thus spending a total of 3.2 billion dollars on food valued at the farm price level. The United States was importing on the average 2.3 billion dollars of food for 1954-56. No figures are available to determine the quantity of these imports which were consumed by food producers. It was therefore assumed that the proportion of food imports consumed by the farm population was the same as the proportion the farm population was of total population, i.e., 11.5 per cent.[23] Food producers were thus consuming 0.3 billion dollars of food imports which, when subtracted from their total food consumption of

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[21] USDA, Food Consumption of Households in the United States, AMS, December 1956, p. 15.

[22] U.S. Department of Commerce, Statistical Abstract of the United States 1957, Bureau of the Census, Washington, D.C., 1957, p. 639.

[23] USDA, Farm Income Situation, Economic Research Service FIS-191, July 1963, p. 37.

3.2 billion dollars, resulted in their consuming 2.9 billion dollars of domestically produced food. Food producers were, therefore, consuming 10.8 per cent of the total domestic food production.

On the basis of the Household Food Consumption Survey of 1955, FAO derived an income elasticity coefficient of total food expenditures for rural consumers of 0.18.[24]

The agricultural sector's price elasticity of demand for industrial goods was implicitly assumed by Enke to be less than unity when he assumed that the income effects outweighed the substitution effect of a change in the price that a fixed agricultural output could command.[25] Gutman also assumed the same price elasticity to be unity or less.[26] For the purpose of the analysis that follows, the value of unity will be used. This is the value at which the terms of trade are most favorable for agriculture within the range given by the two authors, i.e., the more inelastic the agricultural sector's price elasticity of demand for industrial goods, other things equal, the more the terms of trade will turn against agriculture (see Fig. 14). This then gives us a limiting case. If income declines in this case, it is even more likely to occur under the Enke-Gutman assumptions.

The industrial sector's price elasticity of demand for agricultural goods was assumed by both authors to be less than unity. Since the more inelastic the demand, the more the terms of trade

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[24] FAO, The State of Food and Agriculture, 1959, Rome 1959, p. 195.

[25] Stephen Enke, op. cit., p. 88.

[26] G. O. Gutman, op. cit., p. 326

would turn against agriculture (see Fig. 13), an upward limit of unity will be employed.

It is not to be implied that the upward limits of unity for the above two price elasticities are applicable for a developed country like the United States. Certainly a value of unity would be an upward limit for industry's price elasticity of demand for food: Schultz estimated a range of price elasticities for all food at retail between -0.25 and -0.40.[27] However, agriculture's price elasticity of demand for non-food is likely to be greater than unity in the United States. One would expect, however, that the lower the level of per capita income of the agricultural sector the more likely its price elasticity of demand for non-food would be unity or less. In the diagrammatic analysis for the United States that follows, the value of unity was used for both price elasticities to accord with the assumptions of Enke and Gutman and to facilitate the extension of the United States case to that of the developing countries.

The relationship between the above variables is given in diagrammatic form in Fig. 15. This is the same diagram as Fig. 11 in Chapter III. The distance OB on the food axis is 10.8 per cent of the total quantity of food, OD, which represents the quantity of food consumed by the agricultural sector in the United States. The remainder, BD, is exchanged for ED of non-food. The quantity ED of non-food represents the proportion of industrial output that is not consumed by the industrial sector. (The total quantity of non-food is not shown on the vertical axis of the figure).

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[27] Theodore W. Schultz, The Economic Organization of Agriculture, McGraw-Hill, 1953, p. 187.

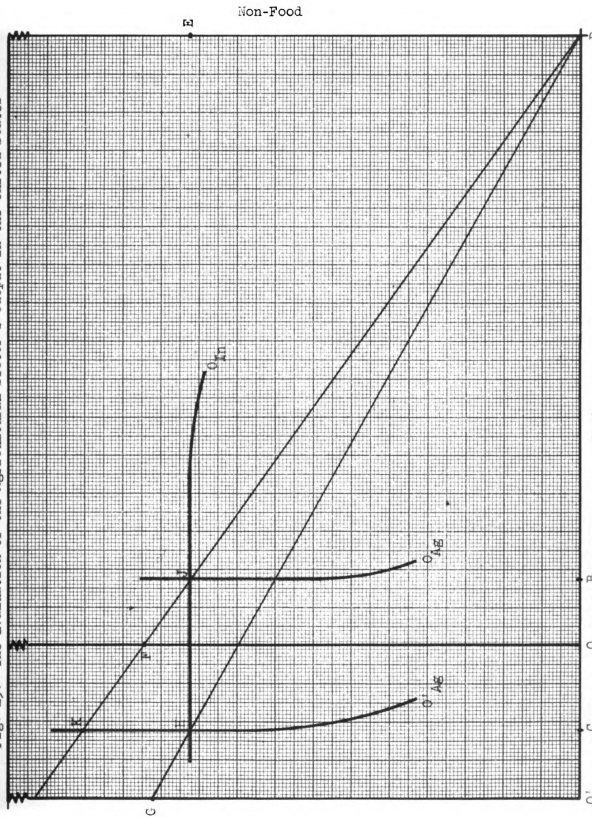

Fig. 15. The Evaluation of the Agricultural Sector's Output in the United States

Since BD of food is exchanged for DE of non-food, the price of food in terms of non-foods is given by the slope of the line beginning at D and passing through J. An increase in the food productivity of the agricultural sector is introduced by shifting the food origin from O to O'. The quantity of food has increased from OD to O'D, an increase of 25 per cent. This represents an increase of income to the agricultural sector of 25 per cent in terms of food. With an income elasticity of demand for food of 0.18, the quantity of food consumed by the agricultural sector increased from OB to O'C, an increase of 4.5 per cent. Assuming that both price elasticities are unity, i.e., the O_{In} offer curve is parallel to the food axis between the points J and H at a level of DE on the non-food axis, and the O'_{Ag} offer curve is perpendicular to the food axis between the points H and K at a distance C from the O' origin on the food axis, the intersection point of the two offer curves is at H. The new equilibrium price of food in terms of non-food is given by the slope of the line beginning at D and passing through point H.

Although the agricultural sector has increased its quantity of food by 25 per cent, its purchasing power to obtain non-food and food services has declined. The original quantity of food, OD, expressed in terms of non-food is equal to OF. The greater quantity of food, O'D, when expressed in terms of non-food is equal to O'G. Inspection of Fig. 15 indicates that the distance OF is greater than the distance O'G. Therefore, the increased productivity of the agricultural sector has brought about a decrease in the sector's income in terms of non-food. Assuming no change in the population of the sector, the per capita income of agriculture has fallen in terms of industrial goods.

There is nothing new and startling in this discussion. It simply shows diagrammatically what every agricultural economist knows, namely, that an increase in agricultural production has not meant improvements in farm income. Those improvements which have occurred stem from out-migration of labor, government price supports, export programs, farm reorganizations to reduce costs, etc.

Generalization of the United States Case

If the above-mentioned values of the variables are altered, some interesting results occur. For example, if the proportion of the total output of food consumed by the agricultural sector was 90 per cent rather than 10 per cent and the other variable values remained unchanged, the terms of trade would be more unfavorable for agriculture. In Fig. 16 the slope of the line beginning at D and passing through H' is less than the slope of the line beginning at D and passing through H. This condition arises because of the fourth generalization given in the conclusion of Chapter III, i.e., the larger the initial quantity of food offered, the less will be the proportional increase in the quantity of food offered to the industrial sector, and, thus, the less the price of food in terms of non-food will decline.

If now the proportion of the total food supply consumed by the agricultural sector is held at 10 per cent, and the agricultural sector's income elasticity of demand for food is increased from 0.18 to 0.90, the terms of trade become more favorable for agriculture. This is shown in Fig. 17, for the slope of the line beginning at D and passing through H is much less than that of the line beginning at D and passing through H".

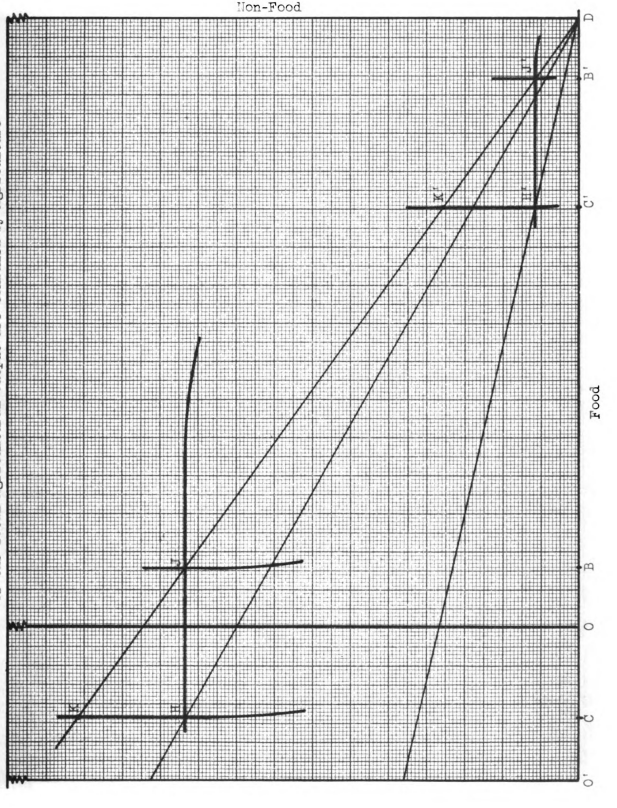

Fig. 16. The Evaluation of the Agricultural Sector's Output when Various Proportions of the Total Agricultural Output are Consumed by Agriculture

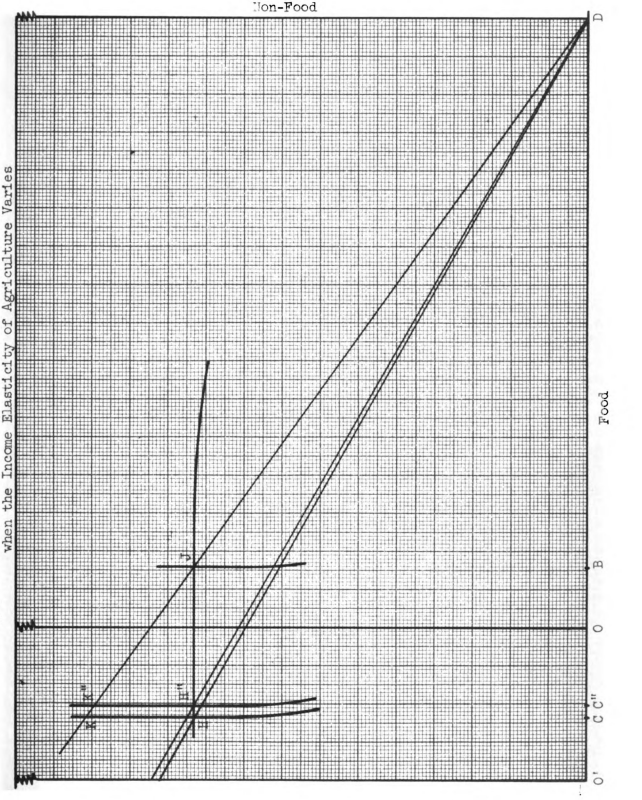

Fig. 17. The Evaluation of the Agricultural Sector's Output when the Income Elasticity of Agriculture Varies

The smaller the quantity of the total food supply consumed by the agricultural sector, the less unfavorable the terms of trade will be for agriculture; and the closer the agricultural sector's income elasticity of demand for food approaches unity, the closer the value of the increased agricultural output in terms of non-food approaches the value of the initial agricultural output. If the agricultural sector's income elasticity of demand for food is unitary, the proportion of the total food supply consumed by the agricultural sector has no effect upon the terms of trade, and the value of the increased quantity of agricultural output in terms of non-food is equal to the value of the initial agricultural output. In Fig. 18 the terms of trade remain unchanged regardless of whether the agricultural sector consumed 10 or 90 per cent of the total food supply. It can also be observed that the distance O'G is equal to the distance OF on the non-food axis. Therefore, when the two price elasticities are unitary, an increased agricultural output is worth a greater quantity of non-food only when the agricultural sector's income elasticity of demand for food is greater than unity.

Table I contains both developed and developing nations. However, none of their rural sectors has an income elasticity of demand for food greater than unity.

In a special supplement to the FAO Commodity Review, the Commodities Division of FAO Economics Department presented the results of a study designed to determine the prospective production and demand for primary products by 1970.[28] Their estimates of

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[28] FAO, Agricultural Commodities Projections for 1970, FAO Commodity Review, Special Supplement, Rome, 1962.

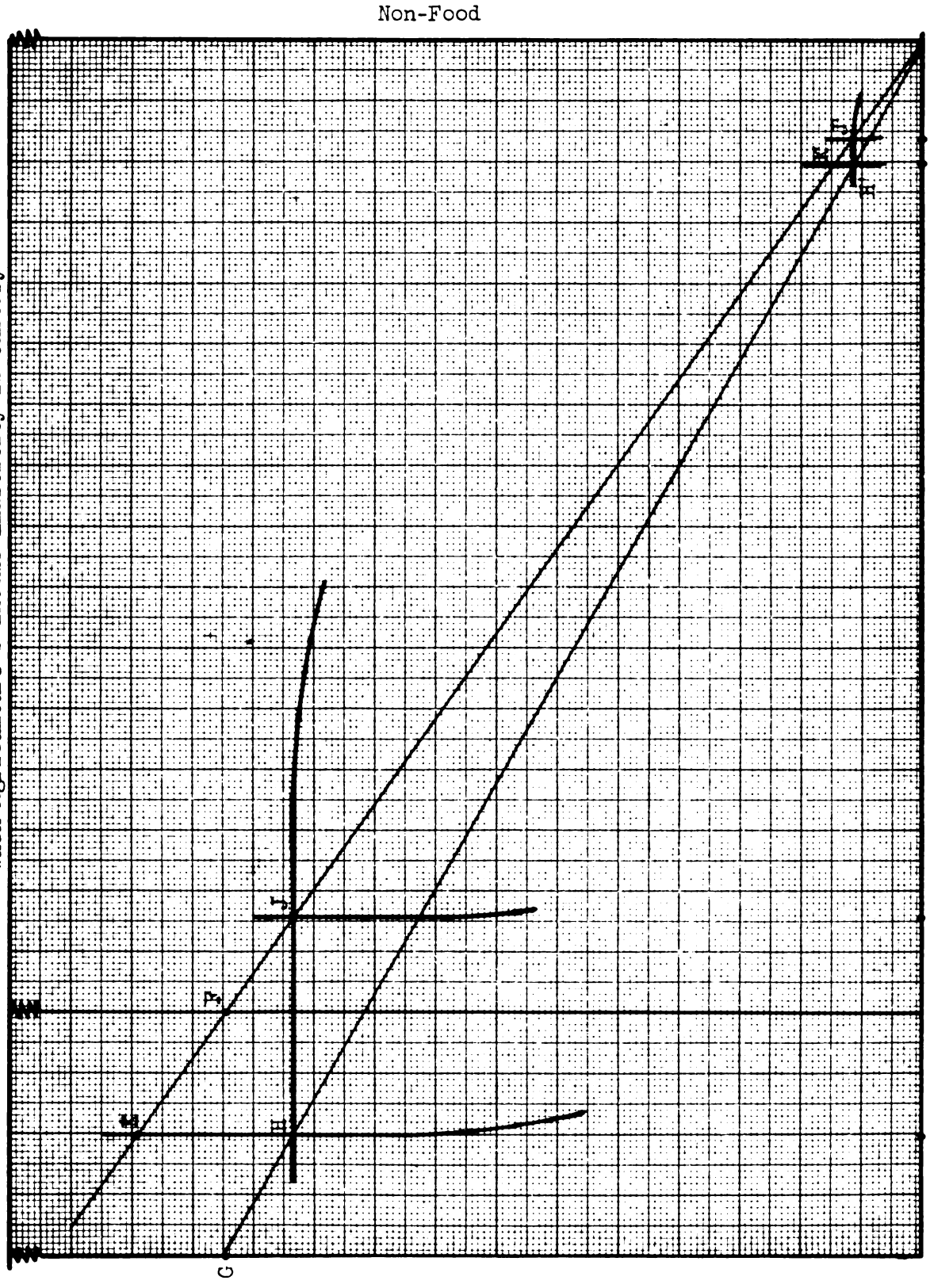

Fig. 18. The Evaluation of the Agricultural Sector's Output when Agriculture's Income Elasticity is Unitary

TABLE I

Income Elasticity Coefficients of Food Expenditure in Rural Districts in Selected Countries

Country	Year	Total Food Expenditure
United States	1955	0.18
United Kingdom[a]	1953/54	0.60
Italy[b]	1953	0.65
Italy[c]	1953	0.74
Japan	1955	0.48
India[d]	1952	0.87
West Pakistan[e]	1961	0.75
Taiwan	1950/51	0.54

a. County of London
b. Central North Region
c. South
d. NSS Fourth Round
e. Sub-sample NSS Third Round

Source: UN, The State of Food and Agriculture, 1959, FAO, Rome, 1959, p. 195; Christoph Beringer, PL 480 and Economic Development, Institute of Development Economics, Karachi, 1963, p. 43; Mo-huan Hsing, Relationships between Agricultural and Industrial Development in Taiwan During 1950-59, a report prepared for ECAFE under the sponsorship of JCRR, December 1960, p. 101.

income elasticities and the assumptions with respect to population and income changes upon which the estimates were made are given in Table II. Here again, none of the estimated elasticities exceeded unity.

These conclusions are based on the assumption that the industrial sector's price elasticity of demand for food and that agriculture's price elasticity of demand for non-food are both unitary. Because of the scarcity of reliable time-series data, empirical justification of these assumptions for developing economies is extremely difficult to obtain. The following are intended only to be suggestive of possible values.

C. M. Palvia[29] estimated the price elasticity of demand for farm products in India at -0.3. If this value is appropriate for the industrial sector's demand for food, assuming the agricultural sector is consuming 50 per cent of India's total food supply, and the agricultural sector's income elasticity for food is 0.87; the agricultural sector's price elasticity for non-food can be as high as -1.9 without causing the terms of trade to become more favorable for agriculture than in the case where both elasticities are equal to one.

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[29] C. M. Palvia, An Econometric Model for Development Planning (With Special Reference to India), dissertation, Rotterdam School of Economics, The Hague, 1953, pp. 32-33, as given in Ansley J. Coale and Edger M. Hoover, Population Growth and Economic Development in Low-Income Countries, A Case Study of India's Prospects, Princeton University Press, 1959, pp. 128-9.

TABLE II

Income Elasticity of Demand for Food
and Assumptions Made on Population and Income Growth

		Asia and Far East (excl. Japan)	Near East and Africa (excl. S. Africa)	Lat. America (excl. Argentina and Uruguay)	Japan	Mediterr. Europe	North America
GNP per caput (US $ 1/ 1957/59)		165	260	491	910	575	2 190
Income 2/ elasticity of the demand for all food expressed in terms of:							
Farm Value		0.9	0.7	0.6	0.6	0.55	0.16
Basic assumptions:		..... per cent per year compound					
Population		2.3	2.5	2.7	0.7	1.0	1.8
GNP per caput	(Low	1.3	1.5	2.0	5.3	3.9	1.3
	(High	2.5	2.8	2.8	6.3	5.2	2.5
GNP	(Low	3.6	4.0	4.7	6.0	4.9	3.1
	(High	4.9	5.3	5.6	7.0	6.2	4.4

1/ Converted into US $ at 1955 prices according to purchasing power parity.

2/ Value of the income elasticity in the base period 1957/59. The values were derived from the projected demand for each major food group in each country or group of countries.

Although there were no estimates available for the agricultural sector's price elasticity of demand for non-food, Raj Krishna,[30] with limited empirical evidence, highly discounted the possibility of a negative price elasticity for the market supply of wheat; or, alternatively, that the elasticity of demand for other products by wheat producers is unity or less. However, the amount the demand elasticity was greater than unity could not be determined. The author's objective was to establish that the elasticity of the excess supply curve was not negative.

Assumptions Relaxed

On the basis of the evidence available it would appear that an increased agricultural output is not likely to command a greater quantity of industrial product. Therefore, with population unchanged, the quantity of labor in each sector held constant, and the initial wage differential representing an equilibrium position between the two sectors, the agricultural productivity increase would cause the per capita income of agriculture to become a smaller proportion of the industrial wage. Thus, the differential between them would increase. Labor would have an added incentive to flow from agriculture to industry, and the industrial wage would not be forced to increase, thereby reducing the investment fund available for industrial expansion.

If the assumption of a fixed population was relaxed, much the same result could follow. If the increased population of the

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[30] Raj Krishna, "A Note on the Elasticity of the Marketable Surplus of a Subsistence Crop," Indian Journal of Agricultural Economics, Vol. XVII, (July-September 1962), pp. 79-84.

agricultural sector increased output less than the population increase, the per capita income of the sector would be lower. The differential between the per capita income of agriculture and the initial industrial wage would have widened, and the enticement for labor to migrate from agriculture to industry would have increased over the case of constant population.

The analyses of Chapters III and IV maintained the quantity of labor employed by each sector unchanged. Each sector employed the quantity, for example, as indicated in Fig. 1. The objective of the analysis was not concerned with the consequences of labor migrating from agriculture to industry, but only that such a stimulus to migrate would be present. If now industrial productivity was increasing just enough to employ its increased population, an increased productivity of agriculture would reduce the sector's per capita income in terms of industrial goods which would increase the differential between the agricultural sector's per capita income and the industrial wage. Agricultural labor would migrate to industry. The increased supply of labor in the industrial sector would reduce the industrial wage. At the same time, as labor left agriculture, the per capita income of those who remained would increase. Labor would continue to migrate until the fall of the industrial wage and the rise of per capita income in agriculture restored the equilibrium differential between the industrial wage and the per capita income of agriculture. If agricultural population increases are taken into consideration, the influence of out-migration on increasing the per capita income of agriculture could be reduced or completely offset depending upon the increase of output from a greater population and the relative rates of increase in population and out-migration.

If the assumption of a closed economy is dropped, the threat of increasing agricultural prices as per capita income increases is removed. Rather than being forced to depend upon increased domestic production, agricultural products could be procured in the international market at world prices. If world and domestic prices were the same, the increased demand for agricultural products would alter relative prices less rapidly, or not at all if the economy considered is a miniscule factor in the world market. Although the major domestic impetus would not be present for increasing agricultural productivity, an increase of agricultural output for export by a small country, if the price change was small, would increase the agricultural sector's income and thus force an increase in the price of agricultural labor to the industrial sector.

The considerations just mentioned apply when the potential for increasing international trade is present in the country. Most large developing economies lack this potential. Industrial exports are difficult to expand since these countries must compete with the well-established advanced nations for new markets and/or their exports are primary products and to increase their volume is likely to reduce foreign exchange earnings. Also, with shortages of foreign exchange, industrial products required for industrialization are likely to be given priority over agricultural products. Although PL 480 shipments can be obtained without creating a drain on foreign exchange, the large developing countries cannot hope to satisfy their increasing agricultural requirements from this source.

In view of these qualifications, it would appear that the closed economic analysis developed in this thesis would have a great deal

of relevancy for the "open economies" of most of the large developing nations.

CHAPTER V

SUMMARY AND IMPLICATIONS

Summary

Certain characteristics appear to be present in all awakening economies. One of these is that as per capita income increases, the initial level being very low, a large part of the increased income is spent on food. The nature of most food products and the organization for food production in most developing countries is such that food output is difficult to expand to meet this new demand. The result often is a rapid increase in the price of food, or at least pressures in that direction.

The governments of these countries can assist in alleviating these difficulties by initiating autonomous agricultural investment programs. However, the developing countries' indigenous leaders are prone to emphasize industrial investment and thereby increase the demand for food without materially increasing its supply.

Some economists have bolstered this emphasis by arguing that increasing agricultural output will only increase the income of agriculture, thereby increasing the price industry must pay to obtain agricultural labor. The greater the costs of labor to industry the less will be the profit that accrues to both private and public entrepreneurs. These profits are a major source of industrial investment. To reduce them is to reduce the rate of industrial expansion.

The validity of this economic argument was analyzed in the following manner. The industrial price elasticity of demand for agricultural products was assumed by both Gutman and Enke to be less than unity. This did not seem to be too unrealistic because of the essentiality of food intake. The agricultural sector's price elasticity of demand for industrial products was assumed by both authors as being unity or less. This assumption is rather prevalent in the literature. This, together with the limitation of data, probably explains Raj Krishna's satisfaction with demonstrating only that the elasticity of the excess supply of wheat was not negative. Whether Krishna's conclusions with respect to wheat apply to all food products is difficult to determine.

An upper value of unity was assumed for both of these elasticities. Given price elasticities of this value, the value of an increased quantity of food in terms of non-food would be less than the initial quantity of food as long as the agricultural sector's income elasticity of food was never greater than one. This result was true regardless of the proportion of total food consumed by the agricultural sector. The rural population's income elasticity of total expenditure on food was less than one in all cases where data were available. Therefore, since the purchasing power of the greater agricultural output is less than the initial quantity, the industrial wage need not rise and may even decline and still attract agricultural labor. It was, therefore, concluded that increasing agricultural output would not be inimical to industrial growth, for the rate of industrial investment would not decline but could possibly increase.

The implications of these conclusions for development policy are rather far-reaching. They have a bearing on such things as the allocation of autonomous investment between agriculture and industry, migration of labor between the two sectors, income distribution, tax policy, and agrarian structure. The purpose of the following is to suggest the possible nature of these implications.

Investment Allocation

Since industrialization is a major objective for most developing economies, the problem becomes one of allocating autonomous investment funds to maximize industrial expansion. In terms of the static analysis of the previous chapters, a concentration of investment funds into industry may not bring the desired results. Food prices are likely to soar and the industrial wage to increase. If the industrial wage should rise enough to offset the increased industrial productivity brought about by the autonomous industrial investment, induced industrial investment would decline.[31] However, if agrigultural productivity is increased, presumably requiring a finite autonomous investment in agriculture, food prices will fall (or rise less rapidly). If they should fall enough that the purchasing power of the greater output was less than the initial quantity, the likely result indicated above, induced industrial investment would increase. Therefore, the addition of an autonomous

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[31] Throughout this section and others to follow the terms autonomous industrial investment and induced industrial investment are used. In terms of Fig. 1 (a) in Chapter III, an increased autonomous industrial investment refers to an upward shift of the marginal physical product curve. An increased induced industrial investment refers to an increase in the size of the area det minus the area OWd.

agricultural investment of some magnitude would bring about greater total industrial investment than an autonomous industrial investment program alone.

The best autonomous investment program, best in the sense of maximizing total industrial investment, may be some combination of an autonomous industrial and agricultural investment. However, the information is not available in this thesis to determine the precise makeup of such a program. It is not possible to determine the increase of induced industrial investment brought about by an autonomous industrial investment, the increase in the industrial wage brought about by an autonomous industrial investment, or the magnitude of the decline in the industrial wage brought about by an autonomous agricultural investment.

The determination of an appropriate investment program is further complicated when other factors are introduced. For example: What effect do population changes have on the productivity of each sector? Does migration from agriculture exceed population growth enough to increase the per capita income of agriculture, thereby increasing the demand for industrial inputs and consequently the productivity of agriculture? As labor migrates from agriculture, what will be the effect on agricultural productivity as capital is substituted for labor in agricultural production? These questions together with others need to be resolved if an appropriate investment program is to be developed.

Labor Migration

The distribution of the labor force between the two sectors was held onstant in the previous chapters. However, as was

indicated, a fall in the purchasing power of agriculture, brought about by an increased output, would increase the differential between the industrial wage and the per capita income of agriculture. Therefore, an additional incentive would exist for labor to migrate from agricultural to industrial employment. Whether the actual shift of labor between the two sectors represented an absolute or relative decline of the total labor force employed by agriculture, would depend on the initial proportion of the total labor force employed by agriculture, the population growth of both sectors, and the rate of industrial expansion.

Income Distribution

The income analysis to this point has been concerned with the capability of each sector, specializing in the production of either agricultural or industrial products but consuming both, to purchase the product of the other sector. The income concern now becomes that of determining the distribution of increased real income given by the bundle of products held by each sector after exchange has taken place. This analysis requires more empirical information than was provided in the analysis of Chapter IV -- data which do not appear to be available. However, setting up a hypothetical example can demonstrate the usefulness of the model if the information were available.

Let it be assumed that the price elasticities are unity, the agricultural sector's income elasticity for consuming agricultural product is 0.9, and that 50 per cent of the total food output is being consumed by the agricultural sector. The change in the terms of trade are shown in Fig. 19 by the change in the slope of the line beginning at D and passing through the points J and K, the initial

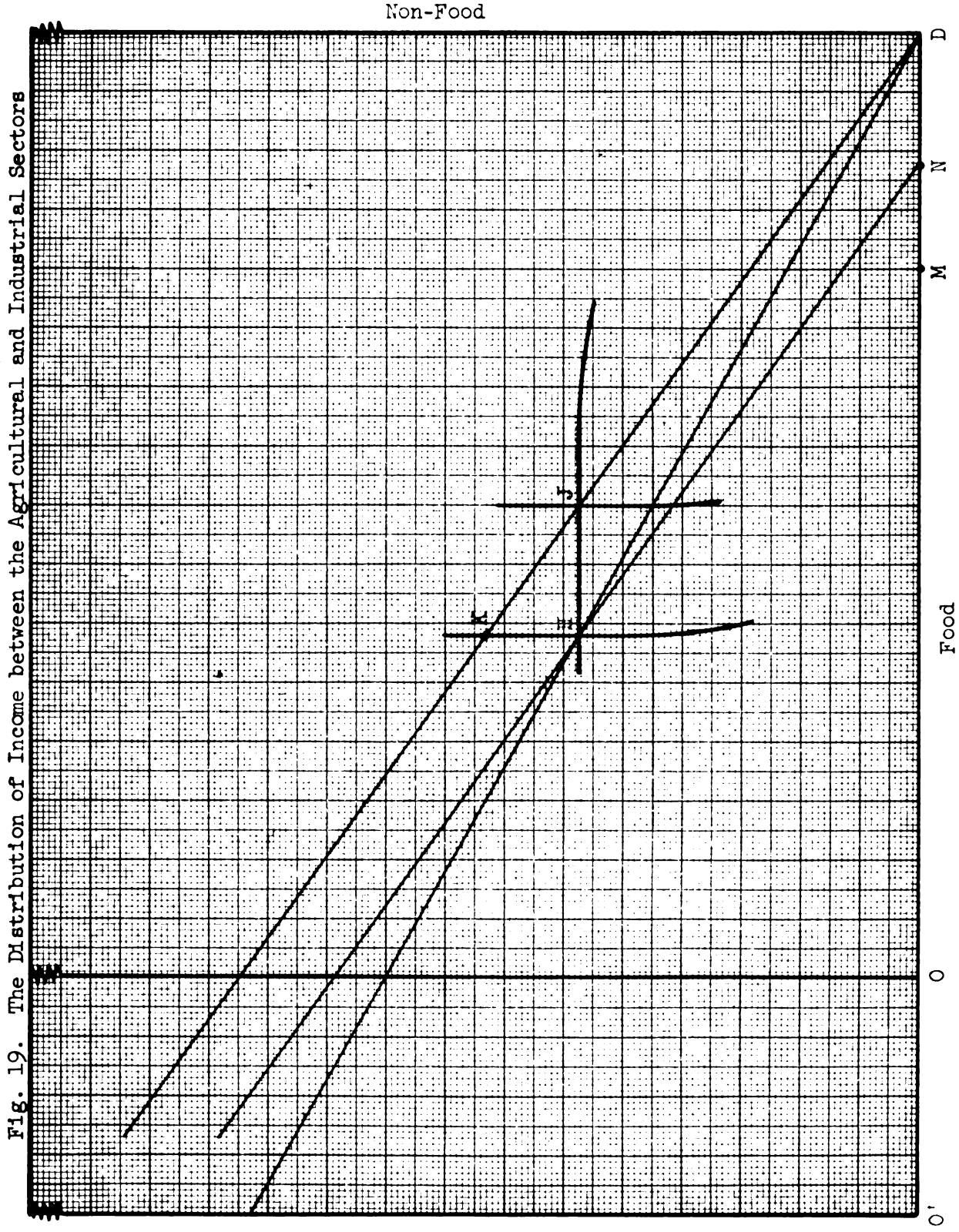

Fig. 19. The Distribution of Income between the Agricultural and Industrial Sectors

price of food in terms of non-food, to that of the line beginning at D and passing through H, the new price of food. The total quantity of food and non-food is distributed between the two sectors, initially, as given by point J and, after the increase OO' in the output of food, by the point H. Evaluating the combination of the two goods held by each sector at point H, using the initial price for a base, the increased income of the industrial sector in terms of A is given by the distance DN. (Although the industrial sector's community indifference curves are not shown, they are concave with respect to the agricultural sector's origins. The movement from point J to point H is a movement from a lower to a higher industrial sector indifference curve.) If the agricultural sector's origin remained at O, its income in terms of food would decline by the distance DN. The agricultural sector's origin, however, does not remain at O but is at O'. By subtracting the hypothetical loss from the gain of the sector, the income position of the sector can be determined. The distance DM is equal to OO', the increased output of food by the agricultural sector. Subtracting the distance DN from DM, the increased income of the agricultural sector in terms of food, gives the distance NM. In other words, the increased output of food, OO' or DM, is distributed between the two sectors with DN accruing to the industrial sector and NM to the agricultural sector. It is difficult to determine what will be the probable distribution of income between the two sectors unless the specific price elasticities, the agricultural sector's income elasticity for food, and the proportion of total food consumed by the agricultural sector are precisely known. Small variations in any of these have an impact on the distribution of real income between the two sectors. However, the more

the terms of trade turn against agriculture, other things being equal, the smaller will be the real income that accrues to the agricultural sector. It is even possible, if the terms of trade should move enough against agriculture, for the agricultural sector to suffer a decline of its total income.

Tax Structure and Policy

Given the objective of industrialization, the tax structure of developing economies should be designed to maximize this objective. It is often concluded that industrial investment is maximized by taxing agriculture heavily, i.e., milking agriculture for industrial investment funds. Some modification is required because of the costs of effectively taxing the agricultural sector of most developing economies. There may be other reasons why an increased taxation of agriculture may not maximize industrial investment. This possibility can be illustrated by Fig. 20. Again, a definitive conclusion cannot be reached because of the lack of data.

The price elasticities are assumed to be unity. The agricultural sector's income elasticity for consuming food is 0.9. The agricultural sector is consuming 50 per cent of the total food supply. An increase in the productivity of agriculture increases its income in terms of food by the distance OO'. The greater quantity of food does not command as large a quantity of non-food as the initial output; the distance OF is greater than O'G. The industrial wage can fall, increasing the induced industrial investment.

Assume now that the government taxes O'O" of the increased output of food which it invests in industry, i.e., an autonomous industrial investment. On the basis of agriculture's increased disposable

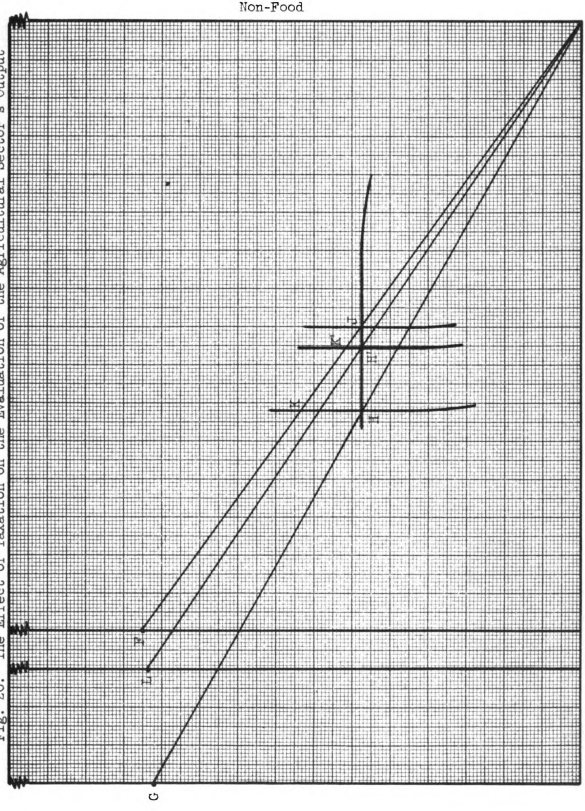

Fig. 20. The Effect of Taxation on the Evaluation of the Agricultural Sector's Output

income of food, OO", the purchasing power of agriculture has increased over what it would have been without the tax, for the distance O"L is greater than the distance O'G. The industrial wage cannot fall as much and, therefore, the induced industrial investment will not be as great. The question then arises: Does the autonomous industrial investment, made possible by the taxation of agriculture, more than offset the reduction of induced industrial investment enough to increase total industrial investment over what it would have been in the absence of the tax? In other words, is the induced industrial investment, made possible by the tax, as great as the increased induced industrial investment in the absence of the tax? Again, the result depends upon the terms of trade. The more the terms of trade turn against agriculture the greater the possibility of increasing induced industrial investment. The greater the induced industrial investment from given output increases, the more likely agriculture's retention of its increased output will bring about a greater induced industrial investment than that obtained by taxing away the increased agricultural output.

Taxation is one of the major sources of autonomous investment funds. If it is true that increasing the income of agriculture in terms of agricultural products is the best source of industrial investment, taxation of the industrial sector could supply at least part of the autonomous investment in agriculture. The agricultural sector could also be taxed. However, the effects of a tax to obtain autonomous investment funds from agriculture could reduce the productivity of the sector. There is little question that large projects such as irrigation systems, etc., require government action

to establish them. Taxing individual farmers to construct such projects can increase the productivity of the sector. However, if the farmer's incomes are close to subsistence, taxing them is likely to reduce their purchase of industrial inputs such as fertilizer, improved seeds, and simple implements. These inputs can materially increase the agricultural sector's productivity. Therefore, if farmers reduce the use of these inputs, the output potential of the agricultural sector falls. A proper tax program for obtaining autonomous investment funds would thus depend upon the specific needs and conditions that were present.

Agrarian Structure

The analysis of the previous chapters assumed an agricultural sector predominantly comprised of small owner-operators. If the rate of labor migration, likely to occur on the basis of the analysis of the previous chapters, and the rate of bringing new land under cultivation does not exceed the agricultural sector's rate of population growth, the result will be increased fragmentation of land holdings in many but not all countries, depending on inheritance institutions. However, where fragmentation does occur it would not be as great as it would be if the stimulus for labor to migrate was not present. If, on the other hand, the rate of labor migration from agriculture, together with the rate of increase in the supply of new land, exceeded the agricultural sector's rate of population growth, land holdings would tend to be consolidated and individual holdings enlarged, or some lands turned to less intensive use since the labor force is smaller; also some land may stay under the same ownership and not be cultivated.

If the agricultural sector is comprised primarily of large landlords employing agricultural labor, the analysis is somewhat different. The distribution of increased agricultural output in the agricultural sector depends on the population condition of the agricultural sector. If it is "overpopulated" in the sense that more agricultural labor can be acquired at the subsistence wage, the major share of the increased productivity would accrue to the landlords. If it is "underpopulated" in the sense that more labor can only be obtained by landlords by paying an increasing supply price, a greater share of increased agricultural productivity would accrue to agricultural labor.

An examination of the realities of population increases in developing countries reveals rapid rises in population. Thus, following Dovring, a substantial industrial expansion program (and/or agricultural export program) is required if the rural population is to be kept from increasing in absolute numbers. Thus, something akin to "overpopulation" is more likely to be the case.

One would expect the income elasticity for food to be much less for landlords than for agricultural labor. Therefore, under conditions of "overpopulation" a larger share of the increased agricultural output would be offered to the industrial sector than if the sector was "underpopulated." This would force the terms of trade more against agriculture. Other things being equal, the terms of trade would likely turn more against agriculture than if the sector was comprised primarily of owner-operators.

The loss of purchasing power on the part of landlords would probably increase their oppression of agricultural labor. With

the stick of increased landlard oppression and the carrot of an increase in the appeal of industrial employment, the flow of agricultural labor into industrial employment would increase. If the rate of migration was great enough, the agricultural sector could become "underpopulated." As the price of agricultural labor to the landlords increased, agricultural labor which remained in the agricultural sector would be in a better position to become owner-operators. Therefore, if the stimulus for agriculture labor to migrate to industrial employment is strong enough, i.e., the terms of trade turn enough against agriculture, the agrarian structure could be transformed from that of landlord-tenant to owner-operator.

One change of agrarian structure brought about by the development process -- the rise in income per worker in the agricultural sector relative to that in the non-agricultural sector -- suggested by Kuznets earlier, is difficult to reconcile with the static analysis above. The reallocation of income brought about by government programs may be part of the explanation, but the assumption of agriculture's price elasticity of demand for industrial product as being unity or less, and the conclusion reached by the analysis that the capability of agriculture to purchase industrial products declines with increased output, hardly suggests the conditions that permit the private capital investments necessary to produce the relative productivity changes suggested by Kuznets. However, when migration is taken into consideration, although the income of the agricultural sector declines, if the outflow of labor is greater than the increase of population, the per capita income of agriculture would increase. Also a large out-migration of labor would

increase the substitution of capital for labor. The higher per capita income of agriculture would increase the purchase of capital inputs from the industrial sector. This is probably not a complete explanation. When all the dynamics of economic development are taken into consideration, there are probably shifts of demand curves as well as changes in elasticities which may be neither a price nor an income elasticity change, but a change in economic structure.

There are many complex interactions in the dynamics of development. However, the proper policy may not be as difficult to determine as indicated here if the priorities of the emergent societies can be specified. This would permit a closer approximation of an appropriate investment program as well as narrow the required empirical estimates. It would also be much easier to do for a specific economy than for developing societies in general.

Further Research

The importance of the implications growing out of the analysis conducted in this thesis indicates that the analysis needs to be much more comprehensive -- to represent a basis for policy development. It is not enough to demonstrate that an increased agricultural productivity is more than offset by an adverse movement in the price of agricultural goods, but it is necessary to determine by how much. The amount the total revenue falls with an increased agricultural output relative to the initial quantity in terms of industrial goods determines the amount the industrial wage can fall and/or the increase in the incentive for agricultural labor to migrate to industry. However, to determine the relative values of the two agricultural outputs, a more precise estimate of the price elasticities

is required than that which was assumed in the analysis. Although some discussion has appeared in the literature, particularly with respect to the elasticity of the excess supply curve for agricultural products, little empirical evidence appears to be available.

The proportion of the total agricultural output consumed by the agricultural sector also becomes important in determining the relative values of the two agricultural outputs in terms of industrial products. Although fairly specific estimates are available for the United States, such data are needed for the developing countries.

Adequate consideration of investment allocation and tax policy require a capital/output ratio for both industry and agriculture as well as a relative evaluation of the two agricultural outputs. For example, in the case of investment allocation, an industrial and agricultural capital-output ratio are required in order to facilitate a comparison of the induced industrial investment generated by a given autonomous industrial investment with the induced industrial investment generated when the same capital is applied to increase agricultural output. In the case of the taxation analysis, not only are the capital/output ratios required for comparison but the costs of tax collection as well.

The analysis made in this thesis held all variables constant with the exception of an increase in the productivity of the agricultural sector. Thus a change in the sector's productivity was manifest by a shift of the agricultural sector's offer curve. If population, the distribution of the population between the two sectors, and other variables are permitted to vary, the location of the offer curves would be extremely difficult to determine. It would probably be much more appropriate to develop and adopt a

mathematical model that could simultaneous deal with a number of variables at the same time. However, the development of such a model requires a substantial amount of statistical and empirical data not now available, and that which is available is subject to substantial statistical errors. Whether the advantages of the model would overcome the non-reliability of the present data is open to question. Even any conceivable mathematical model would need to be supplemented with "judgement" and implicit evaluation of social, cultural and institutional factors to provide the basis for predicting response to change in economic or policy variables. Thus aggregate analysis will probably have to give way to a series of less ambitious studies that in any given situation can be useful in guiding policy decisions and provide at least partial answers to specific questions.

If the full implications of the analysis made in this thesis are to be explored, a great deal of research is left to be done.

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