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THE POLITICAL ECONOMY OF EMPLOYMENT  
ORIENTED DEVELOPMENT, AND A LABOR  
SUPPLY OF ECONOMIC DEVELOPMENT

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16. Abstracts The system presented in this paper fills a major gap in the theory of a dualistic economy. It examines the functioning of the food and labor market as two independent markets and examines the interaction between the two and its effect on labor mobilization. It explicitly allows for a) the varying share of labor in the total agricultural output b) for the varying response of food consumption to income and price changes for the two classes in the agricultural sector. This is a significant improvement over the existing dualistic theories that treat growth of agricultural output as being synonymous with growth of agricultural marketings. This model therefore, analyzes the rate of growth of non-agricultural employment in terms of the growth rate of agricultural output as well as of changing factor shares in the agricultural sector.			
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# The Political Economy of Employment Oriented Development

Uma J. Lele and John W. Mellor

*and*

# A Labor Supply Theory of Economic Development

John W. Mellor and Uma J. Lele

June, 1971.

THE POLITICAL ECONOMY OF EMPLOYMENT ORIENTED DEVELOPMENT

Uma J. Lele and John W. Mellor

AND

A LABOR SUPPLY THEORY OF ECONOMIC DEVELOPMENT

John W. Mellor and Uma J. Lele

Occasional Paper No. 42 and No. 43  
Department of Agricultural Economics  
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USAID-Employment and Income Distribution Project

II

## PREFACE

It is increasingly apparent that the ramifications of the "green revolution" extend far beyond the agricultural sector. The new technological changes in agriculture offer opportunity for greatly accelerating the rate of growth of employment and thereby achieving a much broader and more equitable distribution of the benefits of economic development. The two papers included here present the conceptual basis for a major research thrust into the relationship between technological change in agriculture and increased employment.

In "The Political Economy of Employment Oriented Development" we examine the implications of the new high yielding grain varieties to policy for agricultural development and to various aspects of general economic development including the choice of industrial structure, the choice of production technique, the domestic savings rate, the scale of industrial organization and the level and composition of trade.

The precepts concerning technological change in agriculture upon which the first paper is based are examined in the context of a mathematical growth model in "A Labor Supply Theory of Economic Development." That paper presents a general equilibrium system for a dualistic economy in terms of the food and the labor markets. It examines the effects of change in: (A) agricultural output and factor shares induced by technological change, (B) population, and (C) growth of capital stock in the nonagricultural sector on (1) the supply of marketable agricultural surplus, (2) the equilibrium level of nonagricultural employment, (3) the equilibrium terms of trade between agriculture and industry, and (4) the equilibrium real wage. The model also examines (a) the rate of growth of nonagricultural employment and its relationship with the growth of capital stock over time, and (b) changes in terms of trade over time between agriculture and nonagricultural sectors. The presentation, like any mathematical model involves a number of simplifying assumptions. The model, in particular, emphasizes the role of technological change in agriculture on the rate of growth of agricultural marketings and the potentials for nonagricultural employment. Another model is now being prepared based on this first model which incorporates a third market, the capital market, into the formulation.

A third paper entitled, "A Further Note on Dualistic Models," by Uma J. Lele points out the basic relevance of dualistic models to analysis of the implications of technological change in agriculture to overall development and then states the basic shortcomings of these models as currently developed for the purposes of viewing contemporary technological change in the agricultural sector. That paper provides useful background for the basic model presented here.

A series of empirical studies are underway in which we are testing various parts of the formulation set forth in this model. These empirical efforts include studies of the technological bias of current agricultural technology and their first round effects on the distribution

of income and level of marketings. Another series of studies is examining the employment potentials in the agricultural sector as they relate to the new technologies in agriculture including both primary and secondary employment effects. Special attention is being given to the problem of allocating rural labor amongst various alternatives subject to the various restraints of food supply, capital and administrative talent. Other studies are concerned with the special problems of small farmers in a context of rapid technological change; the various factors which affect movement of rural labor to employment opportunities, within the context of technological change in agriculture, and the special relationships between development in the rural sector and increased employment in small scale industry. Papers reporting the results of these various studies will be issued in this series.

The papers in this series are part of a larger series which includes papers from a previous AID research contract concerned with the role and function of agricultural prices in economic development. Many of those papers, particularly those concerned with intersectoral resource transfers have relevance to the current research on employment and income distribution.

John W. Mellor

Ithaca, New York

June 10, 1971

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June, 1971

THE POLITICAL ECONOMY OF EMPLOYMENT ORIENTED DEVELOPMENT

Uma J. Lèle and John W. Mellor

Occasional Paper No. 42  
Department of Agricultural Economics  
Cornell University  
USAID-Employment and Income Distribution Project

UI

# THE POLITICAL ECONOMY OF EMPLOYMENT ORIENTED DEVELOPMENT

UMA J. LELE AND JOHN W. MELLOR

## I.

Unemployment and maldistribution of wealth are now at center stage in the drama of economic development. Prime Minister Indira Gandhi's sweeping election victory, based on Garibi Hatao--down with poverty, is to be consummated through greatly increased employment of the poor. Throughout the developing world population growth has added immensely to the army of unemployed while economic policies have failed to increase incomes rapidly and have raised employment even less. Unfortunately, however, increased employment exacerbates the equally explosive problem of inflation. As the poor are employed and spend their incomes on food and other consumer goods, prices tend to rise. Most governments then sacrifice employment of the poor to restrain the price increases resented by the urban middle classes.

Here is the dilemma of the employment problem and it is this which gives special relevance to the "green revolution." The new agricultural technologies can provide the food needed to complement increased employment. Concurrently, as agricultural production increases, the employment generated purchasing power of the poor can prevent the fall in prices which would dull incentives to peasant agriculturalists.

Likewise, the greater purchasing power of agriculturalists provides demand for increased output from the industrial sector.

The utopian promise is in sharp contrast to widely reported realities of the "green revolution." All too often income inequity and unemployment have been dramatically highlighted by the new high yield varieties of grain. As compared to smaller cultivators, the larger farmers can better afford the risks of innovation and they wield more political power over the developmental agencies which provide access to credit and the crucial purchased inputs such as fertilizer, seed and pesticides. More striking, the chasm separating the kulak cultivator from the landless laborer is drastically widened as yields per acre rise dramatically, and employment increases little. Introduction of labor intensive irrigation and multiple cropping may reduce the rate of increase of disparities but the disparities remain and grow until additional action is taken. For laborers to receive the benefit of even these secondary effects, the political environment must be favorable and economic policy astute. The benefits for the poor do not rise automatically from the system as they do for the rich. An additional danger from the system is that the increased profitability of farming tempts landowners to resume cultivation of their tenancies and thereby convert poor tenants into destitute laborers.

If the extraordinary promise of the emerging agricultural technologies is to be realized, drastic change in policies towards employment and industrialization will be needed.

## II

Past failure to generate rapid increase in employment can be largely explained in terms of the ascendant theories of economic growth and consequent policies of capital intensive production and import substitution. Such development strategy was prompted by emphasis on structuring the economy towards heavy capital goods production and reinforced by assumption of low growth potential for exports. The domestic capital goods sector was to be built at an early stage of development to force immediate savings and investment and to refrain from long run reliance on imports. At the extreme one first produced not food, not fertilizer, not fertilizer factories, but the industries which produce fertilizer factories.

It was also believed that minimization of employment and thereby of consumption in the short run would conserve resources so that they could be ploughed back into further expansion of the manufacturing sector. The conclusions that follow from such assumptions may be stated succinctly but

simplistically as follows: The lower the rate of growth of employment and consumption in the short run, the higher their levels in the long run. It is a bourgeois approach, for it is the poor who die in the short run.

Contrary to the theory, the practice of capital intensive industrial expansion has resulted in relatively low rates of savings. This is because the complexity of these industries caused low profits and even losses. Ironically, the prophecies of low growth potential for exports have been fulfilled precisely because the policies followed were based on that initial assumption. Clearly, the low income countries have little immediate comparative advantage over their high income counterparts in export of capital intensive products. India's highly sophisticated Second and Third Five-Year Plans are classic examples of these various assumptions, strategies and consequences. The Philippines and much of Latin America are less precise but still conforming illustrations.

Unfortunately, though the hopes of the investment and capital goods orientation were belied, it is unlikely that an orientation toward employment, consumer goods and trade would have been generally successful without a technological breakthrough in agriculture. If India in the 1950's and 1960's had expanded nonfarm employment at the otherwise feasible

rate of 7 percent per year, the added expenditure on food of the newly employed laborers would have driven up real agricultural prices by roughly 10 percent per year. Not only would the economic base for growth in employment have been cut off, but the situation would have been politically unacceptable as well. World supplies of food were not available on the massive scale needed to back employment-oriented growth strategies in the developing world as a whole, even though individual small countries such as South Korea, Hong Kong and Singapore have been successful in matching employment growth with imported food.

### III

Precisely because development policies of the past two decades have been consistent with the old reality of stagnant agriculture, so the new reality of technological breakthrough in agriculture requires a new strategy. Accelerated growth in food production provides striking opportunities for reversal of the low employment, 'basic industry' approach. Such a change has far reaching implications not only to the industrial structure, but to the choice of production technique, the domestic savings rate, the scale of industrial organization and the level and composition of trade. Further, because of its' distributional bias towards the rural elite,

technological change in the agricultural sector, may itself be turned into an engine for growth in industrial employment.

The upper income rural people who receive the primary benefit of the new yield-increasing agricultural technologies already eat well. Consequently, they market the bulk of their additional production and thereby support growth in nonfarm employment. This contrasts to traditional means of increasing agricultural production through labor-intensive methods of land reclamation and more careful crop husbandry. Thus, in India of the 1950's food grain marketings increased little faster than production; by the late 1960's, the new technologies had caused food grain marketings to grow about 60 percent faster than production.

Unfortunately, the potential for increasing employment provided by larger food marketings may easily be lost by inappropriate supporting policies. If increased domestic food production is used only to replace food aid no significant increase in nonagricultural employment will occur. If the food is exported instead of being consumed domestically, growth of employment will depend on the manner in which the foreign exchange is used. In most Latin American countries the pattern has been one of investment abroad or increased imports of consumer goods for upper income classes, instead of alleviating the domestic employment problem. If the foreign exchange is

used for import of capital goods, so as to expand the domestic industrial sector, employment will increase. How much employment increases will, of course, depend on the technology of industrial development. The tendency has been to fritter away the potential on capital intensive industries. Mexico seems to be a classic case of the agricultural breakthroughs adding to rural income disparities but not being used to accelerate growth of industrial employment. Taiwan and Japan illustrate particularly successful use of agricultural progress to increase employment.

If food imports cannot be reduced or exports increased, the politically powerful landed classes will press for price supports and government purchases to maintain high agricultural prices. What policymakers often fail to realize is that an employment oriented policy increases demand for food and thereby maintains agricultural prices without other action. It is thus obvious that the landed classes will receive a pay-off from technological change no matter what the strategy for maintaining prices, i.e., whether prices are maintained by increased exports, reduced imports, building of stocks or increased employment. Laborers will, however, benefit only from increased employment. The best strategy is obviously the latter. Unfortunately, the landowning classes, with their desire for expediency in delivery of benefits, do not support the employment option.

The rapidly rising income of prosperous landowners and peasants also offers a large and growing tax base for the support of employment programs. Even prior to the "green revolution" the landed interests were undertaxed. Latin America is notorious in this respect and in India upper income rural people pay only about one-third as much in taxes as urban people in the same income bracket.

The landed interests evade the taxes which could support employment programs and maintain high agricultural prices despite the poverty of the masses. It is these tendencies, founded on greed and ignorance, which turn the green revolution red, not the underlying nature of the new agricultural technologies.

#### IV

Sharp acceleration in the agricultural growth rate places the immediate burden of employment expansion on programs for rural public works. Fortunately, increased demand for purchased supplies such as fertilizer and increased marketings of food, both of which accompany the agricultural breakthrough, greatly increase the rate of return to labor intensive rural public works such as roads, landleveling, irrigation schemes, and rural electrification. Some of the increased food production may thus be used to feed an expanded rural labor force which

in turn facilitates further increases in agricultural production. In addition, adroit handling of productive public works may allow tapping of local tax bases that are not available for distant central government purposes.

A disturbingly high degree of scepticism exists among bureaucrats regarding the effectiveness of such investment. They believe, with some reason, that resources allocated to rural public works will disappear in the coffers of local politicians and enlarge the scale of political patronage. Their views are also influenced by the failure of many such schemes in the pre-"green revolution" environment of largely subsistence agriculture in which there was little economic incentive for villagers to support such schemes.

The increased employment and income consequent to agriculture-led growth cause a much more than proportionate increase in the demand for fruits, vegetables and livestock products. These in turn use large quantities of both production and processing labor. As long as the basic food grains sector is stagnant, however, its effect both on labor supply and output demand prohibits an increase in the production of these types of agricultural commodities. In the case of livestock products, grain shortages also raise the costs of production. A rough estimate for India shows that the "green revolution" and its ancillary effects

are consistent with an increase in milk production alone which could provide a 50 percent increase in annual employment and income to the 15 million landless labor families. These secondary potentials in agriculture require substantial public investment in new forms of research, education, credit and market development.

While one set of policies expands rural employment, care must be taken not to allow other policies to throw additional laborers on the market. Tenants must be protected from eviction by avaricious landowners. Small farmers must be assisted by reducing the risks of innovation and increasing the availability of credit and production supplies. Laborers must not be capriciously displaced by machinery. Mechanization is a particularly complex issue in which bad policy may destroy many jobs, while a selective effort may actually increase production and total employment through reduced costs of transportation, improved methods of water distribution, and the breaking of labor bottlenecks.

Manufacturing and service industries must be the principal long run source of expanded employment. Rapidly rising incomes of agriculturalists can facilitate accelerated growth in industrial employment through increased demand and greater savings and investment. It may be necessary to reinforce these tendencies with a redistribution of income and additional investment incentives.

Economists have for too long been the jesters who rationalized the desires of the rich to keep their money by stating that growth requires investment and saving and that the rich save more than the poor. In many countries the rich not only save little, but the pattern of their consumption is loaded towards imports and capital intensive types of domestic production. A higher proportion of wealth in lower income hands would in many countries direct consumption towards products providing more local jobs, and raise savings and investment rates in newly profitable local industries as well. Latin America is replete with countries needing redistribution of income in order to foster a more employment oriented industrial structure. It is not accident that the high growth rate countries such as Taiwan, South Korea and Japan have much broader distribution of income than lower growth rate countries such as the Philippines.

Rapid expansion of small scale industries, both directly in the production of consumer goods and ancillary to larger scale firms offers one of the most effective means for employment expansion. Products such as sewing machines, bicycles, transistor radios, agricultural implements and other small tools and machinery have considerable potential for being manufactured in whole or in part in small scale industries that make many more jobs per unit of capital than do the large scale industries introduced under modern import displacement schemes of development.

In addition, in absence of an organized capital market and of investment oriented price and fiscal policies in the agricultural sector, small industries provide an efficient way of fostering and mobilizing small savings in the agricultural sector. Development of medium and small industries may also bypass the route of the rural-urban dichotomy followed by most industrialized nations of today and the social, political and environmental consequences of that route. Development of small scale industries requires large public investment in power and transport and attention to many special problems of credit, relations with large scale industry, and access to export markets, supplies of raw materials and machinery.

All the employment measures delineated here are initially more profitable and progress more rapidly where agriculture is already prospering most. Consequently, explosive widening of regional income disparities is one of the most intractable consequences of the "green revolution." It is the poorer class in the backward regions who suffer the greatest inequity in economic development.

Unfortunately, the politics of regionalism reinforce an already difficult economic problem by restricting free transfer of food to these regions and of surplus labor away from them thus seriously hampering a regional balance in development. The limited cost benefit calculations conventionally used in the

allocation of investible funds by planners and aid giving agencies further reinforce regional imbalances. A fresh view must be taken of the problems of interregional resource allocation with a much longer run multiplier effect of investments in mind. The economic disparities between the two wings in Pakistan have vividly brought home the stark effects of narrow cost benefit analysis.

## V

In the past, massive foreign aid in the face of a stagnant agriculture has pushed low income countries towards capital intensive industries in which they have the least comparative advantage. This has meant high cost production, relatively low rates of return, and consequent poor capacity for repayment of loans. The aid giving agencies have also encouraged low income countries to adopt the technology of high income countries, suited to different proportions of capital and labor.

Success in the agricultural sector has provided a new impetus for development of agricultural technologies which cater to the different physical conditions prevailing in low income countries. A similar effort must be launched in other sectors of the economy to evolve technologies suited to the economic condition of abundant labor. Foreign aid can play a significant role in developing the necessary scientific infrastructure. To do so

will require that program development and appraisal make less use of foreign consultants and their technological biases and more use of the rising research and development capabilities of the aid receiving nations.

Carefully used, in conjunction with a buoyant agricultural sector, foreign aid may supply the capital to complement labor using industries. This may lead to low cost production, high profits and increasing capital formation. The contrast of this approach with the capital intensive one may explain why foreign aid has been so effective in some countries such as Taiwan and South Korea and so ineffective in others.

Since the agricultural breakthroughs have been significant mainly in foodcrops, shortage of other agricultural raw materials such as cotton and oilseeds, are now likely to be serious constraints on employment expansion. Foreign aid could play a particularly significant role in identifying and supplying these commodities in the short run and in providing technological assistance to increase their production in the long run.

The form of aid thus needs to be complementary to the form of the development process. Where the agricultural sector moves rapidly there may be a need for foreign aid in the form of capital goods and foreign exchange. If the agricultural sector is stagnant, however, and hence inhibits the growth of employment, foreign aid may emphasize development of the technological

infrastructure for fostering the seed-fertilizer revolution. While these longer term policies are being implemented, food aid can be used for expanding employment in balance with growth in capital. East Pakistan is particularly in need of the latter strategy.

The development of a labor intensive industrial sector also has significant implications for expansion of trade. Demand will expand rapidly for many types of imported raw materials and capital goods to combine with labor. The immediate need for foreign exchange is often viewed by planners as unfortunate. However, what is not recognized is that development of a growing domestic market for labor intensive industrial products may prepare the way for eventual export. The experience of Japan and Taiwan and more recently of India demonstrates the large potential for exports of labor intensive goods, not only to other low income countries, but also to advanced industrial nations where labor has become increasingly dear. Success in exports may even allow supplement of domestic agricultural production with food imports to sustain a somewhat faster growth of employment than would otherwise be possible. Commercial food imports by Communist China appear to have allowed a much more employment oriented approach than that followed by the Soviet Union. India could profitably develop rice imports from Thailand for the same purpose.

In the long run, expansion of trade is to be preferred to aid as trade encourages specialization in those types of commodities which use more of labor relative to capital. However, foreign aid can play a particularly useful role during the interim period when demand for imports of capital and raw materials outstrips the long run export capability.

The developmental approach outlined above provides a positive alternative to the capital-intensive, import-displacing, low-employment growth pattern followed by many low income countries. At the theoretical level, our approach emphasizes a consumer goods orientation. We contend that this would accelerate growth of employment, savings and exports. We have shown how release of the food constraint is a sine qua non for such an approach. Several factors play a crucial role in determining whether the potentials offered by technological breakthrough in agriculture are fully exploited.

First, although the magnitude and the momentum of the agricultural revolution may be disputed, the revolution is a fait accompli in the important sense that the concept of agricultural development has been drastically changed. However, if the myriad scientific, administrative, institutional and political intricacies of the "green revolution" are not attended diligently the revolution may halt.

Second, both to accelerate growth in agricultural production and broaden distribution of benefits, effective policies are needed to extend the "green revolution" to small farmers, to prevent displacement of tenants, to confine farm mechanization to the few socially desirable functions and to expand rural employment through diversification of agriculture and development of productive rural public works programs.

Third, success in agriculture provides opportunity for a fresh look at industrialization policies. Governments of many countries are geared to the ideology of large public sector capital-intensive enterprises and are often neither willing nor equipped administratively to cater to the needs of a more atomistic employment oriented type of industrial development. Public sector investment need not be deemphasized, but it may need to be redirected. New industrial policies may need to be coupled with encouragement to private investment and discouragement to import oriented conspicuous consumption by high income groups.

Fourth, export markets must be sought more zealously. Industrialized countries have often followed a policy of too much rhetoric and too little action on the question of allowing imports of competitive products from low income countries. On the other hand, the onus often lies with the low income countries' lack of initiative, poor quality standards, and

delays in deliveries of goods. Improved agricultural and employment conditions should give impetus to the reform of export and import policies.

Fifth, a strong argument must be made for accelerating the flow of aid to low income countries. American aid in particular has dwindled to appallingly low levels while the poor countries are lectured for not sharing the income of their faster growing regions with their laggard ones. The agricultural breakthroughs, in which foreign assistance may claim a significant credit, provide new potential for self-sustained growth in low income countries. Our analysis emphasizes the need for a careful examination of the manner in which growth is fostered through aid and a clear need for a short run increase in aid while growth of agricultural production is accelerating.

To maintain a high growth rate in food production and to foster employment oriented industrialization obviously requires policies in low income countries that go beyond the tokenism of socialist slogans and symbolic nationalizations. It also requires more from the high income countries than pious lectures about free trade and boot strap development.

June, 1971.

A LABOR SUPPLY THEORY OF ECONOMIC DEVELOPMENT

John W. Mellor and Uma J. Lele

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Department of Agricultural Economics  
Cornell University  
USAID-Employment and Income Distribution Project

## A Labor Supply Theory of Economic Development

John W. Mellor and Uma J. Lele\*

Macro planning models for low income countries typically emphasize growth in per capita consumption over time at the cost of immediate growth of employment. This generalization includes not only the earlier simple aggregative models of Harrod-Domar and Fel'dman-Mahalnobis, but a considerable number of the recent, more complex multisectoral, intertemporal models.<sup>1</sup> A low employment component in these models is a product of the assumptions on which they are built. For example, these models generally assume a low growth potential for exports, limited foreign aid and hence a balance of payments constraint. Most important, they assume a technologically stagnant agricultural sector, a sector which produces up to half the GNP and an even larger proportion of consumption goods. Further, these models often assume a domestic savings constraint or assume that output is only produced by capital. Employment thus becomes only a by-product of growth of output rather than being an explicit variable.

The employment question is relegated to the background by rigid assumptions about capital output ratios and composition of demand thus ignoring the implications to employment of choice of technique and of industrial structure as well as of technological change. As a result of such assumptions these models may either produce import-displacing, capital intensive patterns of growth

that have a low employment potential or recommend massive investments in agriculture to keep up with growth in the demand for food.<sup>2</sup>

The Indian development experience provides an excellent example of these assumptions and policies. The low employment, capital intensive, import-displacing pattern of industrial development in India seems to have been justifiable, expost facto. However, each of the justifying factors is in part a product of government policy and thus the premises of the planning models have been substantially self-fulfilling.

Per capita agricultural output did not increase significantly in the first twenty years of planning and showed substantial year to year fluctuations. This was followed by a failure to mobilize market surplus of food through the open market or through governmental policies of food procurement.<sup>3</sup> Given an essentially stagnant agricultural sector relative agricultural prices would have increased significantly if the growth of employment had been considerably more rapid than that actually accomplished in the past two decades.

Exports were stagnant not only because of the low growth potential for traditional exports but also because of failure to develop export markets for nontraditional manufactured goods. The latter itself was in part a consequence of a stagnant agriculture and a low rate of savings, and in part a product of the industrial structure implicit in the planning models. Small and uncertain per capita foreign aid reinforced the foreign exchange constraint.

Finally, the pattern of industrial development provided by the planning models failed to boost the saving rate among small savers or to effectively channel what small savings did occur.

Dualistic models of the Lewis type, which perceive economic development as synonymous with growth of non-agricultural employment provide a clear alternative to these capital oriented macro-models.<sup>4</sup> They have however, never received serious consideration at the policy level. This is because of the failure of the dualistic models to analyze realistically the mechanism of food transfers from the agricultural to the non-agricultural sector. The market mechanism to augment the food supplies required to feed the transferred labor does not work with a stagnant agriculture. And the political, administrative nightmare of forcibly extracting food surplus from an essentially stagnant agriculture rarely provides a viable alternative.

In a low income economy aggregate food production is generally highly inelastic to changing terms of trade between agriculture and industry, whereas the marginal propensity of the laboring class to consume food is high.<sup>5</sup> Because of these two features the food supply available to the nonagricultural sector constitutes a major constraint on growth of nonagricultural employment in the case of a stagnant agriculture. With a dynamic agriculture the rate of release of the food constraint is determined by complex forces of which the distribution of the agricultural product within that sector is of particular importance.

Given the possibilities of substantial increases in agricultural production as a result of the so-called "green revolution" there is a significant potential for release of the food constraint. Empirical evidence suggests considerable factor share bias of new agricultural technology. The extent of bias varies substantially among innovations and physical environments. Thus the nature of technological change in agriculture is of interest because of its effect on marketed surplus and labor mobilization for non-farm employment. These vary considerably, first, according to the factor share bias and second according to the demand elasticities of the various income classes.

For these reasons, we present a model which allows emphasis on the food transfer mechanism in a context of technological change in the agricultural sector. The approach has two major distinguishing features. First, rather than assuming that per capita agricultural output in the agricultural sector is jointly mobilized with labor, we treat the food market as an independent market and then examine the interaction between the food market and the labor market. More generally our model is labor supply and consumer goods oriented rather than capital supply and investment goods oriented. It is thus in sharp contrast to the Fel'dman-Mahalnobis models and their various sophisticated derivatives. Second, we explicitly allow for changing share of agricultural output between different classes and examine its

effect on market supplies of food and hence on rate of growth of employment.

Our analysis has the following specific objectives:

1. It provides a general equilibrium system for a dualistic economy in terms of the food and the labor market.
2. It examines the effects of changes in: a) agricultural output and factor shares induced by technological change, b) population, and c) growth of capital stock in the non-agricultural sector on 1) the supply of marketed surplus, 2) the equilibrium level of non-agricultural employment, 3) the equilibrium terms of trade between agriculture and industry, and 4) the equilibrium real wage.
3. It analyzes a) the rate of growth of non-agricultural employment and its relationship with the growth of capital stock over time, and b) changes in terms of trade over time.

In the following section we discuss the assumptions on which our formulation is built. The discussion has a dual purpose. First, where we have departed from assumptions made in other labor surplus formulations we emphasize how our assumptions provide the model a current relevance. Second, we discuss how some of our assumptions help keep the mathematical formulation simple without substantially altering the relevant conclusions. For both these reasons the section should be of considerable interest from the viewpoint of policy analysis, although, to strict model builders, the discussion may seem only peripheral.

### I. Assumptions

We assume that agricultural output is a function of labor, land and technological change. For the reasons outlined below, we further assume that per capita agricultural output can be increased only by technological change in agriculture.

In traditional agriculture, i.e., with no technological change, output increases through a direct input of labor or through land and capital which are largely a direct embodiment of labor. Such increased labor input is the result of an immiserizing process, added labor being employed in production at declining marginal product as population growth reduces per capita incomes, thus increasing marginal utility of the additional income.<sup>6</sup> For these and other reasons of logic supported by the empirical evidence, we assume aggregate agricultural production is highly inelastic with respect to the terms of trade between agriculture and non-agriculture.<sup>7</sup> These assumptions give primacy to technological change in agriculture in fostering a shift in the labor force to the non-agricultural sector.

Technological change in agriculture is often highly biased and varies greatly in the extent of bias. The same rate of increase in agricultural production in two successive periods may be brought about by two completely different technological changes, with highly different effects on marginal productivity of labor and labor use. Thus, although labor's share is

determined at a given level of output by the marginal productivity of labor, its movement over time may be highly variable. We, therefore, examine the effect of changing labor share on the two market equilibria.

Owners of different factors of production evidence sharply differing consumption functions. For simplicity in dealing with this situation, our model divides the agricultural population into two classes--laborers and landowners. Laborers are assumed to have a positive income elasticity of demand for food of less than 1.00, but still substantially higher than that of landlords. Laborers are also assumed to have a negative price elasticity of demand. Landowners are assumed to consume a fixed amount of agricultural output per capita, regardless of its price or their income. Landowner's food consumption could also be expressed as a function of price and income changes just as in the case of laborers. However, empirical evidence shows that landowners with incomes well above subsistence have price and income elasticities of demand for food grains very close to zero.

Our formulation is intended to focus on intersectoral labor transfers. So we simplify our model by assuming that agricultural laborers consume all their income. In the case of landowners, the assumption is somewhat more involved. Since landowners are assumed to have zero income elasticity of demand for food grains the incremental share of landowners is marketed and a commensurate value of commodities purchased from the non-agricultural sector.<sup>8</sup>

These purchases include production inputs from the non-agricultural sector for use in the agricultural sector. Again in keeping with our focus on the labor transfer problem we do not include capital in our agricultural production function. In traditional agriculture, capital is essentially a direct embodiment of labor and, therefore, does not require separate treatment. Technological change generates sufficient increase in landowners' income to provide the required capital. This assumption is quite valid for the common case in which the bulk of increased capital associated with technological change is working capital for financing inputs purchased from the non-agricultural sector.

The sharp dichotomy between landowners and laborers is a very helpful simplifying assumption which distinguishes between those cultivators who predominantly produce for the market as against those whose produce is mostly consumed domestically. The real world of peasant agriculture and gradation in size of farms is accommodated by viewing intermediate situations as appropriately weighted averages of landowners and laborers with a consequent weighted average set of demand elasticities. Since payments to laborers are assumed to be made in kind and since laborers are assumed to sell a portion of their receipts, this allows considerable further flexibility in the tenurial arrangements accommodated by the model.

Landowners are assumed to be fixed in number. This assumption can be modified to incorporate change in the population

of landowners without altering the conclusions. Changing share of output, however, does illustrate many of the interesting results that could be derived by assuming changes in the population of landlords.

Production in the non-agricultural sector is assumed to be a function of labor and capital. No technological change is envisaged in the non-agricultural sector. Nevertheless, neutral technological change as assumed in other dualistic models could be incorporated easily in our system.

A closed economy is assumed. However, implications of this model for trade in non-agricultural commodities are discussed. The assumption of a closed economy focuses attention on the implications of price inelastic aggregate supply of agricultural commodities and the consequent key role of technological change in agriculture to overall economic growth. In practice individual small countries may encounter, through imports, an elastic supply of agricultural commodities. In those circumstances our model points to the desirability of trade if an adequate rate of technological change in agriculture cannot be achieved.

In the non-agricultural sector, the demand for agricultural commodities is assumed to be a function of the price of agricultural goods in terms of industrial goods and of the laborers real income. In equilibrium the wage of the laborers in the non-agricultural sector is equal to the per capita income of the agricultural laborers class.<sup>9</sup> Their income and price elasticities and budget shares are, therefore, assumed to be

the same as those of the agricultural laborers. Further just as in the case of the agricultural laborers, non-agricultural laborers consume all their income. Demand for labor in the non-agricultural sector is determined by its marginal productivity. Non-agricultural profits are all saved and invested.

It is observed that rarely does the absolute size of the agricultural population decline prior to a major decline in the proportion of the population in agriculture and of the proportion of consumer expenditure on basic agricultural commodities. Thus, because our model refers to an early stage of development, we can assume that labor can be withdrawn from the traditional agricultural sector without reducing a) the absolute size of the agricultural labor force and b) per capita agricultural output. As long as industrial employment does not increase at a rate that more than absorbs increase in the population of agricultural laborers, the first condition will be fulfilled. It also seems apparent that with some reorganization of traditional agriculture, involving little additional capital input and marginal changes in techniques, it would be possible to withdraw a substantial amount of labor from agriculture without reducing per capita output. As we will see later this by no means assures constant terms of trade between agriculture and industry when labor is withdrawn from agriculture. These changes in terms of trade emphasize the potential limit imposed by the food market and the importance of viewing the two markets as separate but interacting entities.

Although we assume that the production of the basic foodgrains is inelastic, the production of other agricultural commodities may be quite elastic. This is because they occupy only a small proportion of the land area and use a much higher proportion of nonland inputs in their production. Thus in a practical treatment our agricultural sector would most usefully be defined to include only the basic foodgrains. As the food constraint is relaxed, production of high income elasticity, labor using agricultural commodities might expand in production through the supply of labor in a manner similar to that of industrial goods.

## II. The Formulation

Our static model is comprised of a food market, a labor market, equilibrium in each and a general equilibrium as follows.

Notation:

$A$  = agricultural output

$l_A$  = agricultural labor input

$\bar{Z}$  = land

$t$  = technology

$M_S$  = marketed supply of food

$M_D$  = market demand for food

$\bar{C}$  = total consumption of food by landowning classes

$b$  = relative budget share allocated by laborers to the consumption of food

$s$  = agricultural labor's relative share in agricultural output

- $P$  = price of agricultural goods in terms of non-agricultural goods  
 $Y$  = per capita income of agricultural labor population in terms of agricultural goods  
 $r$  = population of laborers in agriculture as proportion of total labor population  
 $N$  = total labor force, i.e., labor force in the agricultural and non-agricultural sector  
 $L_A$  = agricultural labor force  
 $= rN$   
 $L_I$  = non-agricultural labor force  
 $= (1 - r)N$   
 $W_D$  = demand price of labor in the non-agricultural sector in terms of non-agricultural goods  
 $W_S$  = supply price of labor in the non-agricultural sector in terms of non-agricultural goods  
 $X$  = non-agricultural output  
 $K$  = non-agricultural capital stock  
 $\sigma$  = elasticity of non-agricultural output with respect to capital  
 $1 - \sigma$  = elasticity of non-agricultural output with respect to labor  
 $I$  = investment in the non-agricultural sector

#### The Food Market

Agricultural production is a function of labor, land and technological change. It is linear homogenous with respect to land and labor.

$$(1) \quad A = f(l_A, \bar{Z}, t)$$

$$\frac{\partial A}{\partial l_A} > 0, \quad \frac{\partial^2 A}{\partial l_A^2} < 0$$

The relative share of labor in aggregate agricultural output is determined by the marginal productivity of labor.

$$(2) \quad s = \frac{l_A}{A} \cdot \frac{\partial A}{\partial l_A}$$

$$\frac{ds}{dt} > 0$$

Marketed supply of food to the non-agricultural sector is the difference between output and consumption in the agricultural sector.

$$(3) \quad M_S = A - \bar{C}$$

Budget share allocated by agricultural laborers to food is a function of terms of trade between agriculture and non-agriculture and their per capita income.

$$(4) \quad b = f(P, Y)$$

$$\text{such that } \frac{\partial b}{\partial P} < 0, \quad \frac{\partial b}{\partial Y} < 0$$

Per capita income of agricultural laborers is equal to their share in the agricultural output divided by agricultural labor population.

$$(5) \quad Y = \frac{sA}{rN} = \frac{sA}{L_A}$$

Market demand for food in the non-agricultural sector is equal to the budget share allocated to food consumption out of wage income by the non-agricultural laborers.

$$(6) \quad M_D = b \cdot \frac{W}{P} \cdot L_I$$

#### The Labor Market

The production function for the non-agricultural sector is a Cobb Douglas linear homogeneous function of the first degree.

Thus:

$$(7) \quad X = K^\sigma L_I^{1-\sigma}$$

Demand for labor is a function of its marginal productivity.

$$(8) \quad W_D = (1 - \sigma) \frac{X}{L_I}$$

Labor migrates from agriculture to the non-agricultural sector until the wage rate in the non-agricultural sector is equal to per capita income in the agricultural sector.

$$(9) \quad \frac{W_S}{P} = \frac{sA}{rN}$$

Note that  $W_S$  is stated in terms of non-agricultural goods and, when deflated by the terms of trade index, shows the wage rate in terms of agricultural goods.

Investment in the non-agricultural sector is equal to the share of profits in non-agricultural output.

$$(10) \quad I = \frac{dK}{dt} = \sigma X$$

$$\text{Thus: } \frac{1}{K} \frac{dK}{dt} = \sigma \frac{X}{K}$$

### Equilibrium in the Food Market

$$(11) \quad M_S = M_D$$

The equilibrium in the food market is graphically illustrated in figure 1.<sup>10</sup>

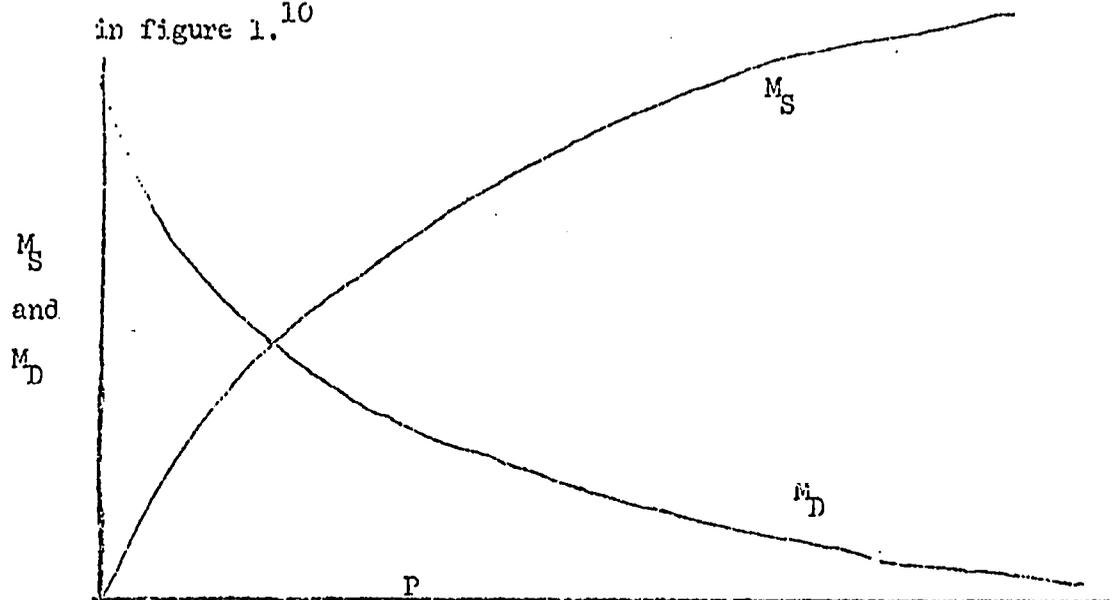


Figure 1: Equilibrium in the Food Market

Setting 3 equal to 6 it follows that:

$$(12) \quad A - \bar{U} - bsA = \frac{bsA(1-r)}{r}$$

12 can be restated as:

$$b(P, Y) = \frac{r(A - \bar{C})}{sA}$$

This will be referred to as an FF function representing equilibrium in the food market, It can be shown that for 12

$$\frac{\partial P}{\partial r} < 0$$

### Equilibrium in the Labor Market

$$(13) W_S = W_D$$

The Equilibrium in the labor market is graphically illustrated in figure 2.

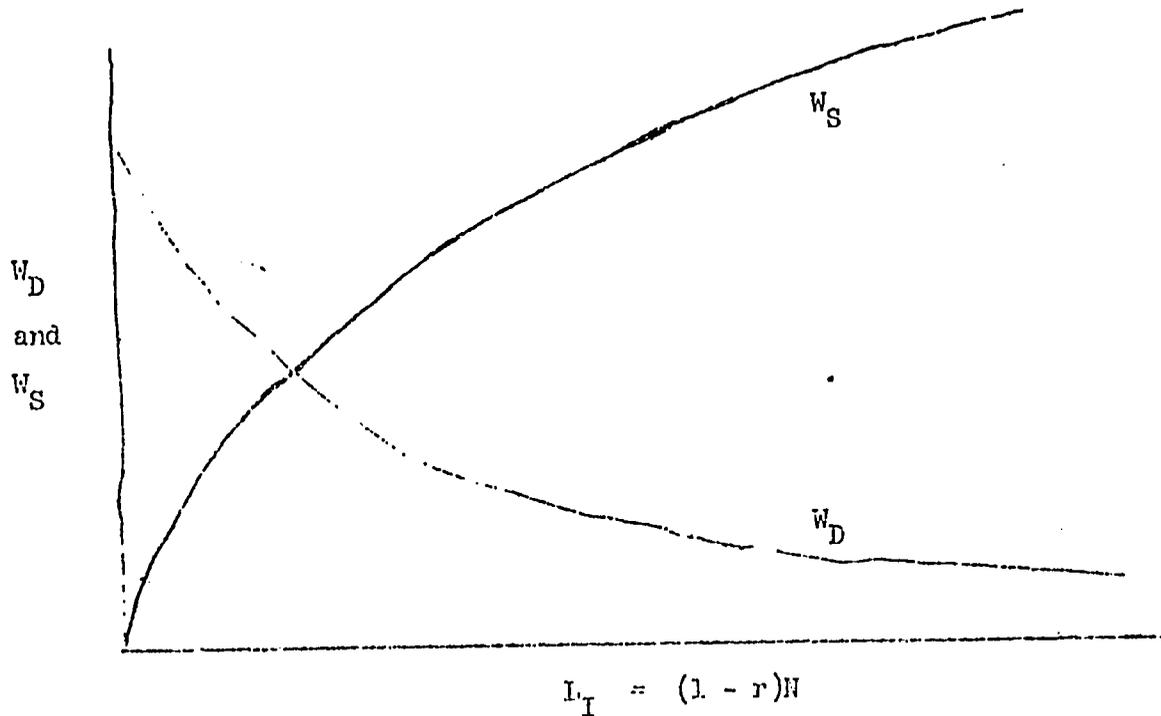


Figure 2: Equilibrium in the Labor Market

From 13 by setting 8 equal to 9 it follows that

$$(14) \quad PY = \frac{(1 - \sigma) K^\sigma}{L_I^\sigma}$$

Substituting for  $L_I$  and  $Y$  14 can be restated as:

$$P = \frac{(1 - \sigma) K^\sigma}{(1 - r)^\sigma N^\sigma} \cdot \frac{rN}{sA}$$

This will be referred to as the LL function representing equilibrium in the labor market. It can be shown that for 14

$$\frac{\partial P}{\partial r} > 0$$

#### The General Equilibrium

Since  $b$  is a function of  $P$  and  $Y$ , substituting

$$\frac{(1 - \sigma) K^\sigma}{(1 - r)^\sigma N^\sigma} \cdot \frac{rN}{sA}$$

for  $P$  from equation 14 and  $\frac{sA}{rN}$  for  $Y$  from equation 5 into equation 12, we obtain a condition for a general equilibrium as follows:<sup>11</sup>

$$(15) \quad r \left( \frac{A - \bar{C}}{A} \right) - b \left( \frac{rN}{sA} \frac{(1 - \sigma) K^\sigma}{(1 - r)^\sigma N^\sigma}, \frac{sA}{rN} \right) s = 0$$

The general equilibrium derived from 12 and 14 may be shown graphically as follows:

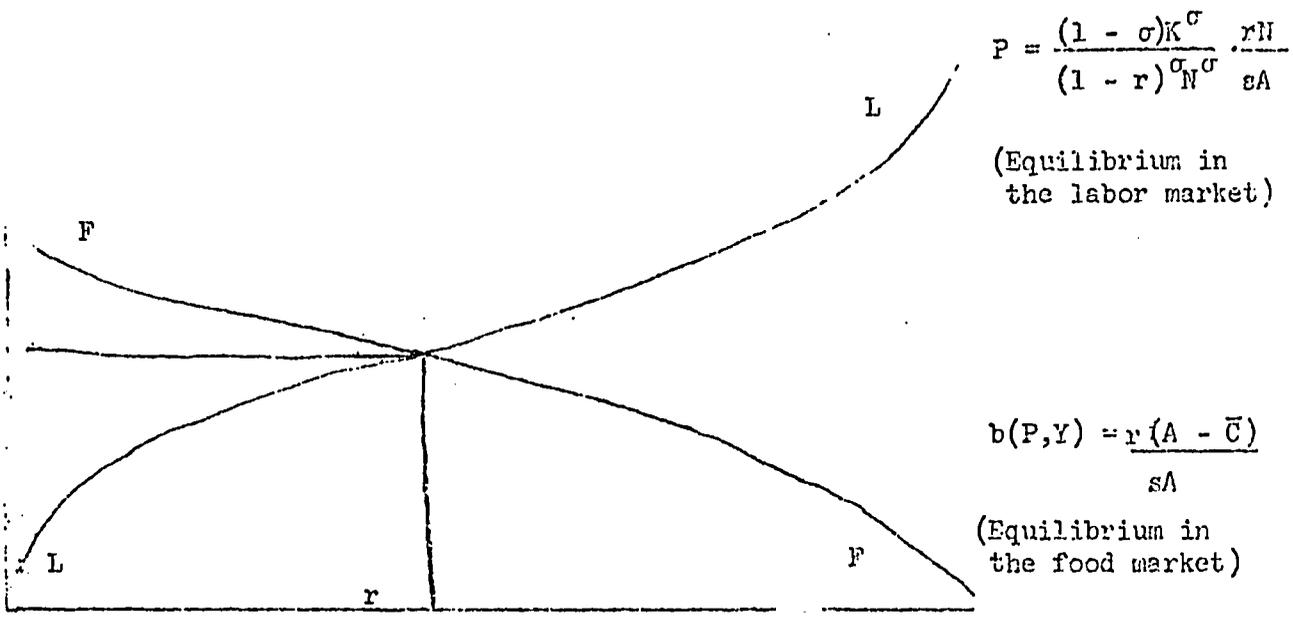


Figure 3: General Equilibrium in the Food and the Labor Market

## IV. Sensitivity Analysis

We will now proceed to investigate the sensitivity of  $r$ ,  $P$ ,  $M_S$  and  $W/P$  with respect to  $A$ ,  $N$ , and  $K$ . This is done by partial differentiation of the solution equations for each of the four endogenous variables in the model with respect to  $A$ ,  $N$ , and  $K$ . Changes in  $A$  (agricultural output) which increase, decrease or leave labor share unchanged are each examined. The signs in the sensitivity matrix presented below are based on the ranges of all possible numerical values that the variables and parameters are likely to take in a dualistic economy.

---

	A			N	K
	$\frac{\partial s}{\partial A} > 0$	$\frac{\partial s}{\partial A} = 0$	$\frac{\partial s}{\partial A} < 0$		
$r$	+	-	-	+	-
$P$	+	-	-	+	+
$M_S$	+	+	+	-	+
$\frac{W}{P}$	+	+	+	-	+

---

The results in the sensitivity matrix are immensely interesting. They show that when the increase in the agricultural output is brought about without changing labor's relative share, as in the case of a neutral technological change, the effect of change in agricultural output on  $r$ ,  $P$ ,  $M_S$  and  $W/P$  can be determined unequivocally for all likely values of

variables and parameters in a dualistic economy. The matrix shows similar unequivocal results in the case of effects of changes in  $N$  and  $K$  on  $r$ ,  $P$ ,  $M_g$  and  $\frac{W}{P}$ .

However, the most interesting results are obtained in the case of an increase in the agricultural output that changes relative factor shares. This may happen, either when technological change is biased or when the increase in the agricultural output is brought about mainly through increased labor input. The sensitivity analysis emphasizes that when factor shares in the agricultural sector change, what happens to  $r$ ,  $P$ ,  $M_g$  and  $\frac{W}{P}$  as a result of increase in the agricultural output depends very much on the relative magnitude of the various counterbalancing forces.

For example, except in the case of  $W/P$ , all the other results obtained for neutral technological change are reinforced when labor's share declines as a result of an increase in the agricultural output. However, in the case of  $W/P$ , the effect of increased agricultural output accompanied by labor's declining share is indeterminate. This is because of the following factors. The equilibrium wage rate in the non-agricultural sector, when measured in terms of agricultural goods, is equal to the per capita income in the agricultural sector. A decline in the labor's share causes a decrease in the proportion of population in the agricultural sector, thus increasing per capita income of the existing agricultural

labor force. While at the same time, a decline in the labor's share also pushes the per capita income of the agricultural labor force downward directly. The resultant wage rate in the non-agricultural sector is thus a combined effect of these two mutually opposite forces and depends upon their relative magnitudes.

When increase in agricultural output is accompanied by increase in labor's relative share, the effect on  $r$ ,  $P$ ,  $M_g$  and  $W/P$  may go in either direction. If labor's relative share increases only slightly, relative to the increase in the agricultural output, the effect of increased agricultural output on  $r$ ,  $P$ ,  $M_g$  and  $W/P$  will be greater relative to that of increased labor's share. However, if the labor's share increases substantially as a result of the increased agricultural output the effect on  $r$ ,  $P$ ,  $M_g$  and  $W/P$  may be opposite to that when increased agricultural output is not accompanied by changing factor shares.

These interactions will be discussed in the dynamic analysis in the next section. The preceding discussion does suggest that in the context of growth the most interesting results in the sensitivity matrix are those relating to labor's share in agricultural output. They show that with increased labor's share, as for production increases in traditional agriculture, proportion of population in the non-agricultural sector may decline, terms of trade may move in favor of the agricultural sector, the marketed surplus of food may decline and the real

wage in the non-agricultural sector may increase. Converse changes may be expected when technological change decreases labor's share in agricultural output. The factor shares in the agricultural sector are thus of crucial importance in the growth of the non-agricultural sector.<sup>12</sup>

### V. Dynamic Analysis

#### Growth of Employment and Capital Stock Over Time

Equation 15, may be differentiated with respect to time, set equal to zero and income elasticity of demand for food substituted for

$$\frac{\frac{1}{\bar{C}_F} \cdot \frac{d\bar{C}_F}{dt}}{\frac{1}{\bar{Y}} \cdot \frac{d\bar{Y}}{dt}} \quad \text{where} \quad \frac{1}{\bar{C}_F} \cdot \frac{d\bar{C}_F}{dt} = \frac{1}{(A - \bar{C})} \cdot \frac{d(A - \bar{C})}{dt} - \frac{1}{N} \cdot \frac{dN}{dt}$$

It can be shown that the rate of growth of per capita real income of the agricultural labor force bears the following relationship with the capital-labor ratio in the non-agricultural sector

$$(16) \quad \frac{1}{\bar{Y}} \cdot \frac{d\bar{Y}}{dt} = \sigma \frac{1}{k} \cdot \frac{dk}{dt}$$

$$\text{where} \quad \frac{1}{k} \cdot \frac{dk}{dt} = \left( \frac{1}{K} \cdot \frac{dK}{dt} - \frac{1}{L_I} \cdot \frac{dL_I}{dt} \right)$$

Equation 16 shows that as long as per capita income of the agricultural laborers increases the capital-labor ratio in the non-agricultural sector also increases. Also, since  $\sigma < 1$  the capital-labor ratio increases more rapidly than the rate of

growth of per capita income. It is interesting to note here that, since  $Y = \frac{sA}{rN}$ , per capita income in the agricultural sector may increase, not only because of increase in agricultural output but, also because of increase in labor's share or due to decline in the labor force in the agricultural sector. It, therefore, seems highly probable that the capital-labor ratio in the industrial sector would rise over time, for even if agricultural output increases only as rapidly as the population growth, and even if labor's share does not increase, just the withdrawal of population from the agricultural sector would cause an increase in per capita income of agricultural laborers.

It is of considerable interest to examine further the factors that would determine the rate of growth of employment in the non-agricultural sector. Solving equation 15 for  $L_I$  and differentiating with respect to  $L_I$  gives us

$$(17) \quad \frac{dL_I}{dt} = \frac{\partial L_I}{\partial A} \cdot \frac{dA}{dt} + \frac{\partial L_I}{\partial N} \cdot \frac{dN}{dt} + \frac{\partial L_I}{\partial K} \cdot \frac{dK}{dt} + \frac{\partial L_I}{\partial s} \cdot \frac{ds}{dt}$$

Thus:

$$(18) \quad \frac{1}{L_I} \cdot \frac{dL_I}{dt} = \frac{1}{N} \cdot \frac{dN}{dt} + \frac{\frac{\alpha r \bar{C}}{A} - sb \{ -(n_A - 1 - \epsilon_{AA}) (\mu - \alpha) + \epsilon_{AA} \sigma \left( \frac{\alpha X}{K} - \mu \right) - s (\epsilon_{AA} - n_A) \}}{(1-r) \left( \frac{A-U}{A} - \frac{sb}{r} \left\{ \frac{\epsilon_{AA} (1-r+\sigma r)}{(1-r)} - (n_A - 1) \right\} \right)}$$

where  $n_A$  = income elasticity of demand for food  
 $\epsilon_{AA}$  = price elasticity of demand for food of  
 agricultural laborers when payments are  
 made in kind.<sup>13</sup>  
 $\mu$  = rate of growth of total labor force  
 $\alpha$  = rate of growth of agricultural output  
 $\beta = \frac{1}{s} \frac{ds}{dt}$  = rate of change of labor's relative share  
 in the agricultural output

It can be shown from 18 that  $\frac{1}{L_I} \cdot \frac{dL_I}{dt}$  is positive for  
 all values of  $\alpha > \mu$ .

Further, from equation 18 may be noted the various factors  
 that influence the magnitude of  $\frac{1}{L_I} \cdot \frac{dL_I}{dt}$ . For example, it may be  
 noted that the larger the value of  $\alpha$ , i.e., the greater the rate  
 of growth of agricultural output, the faster the rate of growth  
 of non-agricultural employment. It should also be noted that the  
 rate of growth of employment is inversely related to the movement  
 of labor's share in agricultural output. When labor's share  
 decreases  $\frac{1}{L_I} \cdot \frac{dL_I}{dt}$  increases. It is also clear from 18 that the  
 larger the share of profits in the non-agricultural output  
 the greater the rate of growth of employment in that sector.

These relationships are of immense interest in the policy  
 context. They indicate that to the extent that technological  
 change in the agricultural sector is accompanied by increased  
 labor's share in output, it would provide a dampening effect on  
 the growth of non-agricultural employment. This would occur

- 1) through its unfavorable effect on marketed supply of food
- 2) through its effect on the level of industrial wages required to withdraw labor from agriculture to the non-agricultural sector

In fact, growth in agricultural output may be completely compensated by increased share of agricultural laborers with no effect on the growth of non-agricultural employment. By the same token technological change that brings about a movement in the distribution of agricultural output against the laboring classes, may enhance the growth of non-agricultural employment. This crucial relationship between distribution within the agricultural sector and its effect on non-agricultural employment through wage rate and through mobilization of marketed surplus is neglected by the existing dualistic models.

These results are of even further interest due to their implications for the magnitude of the capital-labor ratio over time. They show that although the capital labor ratio in the non-agricultural sector will increase with increase in the per capita income in the agricultural sector, the actual magnitude of the capital-labor ratio is contingent upon the rate of growth of agricultural output and the changes in relative factor shares in the agricultural sector. Thus the capital-labor ratio will increase less rapidly if agricultural output grows at a high rate than if it does not. It may increase even less rapidly if increase in agricultural output is accompanied by a decline in labor's share in agricultural output. This is because the opportunity cost of labor to the non-agricultural sector is dependent on

per capita income in the agricultural sector, which is a function not only of agricultural output but also of relative factor shares in the agricultural sector. These complex conclusions are at variance with the simplistic treatment and conclusions concerning capital-labor ratios in the Jorgenson and Fei-Ranis treatment of dualistic models.

These results also have significant implications for trade. A labor augmenting technological change in the agricultural sector, by keeping the capital-labor ratio in the non-agricultural sector from rising as rapidly as it would otherwise may provide considerable continuing comparative advantage in the production and export of labor intensive commodities in a dualistic economy such as ours.

#### Change in Terms of Trade Over Time

Movements in the terms of trade over time may be analyzed by differentiation of  $P$  with respect to  $A$ ,  $s$ ,  $N$ , and  $K$ .

$$(19) \quad \frac{dP}{dt} = \frac{\partial P}{\partial A} \frac{dA}{dt} + \frac{\partial P}{\partial K} \frac{dK}{dt} + \frac{\partial P}{\partial N} \frac{dN}{dt} + \frac{\partial P}{\partial s} \frac{ds}{dt}$$

$$(20) \quad \frac{1}{P} \frac{dP}{dt} = a_1 \cdot \frac{1}{A} \frac{dA}{dt} + a_2 \cdot \frac{1}{K} \frac{dK}{dt} + a_3 \cdot \frac{1}{N} \frac{dN}{dt} + a_4 \cdot \frac{1}{s} \frac{ds}{dt}$$

where  $a_1$ ,  $a_2$ ,  $a_3$ ,  $a_4$  are respectively elasticities of price with respect to change in agricultural output, capital stock, population and labor's share in agricultural output.

Thus:

$$\begin{aligned}
 (21) \quad a_1 &= \frac{\partial P}{\partial A} \cdot \frac{A}{P} \\
 &= \frac{- \left[ \frac{r\bar{C}}{A} - sb (-\epsilon_{AA} + n_A - 1) \right]}{\frac{(A - \bar{C}) r (1 - r)}{A(1 - r + r\sigma)} - sb\epsilon_{AA}} < 0
 \end{aligned}$$

$$\begin{aligned}
 (22) \quad a_2 &= \frac{\partial P}{\partial K} \cdot \frac{K}{P} \\
 &= \frac{b \sigma \epsilon_{AA}}{\frac{(A - \bar{C}) r (1 - r)}{A(1 - r + r\sigma)} - sb\epsilon_{AA}} > 0
 \end{aligned}$$

$$\begin{aligned}
 (23) \quad a_3 &= \frac{\partial P}{\partial N} \cdot \frac{N}{P} \\
 &= \frac{sb \{ \epsilon_{AA} (1 - \sigma) - (n_A - 1) \}}{\frac{(A - \bar{C}) r (1 - r)}{A(1 - r + r\sigma)} - sb\epsilon_{AA}} > 0
 \end{aligned}$$

$$\begin{aligned}
 (24) \quad a_4 &= \frac{\partial s}{\partial P} \cdot \frac{P}{s} \\
 &= \frac{sb (n_A - \epsilon_{AA})}{\frac{(A - \bar{C}) r (1 - r)}{A(1 - r + r\sigma)} - sb\epsilon_{AA}} > 0
 \end{aligned}$$

It can be shown that depending upon whether

$$s b (n_A - \lambda_A - b \sigma \epsilon_{AA}) \gtrless \frac{rC}{A}$$

$\frac{1}{P} \frac{dP}{dt}$  will be  $\gtrless 0$  and prices will increase, remain constant or decrease over time. The movement of terms of trade between agriculture and industry over time are thus dependent upon a complex set of factors and may move in either direction depending upon the magnitudes of these several parameters and variables. It should be noted that the terms of trade are determined by the price, income and output elasticities on the one hand and by the factor shares in the agricultural sector and average propensities to consume of the two income classes on the other.

#### VI. Conclusion

The system presented in this paper fills a major gap in the theory of a dualistic economy. It examines the functioning of the food and labor market as two independent markets and examines the interaction between the two and its effect on labor mobilization. It explicitly allows for a) the varying share of labor in the total agricultural output b) for the varying response of food consumption to income and price changes for the two classes in the agricultural sector. This is a significant improvement over the existing dualistic theories that treat growth of agricultural output as being synonymous with growth of agricultural marketings. This model therefore, analyzes the

rate of growth of non-agricultural employment in terms of the growth rate of agricultural output as well as of changing factor shares in the agricultural sector.

It must, however, be emphasized that this formulation is only a first step forward from the existing dualistic models. It does provide considerable scope for incorporating the third major market in the general equilibrium system, namely the intersectoral capital market. The existing theories, including this one, assume that nonagricultural investment occurs only through savings in that sector. The evidence from Japan and Taiwan and more recently from India indicates that savings in the traditional sector provide a considerable scope for industrialization particularly of the small scale type which does not require lumpy capital investments. In dualistic economies, in which the capital market is ill-organized and inefficient, considerable interest must lie in examining the role of the intersectoral capital market in the pace of industrialization. It is clear that technological change in agriculture with its varying factor bias will be an important determinant of the sign and direction of intersectoral capital transfers.

Further, this model, like its predecessors assumes that supply of consumers goods other than food is highly elastic and that no serious bottlenecks in industrialization occur due to changes in the prices of these goods. It may be worthwhile to examine the effect of varying degrees of elasticity of supply of consumer goods other than food on labor mobilization.

The analysis thus provides a variety of possibilities for developing a more realistic model of industrialization. It also suggests areas of empirical investigation of relationships that are crucial to this analysis and that have been largely neglected in the past. These include:

1. Changes in factor shares resulting from various types of new agricultural technology, e.g. effects of improved varieties, multiple cropping, irrigation, and mechanization, on factor shares in the agricultural sector. Our model provides a relevant framework in which to view the indirect effects of changing factor shares from different technologies.

2. The response of different income groups to price and income changes in terms of domestic consumption and marketing of food. This is of particular relevance in the context of technological change which results in considerable changes in the distribution of the physical product.

3. The capital-labor ratios and the capital-output ratios implicit in different types of non-agricultural investments-- both in the manufacturing sector as well as in the development of infrastructure. By emphasizing labor as a scarce resource when combined with food, our model emphasizes a need for an optimal combination of industries with varying capital-labor ratios. Although not explicit in the presentation of the model, it is apparent that if the rate of increase of the marketed supply of food increases, a short run disequilibrium between capital and labor supplies will be created. This calls for search for

means of reducing capital-labor ratios. The potentials for reducing capital-labor ratios through restructuring of industry needs to be examined. Trade and a new structure of domestic demand incident to redistribution of income also will have considerable implications for the structure of industry.

4. Implications of rapid industrialization to trade patterns. The effect of accelerated growth of marketed food supply on the structure of industrialization on factor intensity and hence on comparative advantage needs increased attention.

5. The balance in foreign aid between consumer goods, including food aid, and capital goods. Past models of growth have favored a major emphasis on capital goods with a resultant small employment component in aid induced growth. Renewed study is needed of the relation and balance between consumer goods, including food, labor mobilization and capital goods. There is implicit in this a concept of balanced aid between capital goods and consumer goods and an interesting set of questions concerning the relative merits of trade and aid from the point of view of employment policy.

All these relationships acquire a new significance in the wake of the new potentials for technological change in the agricultural sector and their implications for expansion of the non-agricultural labor force.

## FOOTNOTES

- \* Cornell University. This paper was initiated with funds from the Cornell University Comparative Economics Program and completed as part of the Cornell University AID research contract on employment implications of technological changes in agriculture. We are grateful to T. C. Liu, Roger Selley, and William Tonek for important suggestions in formulation of the model and to Simone Clemhout, Carl Gotsch, Robert Herdt, Jaroslav Vanek, and Henry Wan for a critical review of the paper.
1. See Jagdish Bhagwati and Sukhomoy Chakravarty for a review of substantial literature on planning models as applied to India. Also see Irma Adelman and Erik Thorbecke. Louis Lefebvre's recent article does examine the question of employment. However, due to his rigid assumptions, his work, like others also reaches the dismal conclusion of a choice between present growth of employment vs. future level of consumption.
  2. As an example of the latter see Sukhomoy Chakravarty and Louis Lefebvre. At an operational level the planning models have proved unsatisfactory for a variety of reasons, among them not the least important is failure to incorporate fluctuations in agricultural production. See, for example, the various formulations of Chakravarty and Lefebvre and Richard S. Eckaus and Kirit S. Parikh for India.

3. A number of empirical generalizations are made at various points in this paper. They are in general drawn from the work of John W. Mellor et. al. and Uma Lele for India T. H. Lee for Taiwan, and Mellor, 1970 for various countries.
4. See W. Arthur Lewis, Gustav Ranis and John C. H. Fei, and Fei and Ranis. For a critical comparison of these models with Dale Jorgensen, 1961-1965 as well as emphasis on the terms of trade problem, see John W. Mellor, 1967.
5. The scant empirical evidence that exists on the relationship of aggregate supply to price changes supports this contention. See for example, Rober Herdt and Howard Bamuz.
6. For analysis of these complex firm-household relationships see Mellor, 1963, and Amartya K. Sen.
7. Assuming a utility function with fixed coefficients and unit elasticity of substitution Sen (p. 437) shows that the response of output to price must be positive. He, however, admits that "without further empirical research we cannot say how realistic are the cases covered here." The exercise is, therefore, only esoteric. In absence of knowledge of the true shape of the utility function a judgement about the most likely supply response must depend heavily on empirical evidence such as that cited in footnote 5.
8. It will be noted that although the emphasis in our presentation is on the labor supply problem, the mechanism discussed includes an increase in demand for goods produced

in the non-agricultural sector, which itself may be an important dynamic of growth.

9. This assumption is different from the assumption in the classical dualistic model. Our assumption may lead to an increasing equilibrium real wage in the non-agricultural sector, as per capita income of the remaining agricultural laborers in the agricultural sector increases a) with withdrawal of labor, b) with increasing agricultural output, or c) with changing share of laborers in agricultural output. Labor migrates from the agricultural to the non-agricultural sector until wages in the non-agricultural sector equal per capita incomes in the agricultural sector. The simplicity of the assumption has increased the analytical facility of our formulation. However, maintenance of the conclusions only requires that wages in the non-agricultural sector be a function of the average income in agriculture. This assumption could be modified to contain the more complex formulation of the Todaro model without altering the conclusions of our analysis. For example, a high non-agricultural wage might be discounted by repeated unemployment.
10. The derivation of the supply and demand curves is based on the assumption that  $b$  is not linear homogenous with respect to  $P$  and  $Y$ .
11. Assuming a price adjustment in the food market and a quantity adjustment in the labor market and using the correspondence principle and Riegel's law it can be shown that for the equilibrium to be stable where  $\frac{ds}{dA} = 0$ , it is necessary that  $b_1 < 0$  where  $b_1 = \frac{\partial b}{\partial P}$ . We are grateful to Roger Solley for derivation of the stability conditions. See Appendix B to this paper.

12. Our exposition places perspective on the controversy between James Nakamura and others concerning the rate of growth of agricultural output in Japan during the Meiji period. Presumably during the Meiji period growth in output was increasingly derived from yield increasing technological change in contrast to the more labor intensive sources of growth in Tokugawa period (see Thomas Smith). The resultant change in factor shares would support a greater growth in non-agricultural employment and greater structural transformation for a given increase in agricultural output. Thus we may at least partially accept Nakamura's analysis of output data without modifying the earlier assertions concerning agriculture's increased contribution to economic growth. A similar argument could be made for Taiwan's accelerated growth in agricultural output in the 1920's and the 1950's.
13. It can be shown that this price elasticity is equal to  $\epsilon_{AA}^* + \eta_A$  where  $\epsilon_{AA}^*$  is the usual price elasticity of demand and  $\eta_A$  the income elasticity of demand for food. We are grateful to Roger Selley for the detailed derivation. See Appendix A to this paper.

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## Appendix A

## A Note on Demand Elasticities, Monetary Payment and Payment in Kind

by

Roger Selley

Consider the demand equation for good  $i$

$$Q_i = Q_i(P_i, \dots, P_N, Y), \quad i = 1, \dots, N \quad (1)$$

where  $Q_i$  is the quantity demanded of good  $i$ ,  $P_i$  is the price of good  $i$ , and  $Y$  is the quantity of the  $j^{\text{th}}$  good received as payment in kind.

Totally differentiating (1) results in

$$dQ_i = \frac{\partial Q_i}{\partial P_1} dP_1 + \dots + \frac{\partial Q_i}{\partial P_N} dP_N + \frac{\partial Q_i}{\partial Y} dY \quad (2)$$

where  $dQ_i$  is the change in the quantity of good  $i$  consumed resulting from the changes  $dP_1 \dots dP_N, dY$ . If we consider a change in the price  $P_j$  while holding all other prices constant, upon dividing through by  $dP_j$ , (2) becomes

$$\frac{dQ_i}{dP_j} = \frac{\partial Q_i}{\partial P_j} + \frac{\partial Q_i}{\partial Y} \frac{dY}{dP_j}, \quad i = 1, \dots, N. \quad (3)$$

If in addition we take the monetary value of  $Y$  as constant, i.e.,

$P_j Y = k$ , we can totally differentiate  $P_j Y = k$ ,

$$(dP_j) Y + (dY) P_j = 0, \quad (4)$$

solve (4) for  $dY/dP_j$  and substitute the result into (3) which after multiplying by  $P_j/Q_i$  becomes:

$$\frac{dQ_i}{dP_j} \frac{P_j}{Q_i} = \frac{\partial Q_i}{\partial P_j} \frac{P_j}{Q_i} - \frac{\partial Q_i}{\partial Y} \frac{Y}{Q_i}, \quad i = 1, \dots, N. \quad (5)$$

Expressing (5) in terms of elasticities results in:

$$\epsilon_{ij}^* = \epsilon_{ij} - n_i \quad (6)$$

where  $\epsilon_{ij}^*$  is the price elasticity of demand for the  $i^{\text{th}}$  good with respect to changes in the  $j^{\text{th}}$  price, all other prices and the monetary value of the payment in kind,  $P_j K$ , held constant, i.e., this is the usual price elasticity of demand discussed in the literature;  $\epsilon_{ij}$  is the price elasticity of demand for the  $i^{\text{th}}$  good with respect to changes in the  $j^{\text{th}}$  price where all other prices and payments in kind are held constant;  $n_i$  is the elasticity of demand for the  $i^{\text{th}}$  good with respect to changes in the payment in kind, all prices held constant. The price and income elasticities presented on page 20 can now be shown to have the following relation to the usual price elasticity of demand:

$$\epsilon_{AA}^* = \epsilon_{AA} - n_A \quad (7)$$

## Appendix B

## Stability Conditions and the Correspondence Principle

by

Roger Selley

Let us hypothesize that the terms of trade increase over time if demand for the marketable surplus exceeds its supply,

$$\dot{P} = H [M_D - M_S] , H' > 0 = \frac{dH}{dx} > 0, y = M_D - M_S \quad (1)$$

and that labor migrates to the nonagricultural sector when the demand price for nonagricultural labor exceeds its supply price,

$$\dot{r} = G [W_D - W_S] , G' = \frac{dG}{dy} < 0, x = W_D - W_S \quad (2)$$

Consider the linear Taylor expansion of the system (1) and (2):

$$\begin{bmatrix} \dot{P} \\ \dot{r} \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} + \begin{bmatrix} \partial \dot{P} / \partial P & \partial \dot{P} / \partial r \\ \partial \dot{r} / \partial P & \partial \dot{r} / \partial r \end{bmatrix} \begin{bmatrix} P \\ r \end{bmatrix} \quad (3)$$

where the partials of  $\dot{P}$  and  $\dot{r}$  with respect to  $P$  and  $r$  are evaluated at an equilibrium point  $(P^*, r^*)$ . A necessary and sufficient condition for local stability of the system (1) and (2) is that the eigen values of the matrix of partials in (3),

$$\frac{1}{2} \left\{ \frac{\partial \dot{P}}{\partial P} + \frac{\partial \dot{r}}{\partial r} \pm \sqrt{\left( \frac{\partial \dot{P}}{\partial P} + \frac{\partial \dot{r}}{\partial r} \right)^2 - \left( \frac{\partial \dot{P}}{\partial P} \frac{\partial \dot{r}}{\partial r} - \frac{\partial \dot{P}}{\partial r} \frac{\partial \dot{r}}{\partial P} \right)} \right\} \quad (4)$$

have negative real parts.

For the eigen values to have negative real parts it is necessary and sufficient that

$$\begin{aligned} \frac{\partial \dot{P}}{\partial P} + \frac{\partial \dot{r}}{\partial r} &= H' b_1 \quad SA/rN + G' (-F''K^2/N^2(1-r)^3 + FSA/r^2N) \\ &= -G' F''K^2/N^2(1-r)^3 + (H' b_1 r + P) SA/r^2N < 0 \end{aligned} \quad (5)$$

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and

$$\frac{\partial \dot{P}}{\partial P} \frac{\partial \dot{r}}{\partial r} - \frac{\partial \dot{P}}{\partial r} \frac{\partial \dot{r}}{\partial P} = H' (b_1 sA/rN) G' (-f''K^2/N^2(1-r)^3 + P sA/r^2N) \quad (6)$$

$$- H' (sA/rN) (b_2 sA/r^2N + b/r) G' (sA/rN) > 0$$

where output is specified by the general production relation

$$X = L_I f[K/L_I] = L_I f[k]$$

$$f' = \partial f / \partial k,$$

$$\text{and } f'' = \partial^2 f / \partial k^2.$$

Dividing (6) by  $H'G' sA/rN$  results in the condition

$$b_1 (-f''K^2/N^2(1-r)^3 + P sA/r^2N) \quad (6a)$$

$$- b_2 (sA/rN)^2/r + b sA/r^2N < 0.$$

By Engel's Laws the percentage importance of food expenditure declines as income increases, i.e.,  $b_2 < 0$ . Assuming diminishing returns in production  $f'' < 0$  and assumes Engel's Laws apply, it is necessary that  $b_1 < 0$  for (6a) and therefore (6) to be satisfied. The partial  $b_1 < 0$  is also sufficient for the satisfaction of condition (5). Equation (6) places a stronger condition on  $b_1$  which depends upon the magnitude of the parameters and variables of the model. Applying Engel's Laws and Samuelson's correspondence Principle permits the unambiguous determination of all of the signs in the sensitivity matrix on page 16.

Since the relative budget share spent on food by laborers can be expressed as  $b = A/Y$  where  $A$  is defined here as per capita consumption of food and  $Y$  is per capita income, the constraints

placed here on  $b_1$  and  $b_2$  can be expressed in terms of elasticities as follows:

$$b_1 = \frac{\partial b}{\partial P} = \frac{1}{Y} \left( \frac{\partial A}{\partial P} \frac{P}{A} \right) \frac{A}{P} = \frac{b}{P} \epsilon_{AA} < 0 \quad (7)$$

$$b_2 = \frac{\partial b}{\partial Y} = \frac{1}{Y} \left\{ \left( \frac{\partial A}{\partial Y} \frac{Y}{A} \right) \frac{A}{Y} - \frac{A}{Y} \right\} = \frac{b}{Y} (n_A - 1) < 0 \quad (8)$$

which can be restated as

$$\epsilon_{AA} < 0 \quad (7a)$$

and

$$n_A < 1. \quad (8a)$$

From the results derived in Appendix A, equation (7a) can be in turn restated in terms of the "usual" price and income elasticities as follows:

$$\epsilon_{AA} = \epsilon_{AA}^* + n_A < 0. \quad (7a-1)$$

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