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Relationship Between Agriculture and Other Sectors

Agriculture in the Open Economy

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THE SIGNIFICANCE of agricultural stagnation in the economic development of the less-developed world has been increasingly recognized. Concern with the race between food and mouths and for the resultant need to activate the agricultural sector is so widespread today, not only in the profession but among policy makers, that it need hardly be elaborated on. Nor, as we may be quick to realize, is this insight really new. In fact, it may be said that evidences of a deep concern with this problem are discernible at the very beginnings of economic science. As agrarian stagnation was understood by the physiocrats, the *produit net* of the soil was used to finance the sterile classes outside of agriculture, permitting no marked upward deviation from the circular flow depicted in their *Tableau Economique*. The classicists, especially Ricardo and Malthus, analyzed the course of stagnation more fully in predicting the long-run cessation of progress. Later in the same century the Marxists shifted the emphasis to the petering out of profits in early commercial capitalism as a causal factor, an approach that led to similar somber predictions for the long run. All these essentially pessimistic views went unchallenged for more than a century, without any competing thesis of growth being elaborated. After the Second World War, interest in prob-

lems of long-term growth was revived. This renaissance was manifested in the one-sector models of growth for the industrially mature economy (Solow, Swan, Phelps, *et al.*)—with which we shall not be concerned in this paper—and in the theories of development in a two-sector underdeveloped world (e.g., Lewis, Leibenstein, Jorgenson, Fei & Ranis, *et al.*), with which we are concerned.

The physiocrats, the classicists, and Marx looked for regularities in the performance of the system they were observing, an approach that lends itself readily to the conclusion that ultimate stagnation is inevitable. The modern view of growth as a feature of a vigorous dualistic society shifting its center of gravity tends to be more optimistic, even though concern with the basic problem of departure from quasi-equilibrium continues to predominate. There can be, in short, little doubt that the assumptions as well as the growth-theoretic constructs of each period are imbedded in actual world conditions as seen through the eyes of the contemporary analyst. Thus, from a long-run historical perspective it may be instructive to think of four types of economic systems that occur in historical sequence: (1) the agrarian society, (2) the open agrarian society, (3) the dualistic society, and (4) the industrially mature society.

It is our view that we are witnessing in most of the contemporary underdeveloped world the attempt of countries to make the transition between open agrarianism and dualism. We must recognize as "normal" the condition in which such attempts are being frustrated by the inability to shake off the endemic structural characteristics of agrarianism. It is precisely for this reason that the study of the causes of stagnation in the open agrarian society—a major concern of this paper—is crucial for an understanding of the dynamics of the contemporary less-developed world in its attempt to activate agriculture in behalf of the process of economic development.

In Section 1 we present a brief statement of the causes of long-term stagnation in the closed agrarian system. Section 2 deals with the breakdown of the closed agrarian system under the impact of penetration of foreign trade and the consequential restructuring of the economy. In Section 3 the essential economic functions that must be performed in open agrarianism will be analyzed. Section 4 describes the propellant forces that dictate the performance of the open agrarian economy over time. Finally, in Section 5, the forces of stagnation that continue to grip the open agrarian economy will be identified and the conditions for successful transition to dynamic dualism elaborated.

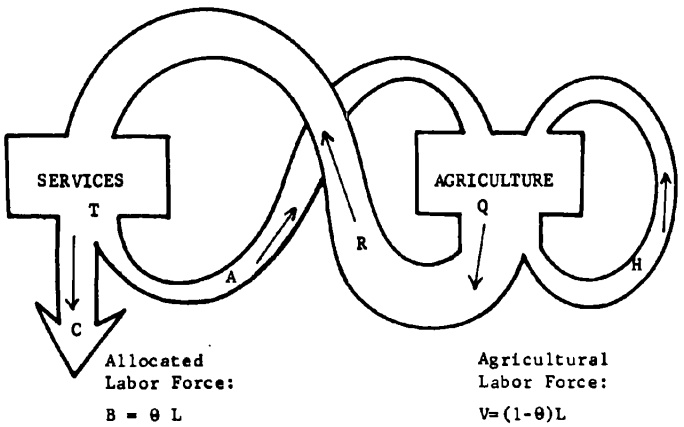
SECTION 1

Causation of Agrarian Stagnation

Let us begin with some of the basic notions of the eighteenth century physiocrats, who envisioned a circular-flow mechanism between two sectors of the economy: a preponderant agricultural sector and a smaller service sector. As shown in Figure 1, the total output of food (Q-units) of the agricultural sector either flows back to that sector to be consumed by the farmers (H-units) or moves to the service sector (R-units) to be consumed by the workers in that sector. In turn, the output of the service sector T either flows back to the agricultural sector (in the form of consumer goods or subsidiary productive services) to sustain agricultural productivity (A-units) or is "consumed" by the nobility, the church, and the aristocracy (C-units) to sustain their cultural, religious and military activities. While, to the eternal credit of the physiocrats, the regularity and stability of such a circular-flow system is identified, it was left to the classicists, about sixty years later, to give, in their positive theory of stagnation, a causal explanation of the same phenomenon.

From our point of view, the most important analytical contribution of the classical economists is the understanding of the role of labor and the problem of the existence (at least implied) of a labor surplus. Suppose the total labor force of L units is allocated to two sectors in such a

Figure 1



way that θL units are workers in the service sector and $(1 - \theta)\ L$ units remain as farmers. Then

$$\theta = R/Q \quad (\text{or } R = \theta Q). \tag{1}$$

This indicates a basic fact of agrarianism: food must be allocated to the agriculture and service sectors in the same proportion as population is distributed.[1] It follows that the expansion of agricultural productivity leading to the availability of R as an agricultural surplus (to sustain the workers in the nonagricultural sector) is a prerequisite to the emergence of the service sector and the expansion of its size θ relative to the total labor force. This physiocratic idea of an agricultural surplus is indeed a powerful tool for the analysis of growth phenomena for all economies with an agricultural base. It should be noted, moreover, that the agricultural surplus defined in this way is quite independent of whether or not the marginal product of labor in agriculture is zero, a question on which, in our view, all too much energy has been expended.

The basic arithmetic of an agricultural surplus can be summarized with the help of three indicators, namely θ, p, and c, where θ is the surplus labor ratio, i.e., the fraction of L in the service sector, $p = Q/L(1 - \theta)$ i.e., the remaining farmers' average productivity, and $c = Q/L$, i.e., the per capita consumption standard in the economy as a whole. From (1) we have

$$p\,(1 - \theta) = c \quad (\text{or } 1 - \theta = c/p) \tag{2}$$

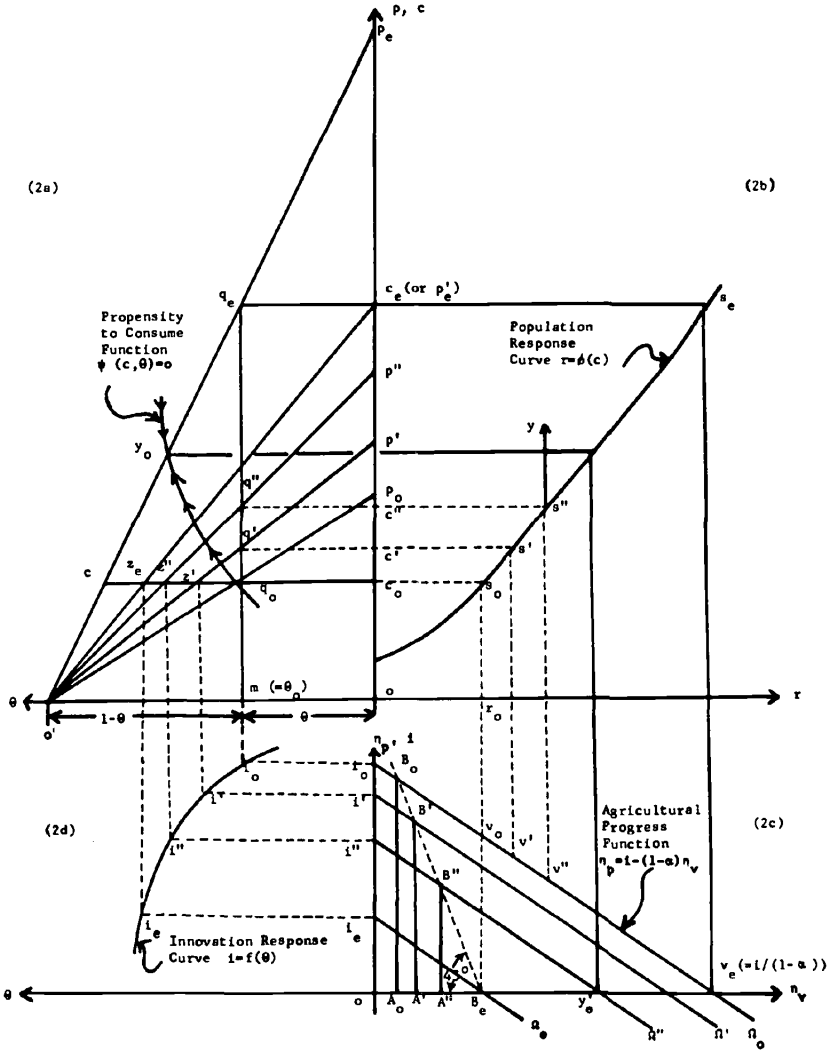
demonstrating that the farmers' fraction of the total $1 - \theta$ must be equal to the consumption standard as a fraction of agricultural productivity (c/p).

The relationships within this triplet θ, p, c can be quickly summarized in Figure 2a in which the vertical axis is used to measure p and c and the horizontal axis (measured to the left) is used to measure θ. Let the distance oo' represent *one* unit (i.e., if the value of θ is given by point "m" then $o'm$ is $1 - \theta$). Suppose points p_o and c_o (with $c_o < p_o$) are indicated on the vertical axis. Let point q_o be the point of intersection of the straight lines $o'p_o$ and c_oc (horizontal line); then the distance q_oc_o is the equilibrium surplus labor ratio θ and $c_o/p_o = 1 - \theta$. (This is easily seen from (2). Thus, when p increases (as in p_o, p', p'', p_e . . .), the value of θ will increase (as in q_o, z', z'', z_e . . .) *if c remains constant* at c_o. On the other hand, the value of c will increase (as in q_o, q', q'', q_e . . .) *if θ remains constant* at θ_o. It is economic common sense

[1] Under the simplifying assumption of no wage gap or consumption standard differential between the two sectors. The (likely) existence of a real world differential could easily be accommodated.

that higher agricultural productivity p will lead either to a higher fraction of the population allocated to the service sector θ or a higher standard of consumption c. These two alternative ways of using the increased agricultural surplus may be referred to as the labor allocation adjustment (when c remains constant) and the consumption adjustment (when θ remains constant).

Figure 2



The above arithmetic of agricultural surplus can be the starting point for developing a thesis of agrarian stagnation. First, the very phenomenon of agrarian stagnation itself must be defined in terms of the long-run stability of the triplet θ, p, and c. Using a Cobb-Douglas production function (with fixity of land),[2] we may relate the rate of technological change "i" (i.e., the intensity of agricultural innovation) and the growth rate of agricultural population $\eta_v = \eta_{(1-\theta)L}$ [3] as follows:

(3a) $Q = e^{it}v^{\alpha}$ (v is agricultural population)

(b) $\eta_p = i - (1 - \alpha)\eta_v$ where

(c) $p = \dfrac{Q}{v}$.

Equation 3b is represented by the negatively sloped straight line (the line labeled Ω_o) in Figure 2c in which η_p is measured on the vertical and η_v on the horizontal axis. This curve may be called the agricultural progress function and reflects the struggle between innovation and the law of diminishing returns. Thus, for a given value of innovational intensity, "i" (represented as the vertical intercept of the Ω_o line), the rate of increase in agricultural productivity declines as the population growth rate increases. The point v_e (where $v = i/(1 - \alpha)$) on the horizontal axis is the point of "long-run stagnation" as p and v take on stationary values (since $\eta_p = 0$ along the horizontal axis). Any thesis of long-run agrarian stagnation must explain how such an equilibrium point on the horizontal axis is reached in the long run.

It is frequently argued that any initial productivity gain in agriculture is bound to lead to upward revisions of the consumption standard. When the increased agricultural surplus is used entirely for such consumption adjustment, to assume the extremal case of this alternative, we have the Jorgenson-Classical thesis of stagnation.[4] For this thesis a population response curve can be postulated by

(4a) $r = \phi(c)$ (population response)

where

(b) $r = \eta_L$ (rate of growth of *total* population),

[2] If land is not entirely fixed, this can be treated as an additional component of innovational intensity.

[3] Where $\eta_x = \dfrac{dx}{dt} / x$, i.e., the rate of growth of x.

[4] See D. W. Jorgenson, "The Development of a Dual Economy," *Economic Journal*, LXXI, 1961; also his "Testing Alternative Theories of the Development of a Dual Economy," in I. Adelman and E. Thorbecke (ed.), *The Theory and Design of Economic Development*, Baltimore, 1966.

and is represented by the positively sloped curve in Figure 2b. This relation simply states that the population growth rate is "controlled" by the consumption standard c (measured on the vertical axis in Figure 2b) and leads us to the conclusion that the operation of a "consumption adjustment" mechanism is likely to culminate in ultimate stagnation.

To illustrate this, let us start from our initial values of p_o, c_o, and θ_o in Figure 2a. We can then determine point s_o on the population response curve in Figure 2b. In case no relative reallocation of labor occurs, i.e., if θ is constant, $\eta_v = r$.[5] Thus we can obtain point v_o on the agricultural progress function in Figure 2c. Since η_p is positive at v_o, the value of p will increase to say p', in the next period (Figure 2a), and the value of c will increase to c'. This, via points s' (Figure 2b) and v' (Figure 2c), further depresses the rate of increase of p (i.e., from v_o to v'). Nevertheless, since v' is still positive, p continues to increase following the sequence p_o, p', p'', ... The long-run stagnation equilibrium position is then given by the triplet p_e, c_e, and θ_o corresponding to the points s_e on the population response curve and v_e on the agricultural progress function. (Conversely, starting from an initial value of p greater than p_e, p will decrease to p_e in the long run.) Thus, according to the Jorgenson-Classical mechanism, the long-run stability of p_e, c_e, and θ_o, as well as r, is due to the fact that the population growth rate is controlled by the consumption standard in such a way as to suppress or encourage labor productivity gains when consumption and productivity levels are too high or too low respectively.[6]

The above represents a modified version of the Jorgenson-Classical thesis of stagnation. The modification comes about through our postulation of the coexistence of two sectors—a point strongly emphasized by the physiocrats, but generally neglected in the classical writings. We have thus shown that, under the assumption of the constancy of θ (the labor surplus ratio), the salient features of the Jorgenson-Classical thesis apply equally well to the two-sector economy.

On the other hand, if the increased agricultural surplus is "used" via a labor reallocation adjustment, we have a possible alternative thesis of

[5] $\eta_v = \eta_{(1-\theta)L} = \eta_{(1-\theta)} + \eta_L$. Thus $\eta_v = \eta_L$ if θ is constant.

[6] To be more precise, this is the Jorgenson "trap" case. Jorgenson, unlike the classicists, also presents a "take-off" case according to which population growth is no longer responsive to increases in the consumption standard while η_P is still positive. For example, if the population response curve in Figure 2b has the shape $s_o s'' y$, the rate of growth of per capita output η_P will stabilize at level v'' (Figure 2c), and continued growth, rather than stagnation, will result.

stagnation.[7] For this thesis the essential assumption is that the innovation intensity "*i*" is inversely related to θ, a relation described by

$$i = f(\theta) \quad \text{with } f'(\theta) < o, \tag{5}$$

and represented by the negatively sloped "innovation response" curve, in Figure 2d. The justification for this relation lies essentially in the fact that a part of the labor force in the agricultural sector is engaged in investment in overhead capital in the agrarian economy and that its presence in that sector is necessary to sustain technical progress. Such progress involves long-term improvements in crop practices, many of which are barely perceptible over the centuries. But even this progress is possible only where terracing, irrigation, and drainage networks, for example, are kept from falling into disrepair. In fact, however, many a keen observer has noted with Ester Boserup that, "besides revenue, they (feudal landlords and kings) need servants, bodyguards and soldiers, and these requirements set an upper limit to the investment activity they are willing to organize. . . . Feudal landlords and government are likely to reduce the village population too much in their desire for soldiers, servants and luxuries." [8] It is the use of labor in maintaining the agricultural infrastructure from one period to the next that may thus be measured. If too much labor is drawn out of the farm sector by the food surplus, the intensity of innovation in agriculture declines.

The technology-adjustment mechanism works as follows: starting again from the initial position at p_o, c_o and θ_o or point q_o, we determine the point i_o (on the innovation response curve), and the point i_o on the vertical axis of Figure 2c. For this i, as we have seen, the agricultural-progress function, labeled Ω_o in Figure 2c, is determined. On the other hand, given the initial value of c_o, we can determine the total population growth rate at the point r_o (on the horizontal axis of Figure 2b) or point B_e (on the horizontal axis of Figure 2c). Since θ is no longer constant, r_o, the rate of increase of *total* population and η_v, the rate of increase of *agricultural* population, are different, and must satisfy the relation $\eta_v = r - \eta_p$.[9] To achieve this, let us construct, from the point B_e, a 45-degree line B_eB_o obtaining the point B_o on the agricultural progress function. It should be noted that $A_oB_o = A_oB_e = \eta_p$ by virtue of the 45-de-

[7] See Fei and Ranis, "Agrarianism, Dualism and Economic Development," in Adelman and Thorbecke, *op. cit.*, for a more systematic critical evaluation of the Jorgenson-Classical thesis.

[8] Ester Boserup, *The Conditions of Agricultural Growth*, Chicago, 1965, p. 96.

[9] This follows directly from $\eta_v = \eta_{(1-\theta)} + \eta_L$ (as $v = (1 - \theta)L$) and $\eta_P + \eta_{(1-\theta)} = 0$ (by equation 2, when c is constant).

gree construction. Since OA_o on the horizontal axis measures η_v, it is true at point A_o (and only at point A_o) that $\eta_v = r - \eta_p$. Thus the initial value of η_v is located uniquely at B_o. Since η_p is positive here, p will increase in the next period, assume to p' (Figure 2a), and, *as long as the consumption standard remains constant,* the value of θ will increase (from q_o to z', etc.) in Figure 2a. This calls into action the technology-adjustment mechanism by depressing the innovation intensity (from i_o to i') on the innovation response curve. A new agricultural progress function Ω' (passing through the point i' on the vertical axis) is obtained at a position parallel to the Ω_o curve. Using the same reasoning as before, given a constant r, the new value for η_v and η_p can then be located at B'. In this fashion the rate of increase of p is continuously depressed and the value of θ continuously increased over time. The long-run equilibrium position is then given by c_o, p_e, and z_e with the relevant agricultural progress function Ω_e in Figure 2c intersecting the horizontal axis at B_e at a point corresponding to the fixed population growth rate r_o.

Any explanation of long-run stagnation in the agrarian system which relies wholly on either the consumption-adjustment or the technology-adjustment mechanism is bound to be off the mark. What is clearly called for is a synthesis of the two mechanisms. This is a natural synthesis, because in the real world, any increase in the agricultural surplus will, in fact, be used partly to increase consumption c and partly to induce greater labor reallocation θ. A host of economic, institutional, and political factors such as the necessity for carrying on feudal wars, the nobility's desire for services, pressure from the cultivator, etc., will operate at all times to determine this division, which may be described as a "propensity to consume" function. This function is represented by the equation:

$$\psi(\theta, c) = o \quad \text{with } d\theta/dc > o \tag{6}$$

and by the positively sloped curve in Figure 2a. All that is assumed is that some of the increase in agricultural surplus will be absorbed by the consumption-adjustment mechanism and some by the allocation-adjustment mechanism. It is easy to see how the twin forces working toward stagnation can be depicted in diagrammatic terms. When labor productivity increases, for example, the increased consumption standard c will induce additional population increase, and the increased labor allocation θ will reduce innovational intensity; both forces operate to put a brake on productivity expansion. In the case indicated in Figure 2, the long-run equilibrium position is reached at some point y_o in (2a) and some

point y'_o in (2c) signifying the long-run stability of the triplet θ, p, and c, as well as i and r.[10]

The above, then, represents our analysis of the economic forces that operate to lock the agrarian economy into a state of long-run stagnation. To be sure, the economy is getting bigger (as both i and r are positive). However, r and i are so "regulated" that biological reproduction r and economic progress i compensate each other in such a way that there will be no marked change in the structure of the economy in the long run. A steady stream of surplus labor supported by surplus food is constantly being funnelled into the service sector at a consumption standard c that is often close to the subsistence level.

Long-run stagnation in such an agrarian setting results in the establishment of certain institutional relations essential to the discharge of the basic economic functions of the system. Crucial among these functions are the delivery of the labor force to the service sector and the delivery of food (R in Figure 1) to sustain these workers. These magnitudes are not determined by pure market forces, and the obligation to deliver is not a commercial contract. The most common historical example is that the nobility, which consumes the output of the service sector (C in Figure 1), is at the same time a landed aristocracy—whether it resides on or near the land (e.g., the feudalistic lords of medieval Europe, the daimyo of Japan) or not (e.g., the scholarly landed gentry in Chinese history, the Church in Europe). It is in its landowning capacity under the feudal system that this nobility exacts labor and/or agricultural output as a statutory obligation. The conversion of such a closed agrarian society into open agrarianism under the impact of outside forces must be accompanied by the development of new institutional arrangements to replace the old social order. It is to this aspect of the problem that we shall now turn.

SECTION 2

Transition into Open Agrarianism

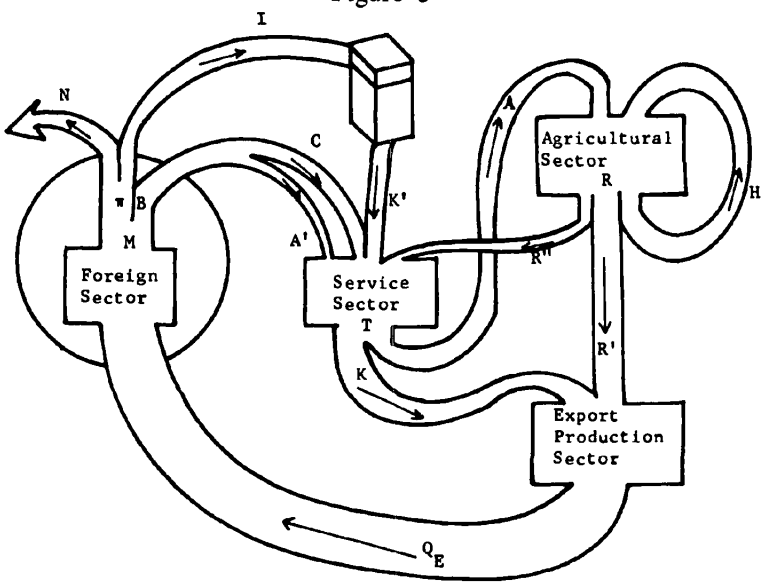
For most underdeveloped countries with a colonial heritage—and this description applies to almost all contemporary underdeveloped countries —what may be termed "open agrarianism" appeared as a result of the

[10] As a check of the consistency of our reasoning, the four unknowns c, θ, r, and i are solved for simultaneously in 3b [with $\eta_p = o$, and equations 4, 5, and 6] to obtain their long-run equilibrium values.

penetration of the closed agrarian system by a new economic agent, namely, the foreigner. Making his debut typically as a trader, the foreigner takes on successively more important economic functions. He is instrumental in the creation of a new sector in the agrarian society, the export production sector. Thus we now have three domestic production sectors to deal with (see Figure 3): agriculture, services and exports. The export production sector generally relies on the exploitation of a cheap labor supply and/or of natural resources productive of specific raw materials, either agricultural (fibers, tropical fruits) or mineral. Inputs flowing into this sector are food R' produced by the agricultural sector and services produced by the service sector K. The output Q_E, of course, flows entirely to the foreign market, i.e., the foreign sector as indicated in Figure 3.

The role of the foreigner expands steadily from that of trader to that of entrepreneur servicing the export sector or actually taking over the direction of its activities. Progressively, the service sector ministers less to the feudal needs of the nobility or the Church and concentrates more on meeting the demands of the export sector for the services of banking, shipping, insurance, warehousing, etc. At a later stage this sector will also turn to the construction of trade-related social-overhead capital

Figure 3



such as electric power, transportation, and housing. Such services flow into the export production sector as an input K.

Another important outflow from the service sector is to the agricultural sector A as an inducement or compensation for the food supply, R' and R'', given up and provided to the workers employed in both the service and export sectors. The principal goods delivered, at least in the early developmental stages, include manufactured goods destined for rural consumption (e.g., cloth, kerosene, candles, sewing machines) which the service sector first imported from abroad A'. Certain domestic services performed by labor employed by the service sector may be added to these goods in the course of the transfer. However, since there is not much value added, for simplicity, we can let $A = A'$.

The economic functions of this "new" service sector thus differ drastically from those of the "old." Instead of serving the interests of the landed aristocracy, its primary function is now to serve the interests of the export-oriented foreigners and their domestic commercial allies. This transition may not occur without a struggle as the feudal aristocracy resists the inroads of the new commercial spirit, and the foreigners attempt to gain adherent allies within the local power structure. The struggle may go on for many decades, even centuries, with the foreigners likely to win out ultimately. Moreover, when the penetration from abroad isn't artificially delayed—as it was in Japan—it is often accompanied by political upheaval. When the new economic order of the open colonial economy is established, the inflow into the service sector will include, in addition to the already referred to food R'' and imported consumer goods A' ultimately destined for the agricultural sector, two other important items. The first is imported luxury consumer goods C for use by the foreigners and by the new domestic commercial class. The importation of these consumer goods may be important for the agrarian system since in the material sense it introduces a completely different way of life into the traditional economy. The service sector thus becomes in essence a "port city," an economic and cultural enclave within the agrarian system. The second is the commercial capital stock K' consisting of inventory, credit in foreign banks, warehouses, transportation equipment, etc., the services of which are used primarily to facilitate the export trade. (Hence in Figure 3, K as well as K' can be identified.) The cause of the addition to the capital stock is "investment" I which consists of the part of the export proceeds M utilized for such trade-oriented capital accumulation.

The establishment of the new service sector introduces into the agrarian economy new agents (the foreigners and a new domestic com-

mercial class), new factors of production (commercial capital stock K'), new production activities (exports), and a new consumption horizon (A and C). What is perhaps most important of all, however, is the introduction and gradual acceptance of a new mode of rational economic behavior. The new life is characterized by an insatiable appetite for economic acquisition which, although taken for granted in contemporary elementary economics textbooks, nevertheless represents a radically different value system from the set of feudal relationships that preceded it. The export goods Q_E are converted into foreign exchange M, which is disposed of as either current expenses B (including A' and C introduced above) or as profits π. Moving out of his exclusive role of trader, the profit-oriented foreigner may take over some of the entrepreneurial tasks in the export production sector itself. Not infrequently he moves into the political sphere as well in order to maintain the necessary minimum levels of government stability and administrative efficiency. All such expansion, the extent of which will vary from case to case, is guided by one primary motive, the enhancement and safeguarding of export-related profits. This maximization of profit is the basic purpose of economic life in open agrarianism. This point is essential for a full understanding of the agrarian system.

Commercial profits π, which are the immediate objective of this activity, can in turn be either reinvested (I leading to the accumulation of capital stock) or repatriated N. The fact that profit repatriation is possible insures that not all the savings generated by the export activity will necessarily be used for capital accumulation within the system. If continuously profitable export potentialities are anticipated, profits are likely to be reinvested in the service or export sector or both. To the extent that such prospects are dim or uncertain, profits will be repatriated and capital accumulation will decline or cease. Thus, it appears that profit repatriation could conceivably be blamed—as it, in fact, has been—as the primary economic evil of colonialism, because it signifies that the foreigner generally regards the economy as an enclave and refuses to invest beyond what is necessary to augment future repatriable profits. Certainly, frustration in the development effort is the norm of performance of this open agrarian system, as observed on the contemporary scene. But as we will see below, this is for reasons quite separate from the phenomenon of insufficient reinvestment. Important as "profit repatriation" may be as a contributing factor, with the vagaries of such exogenous forces as discovery, conditions in international markets, and exhaustion of mineral deposits, it should not be regarded as a primary cause of long-run stagnation. The thesis of long-run stagnation in such

a system holds, even if all profits are reinvested. For this reason we shall assume from now on that $\pi = I$ (or $N = o$) which means that all profits are, in fact, reinvested within the open agrarian system.

SECTION 3

The Anatomy of Open Agrarianism

The new organization that we have just sketched is intended to carry out certain essential economic functions in the open agrarian society. There are four types of such functions: (1) acquisition of the labor force, (2) production of exportable goods, (3) successful sale in the export market, (4) accumulation of commercial capital. These correspond to the four sectors of Figure 3. We shall now proceed to discuss each of these briefly in order to elicit clearly the appropriate analytical assumptions that can be postulated for the successful performance of each of the functions.

Acquisition of the Labor Force

The concepts of surplus labor—labor not employed in the agricultural sector—and agricultural surplus—the food consumed by surplus labor—which are important to the closed agrarian economy, remain relevant, and in fact crucial, to the analysis of the open agrarian economy. As in Section 1, let θL be the surplus labor, with θ as the fraction of the total labor force L which is now being employed in the service sector *or* the export production sector. The total agricultural surplus R in Figure 3 consists of food supply to the service sector R'' and to the export production sector R'. Notice that regardless of the physical location of employment, such allocated labor is used, after a time, directly or indirectly to promote exports, and for all practical purposes, there is no need to distinguish between labor in the service sector and in the export production sector proper. It is quite evident that θL and R—the labor surplus and the agricultural surplus—are the primary means of export production. The export-oriented foreign entrepreneurs are obviously vitally interested in a steady supply of these factors. Barriers to the "free mobility" of these factors are barriers to export expansion. The foreign entrepreneur advocates breaking down these barriers; the physical by such means as road construction and investment in warehousing and in urban social overheads, and the more institutional by laws permitting the trans-

fer of titles to land, commercial codes, etc. However, at any moment in time, the major instrument at the disposal of these entrepreneurs in their effort to induce the desired movement out of agriculture is the delivery of imported consumer goods (A in Figure 3) not previously consumed by the cultivator. The following equation expresses a ratio:

$$w = A/L. \tag{7}$$

We will refer to this ratio as the "inducement ratio"—because "A" is used to "induce" the giving up and delivery of surplus labor and food for export production. The inducement ratio is expressed as total imported consumer goods per unit of total population L.

It should be noted that the prognosis for reaching long-run stationary equilibrium, in the sense of a constant per capita consumption standard c and a constant agricultural productivity p, continues to be valid for the open agrarian economy. In other words, the stand-off between the forces of population growth and technological change, as analyzed in Section 1, continues to hold. Thus Figure 4a is a reproduction of Figure 2a, in which the long-run stagnation point is indicated at q_o—corresponding to the stationary triplet θ_o, p_o, and c_o. The question now is whether this stagnation can be broken by the importation of goods from abroad. For example, suppose food grains are imported to the amount $\bar{w}$ per unit of total population, as indicated in Figure 4a on the vertical axis. Then, with fixed values of p_o, and c_o, the equilibrium allocation point shifts from q_o to q_o'' signifying an increase in θ.[11] This corresponds to what we might have expected intuitively: that "food imports" can substitute for "domestic productivity increase" as a factor causing the reallocation of a larger fraction of labor θ. We then readily have:

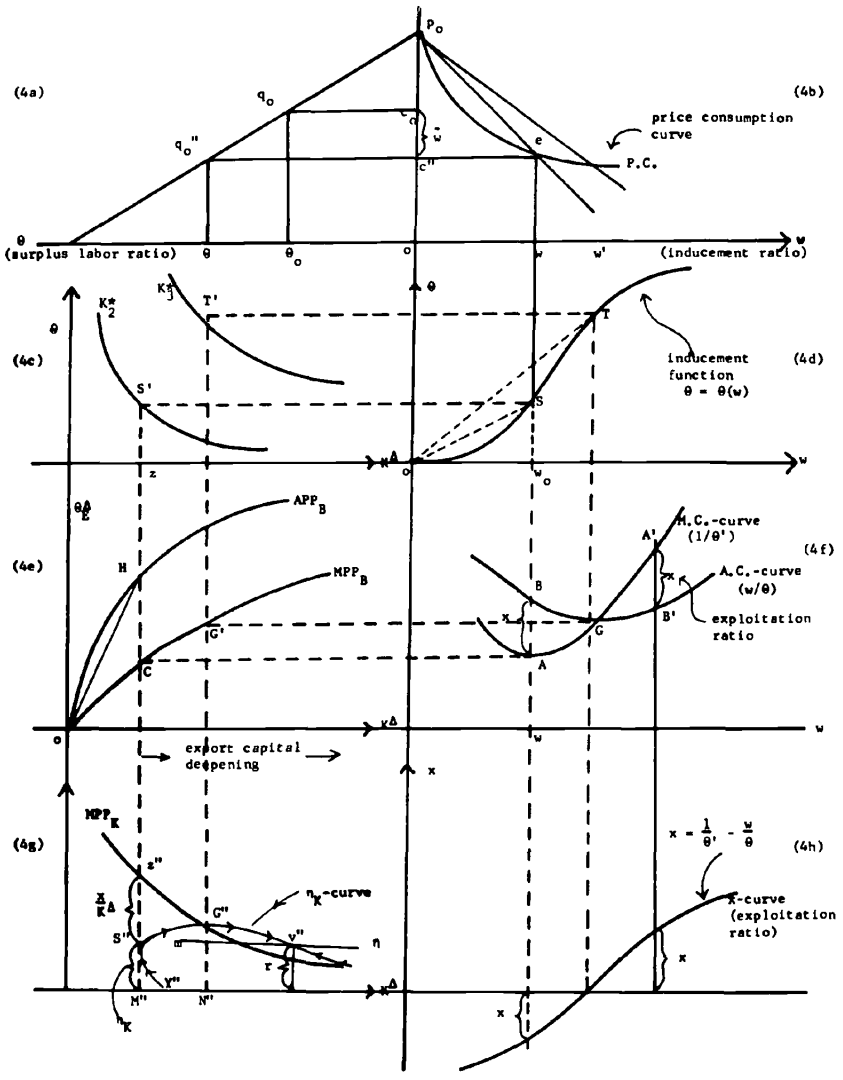
$$\theta = \theta(w) = (1 + (w - c)/p) \quad \text{with } \theta' > o. \tag{8}$$

This simply states that the surplus labor ratio θ is an increasing function of the inducement ratio.

In the more general case, where the initial consumption standard c_o, is sufficiently above caloric minimum to begin with, the larger surplus labor ratio θ can be induced through the delivery of industrial consumer goods—rather than food—to the agricultural sector. In Figure 4b let us assume an indifference map (not shown) of a typical farmer as a consumer. As the farmer's productivity (and hence his income in terms of

[11] This is due to the fact that the consumption demand for domestically produced food is now lowered to point c'' on the vertical axis of Figure 4b. The expression in equation 8 (below) is obtained by replacing c with c $-$ w in equation 2.

Figure 4



food [12]) is at "p_o" a price consumption curve (labeled P.C.-curve) can then be drawn from p_o. Suppose then that the inducement ratio is w units of *industrial* goods as marked on the horizontal axis. Then the equilib-

[12] Abstracting from the possibility that disposable income may be lower by some fraction due to feudalistic tithe remnants or taxes.

rium consumption point is at e with c'' units of food consumed. Returning to Figure 4a, we see that the new equilibrium allocation point is then established at q'', again signifying an increase of θ. In this way we can see that the surplus labor ratio remains an increasing function of w, the inducement ratio, as postulated in equation 8 when the inducement takes the form of imported industrial goods.

In general, we shall refer to the ratio in (8) as the surplus labor *inducement function*. It is presented in Figure 4d, with w on the horizontal and θ on the vertical axis. This function predicts the manner in which surplus labor (and agricultural surplus) can be induced to leave the rural sector through the delivery of imported consumer goods. On the basis of the above discussion, we may assume that the inducement curve is positively sloped and that, furthermore, the excitement of new goods appearing on the taste horizon has its strongest cumulative effects initially, both in terms of choice between food and industrial goods and between leisure and industrial goods. Finally, we may assume that ultimately a "law of diminishing returns to the seduction process" begins to set in (after some point S).

We may thus legitimately think of θ (measured on the vertical axis in Figure 4d) as a measure of the relative "availability" of surplus labor to the export sector and of w (the inducement ratio) as a measure of the cost to the entrepreneurs in the export production sector. Given this inducement function we can readily formulate two equations. The first defines the average cost of labor (in terms of imported goods per unit of surplus labor induced):

$$u = w/\theta \quad (= wL/\theta L). \tag{9a}$$

The second defines the marginal cost of labor:

$$m = dw/d\theta \quad (= 1/\theta'). \tag{b}$$

From the point of view of the export-oriented entrepreneur, the *total* cost of labor is simply the total volume of imported goods used to induce the flow of surplus labor.

Notice that this inducement is strictly a "market phenomenon." If "w" represents the units of imported industrial consumer goods per unit of L, the terms of trade between imported industrial and domestic agricultural goods established in the market are represented by the slope of $p_o e$ (Figure 4b). The total value of consumption (of w units of industrial goods and "c" units of food) of a typical worker, at the established terms of trade, has the same market value as p_o units of food. Moreover, the *total* value of imported goods is equivalent to $\overline{c''p_o}L$ units of food, which

value enables the trading entrepreneur to buy $\overline{c''p_o}L/p_o$ units of labor,[13] or, as a fraction of L, $\theta = \overline{c''p_o}/p_o$. (This can be measured horizontally in Figure 4a as $c''q_o''$ or vertically in Figure 4d as w_oS.) Thus, under open agrarianism, labor, for the first time, becomes a marketable *commodity*—a heretofore completely unknown phenomenon. The relevance of this new maximizing calculus to the labor market can be shown more directly by representing varying levels of u and w—the average and marginal cost, respectively, of surplus labor—by an AC (average cost) and an MC (marginal cost) curve in Figure 4e.[14] Comparing Figures 4d and 4f, we see that the MC-curve reaches a minimum point (at A) as the laws of diminishing returns set in (at S) and that the MC-curve crosses the AC-curve at the minimum point of the latter (at G) when the inducement curve has unit elasticity (at T). Intuitively, we expect the profit-maximizing entrepreneur to carry out his "labor seduction" according to a marginal principle. For this reason, let us define the vertical gap between the MC-curve and the AC-curve. This gap can be expressed by the equation

$$x = MC - AC. \tag{10}$$

We shall term the ratio defined in this equation, the "exploitation ratio," and shall show that it is an important concept in the open agrarian society. As a function of w, the exploitation ratio is plotted in Figure 4b, i.e., the x-curve, and is positive or negative as the inducement curve is inelastic or elastic, respectively.

Production of Exported Goods

Surplus labor is acquired to provide first, the necessary overheads, roads, warehouses, etc., and then, direct inputs into the production of exportable commodities.[15] It is possible to classify various subtypes of open agrarian economies by differentiating among the production conditions prevailing in specific export activities. For example in the ". . . export-dominated economies of South East Asia, two rather distinct subtypes can be identi-

[13] Since p_o is equivalent to the real wage.

[14] At the point w_o in Figure 4d, the slope ow_o/oS of line oS is equal to the height wB in Figure 4f while the inverse slope of the inducement function at point S in 4d is equal to the height wA in 4f.

[15] As Fisk put it, "where external factors, such as the development of European commercial enterprise . . . have brought marketing facilities within reasonable reach of the subsistence units, the labor surplus has been used first to complete the linkage with the markets, and then to increase agricultural production for sale" (E. K. Fisk, "Planning in a Primitive Economy," *Economic Record*, Dec. 1962, p. 472).

fied for the historical pre-World War II period. . . . For one type, export production continued to emphasize traditional, labor-intensive methods applied to an indigenous crop—rice being the outstanding example. For the other type, export production was associated with capital-intensive methods introduced from abroad. Most commonly these were applied to products which were also implanted from abroad—rubber and sugar representing two important examples. . . . Exploitation of mineral rather than agricultural resources for export (e.g., tin and petroleum) may be considered as a variant of the second case." [16] Such further subclassification of the export production sector undoubtedly has more general applicability.[17] It is obvious that, on the whole, the initial contact of the traditional economy is afforded by—and indeed, the initial growth-promoting force of the open agrarian economy is expressed through—the production of agricultural goods for export—a heritage still apparent in most contemporary underdeveloped economies.

Distinctions among particular types of crops and related organizational configurations are of importance and must be dealt with in any complete analysis of the transition from open agrarianism to dualism. However, for purposes of this paper, these distinctions need not distract us from the basic fact of production, namely, that it is through the joint effort of surplus labor B, and commercial capital K that output for export Q_E is generated. Thus we may postulate a production function of the type

(11a) $\quad Q_E = f(K, B)$ (export production function)

(b) $\quad B = \theta L.$

If the exportable item is derived from an exhaustible mineral source, the production function is subject to the condition of long-run decreasing returns. In that case, it is obvious that stagnation is more likely to occur. But, under the more general (neutral) assumption of constant returns to scale, the productivity of surplus labor, $Q_E^{\Delta} \equiv Q_E/B$, is an increasing (and convex) function of capital-per-unit-of-surplus-labor, $K^{\Delta} \equiv K/B$. This production function is expressed by the equations:

(12a) $\quad Q_E^{\Delta} = f(K^{\Delta}, 1)$ where

(b) $\quad Q_E^{\Delta} \equiv Q_E/B$ and

(c) $\quad K^{\Delta} \equiv K/B.$

[16] D. S. Paauw and J. C. H. Fei, "Development Strategies and Planning Issues in South-East Asian Type Economies," *The Philippine Economic Journal,* 1965, Vol. IV, No. 2, pp. 204–205.

[17] For examples, with special reference to Africa, see Robert E. Baldwin, "Patterns of Development in Newly Settled Regions," *Manchester School,* XXIV, No. 2, May 1956.

The function is represented by the APP_B-curve in Figure 4e. In the same diagram, the marginal productivity of surplus labor is represented by the MPP_B-curve. The marginal productivity of capital, as a function of K^{Δ}, is shown in Figure 4g by the curve with a negative slope. When K^{Δ} $(=K/B)$ increases (i.e., as more capital is combined with labor), export-sector capital intensity increases; this is referred to as export capital deepening. (The converse happens as K^{Δ} decreases.) The average-product curve in Figure 4e shows how the law of diminishing returns to capital operates in the process of export capital deepening.

Selling in the Export Market

All exported goods are, by definition, destined for the foreign market. If the terms of trade are t, then the total amount of exported goods Q_E can sell for $M = tQ_E$ units of "foreign goods"—which may be viewed as the revenue in real units of foreign exchange. Thus we have:

$$M = tQ_E. \tag{13}$$

A whole set of factors may affect conditions in foreign markets. If the open agrarian economy that is exporting is a major supplier of a commodity (e.g., cocoa for Ghana), "t" is a decreasing function of Q_E. If the economy is a price taker, "t" tends to take on a constant value in the short run. However, in either case, the terms of trade are likely to change in the long run in accordance with patterns of world demand (the availability of natural or synthetic substitutes), and a variety of other considerations that have been discussed at great length in the Prebisch vs. Kindleberger literature. It is therefore rather difficult to come up with any really satisfactory generalization about the likely behavior of "t." Nor is this paper the appropriate place to make the attempt, purely for the purpose of emphasizing the internal logic of open agrarianism independent of these admittedly important exogenous considerations. We make the simplifying assumption of a constancy of "t" through time, an assumption that permits us, through a redefining of the unit of measurement of imports, to let $t = 1$.

Accumulation of Commercial Capital

As is evident from the flow chart of Figure 3, the proceeds from the export sale can be used in three ways: for investment I, for the luxury

consumption C of the export-related entrepreneur, and for the importation of incentive consumer goods destined eventually for rural consumption.[18] It may be reasonable (but not necessary) to assume that C is proportional to K (i.e., $C = gK$), because it is obvious that the luxury consumption of foreign entrepreneurs tends to be proportional to the stock of commercial capital managed by such entrepreneurs. Finally, since investment leads to capital accumulation, we can summarize this relation as:

(14a) $$I = M\text{-}A\text{-}C$$

(b) $$C = gK$$

(c) $$\frac{dK}{dt} = I$$

(d) $$\eta_K = I/K$$

where (d) is the growth rate of capital.

We must also recall that in performing the four economic functions just outlined, the open agrarian economy must face certain conditions inherited from the closed agrarian system. One of the most important of these is the persistence of population pressures. Let us assume that population continues to grow at a constant rate:

(15) $$\eta_L = r.$$

We should recall here that the long-run stagnation thesis of closed agrarianism (above) provides us with the stability of the population growth rate r, the consumption standard c, and labor productivity p. As is evident from our discussion, these conditions ensure that a steady supply of surplus labor and of surplus food can be induced to flow into the export sector in the open agrarian setting. In other words, the demographic factors inherited by open agrarianism are such that they are "right" for the open economy in which the labor will be induced to move into the export market. It is obvious that such population pressure must be weighed in terms of the over-all factor endowment of the economy as measured by capital per head K^* $(=K/L)$. Thus we readily have:

(16a) $K^{\Delta} = K^*/\theta$ where

(b) $K^* = K/L$ (by 11b and 12c).

[18] If we continue to neglect the possibility of capital repatriation.

These equations show a simple relation between over-all factor endowment K^*, export capital intensity K^Δ and the surplus labor ratio θ. We can imagine that, at any point in time, the economy's over-all factor endowment K^* is fixed. Therefore, as (16a) shows, K^Δ is inversely related to θ, in other words a larger surplus labor ratio θ leads to less capital deepening K^Δ in the export sector. This relationship can be shown in Figure 4c by the system of rectangular hyperbolas—where a fixed rectangular hyperbola represents a fixed value of K^* in (16a).

Figure 4 may now be used to summarize briefly our description of the open agrarian economy up to this point. To begin with, let us suppose that the total stock of capital and the labor force are fixed at any point in time, i.e., K^* is fixed (e.g., represented by the K_2^*-curve in Figure 4c). Using the inducement ratio "w" as an instrument to acquire surplus labor, entrepreneurs tentatively set a "trial" value of w as indicated on the horizontal axis (Figure 4d). This determines the (tentative) values of the surplus labor ratio (i.e., w_oS in Figure 4d), the level of export capital intensity (z in Figure 4c), and the marginal and average productivities of surplus labor (points C and H in Figure 4e). This enables the entrepreneur to calculate his total revenue ($M = tAPP_BB$) in terms of the foreign exchange that can be earned. On the other hand, when "w" is chosen, the entrepreneur can also readily calculate the total labor cost, in terms of the foreign exchange (wL) expended on imported consumer goods. Thus, profits, as the difference between total cost and total revenue, are determined by "w," the inducement ratio.

As we pointed out earlier, the most conspicuous new institutional aspect of open agrarianism is that the society is dominated, for the first time, by the unsatiable acquisitive commercial spirit of the entrepreneurial class. This spirit translates itself concretely into the desire to maximize total profits, or, since at any point in time the capital stock is fixed, the desire to maximize profits per unit of, or the rate of return to, capital. Thus, the entrepreneurs either through calculation or through trial and error experimentation will tend to set w at that level which maximizes total profits at each point in time.

Now let us deduce an explicit expression of the rate of return to capital as a function of w. Notice that investment I in 14a is precisely the definition of profits and that "the rate of growth of capital" η_K in 14d is precisely the definition of the profit rate (i.e., profits per unit capital). The profit rate can be written as:

$$\eta_K = \frac{tf(K^*, \theta(w)) - w}{K^*} - g. \tag{17}$$

The proof is as follows:

$$\eta_K = \frac{M\text{-}A\text{-}C}{K} = \frac{tQ_E - wL - gK}{K} \quad \text{(by 14ab, 7, 13f)}$$

$$= \frac{tQ_E^{\Delta} - w/\theta}{K^{\Delta}} - g \quad \text{(by 12bc, 11b)}$$

$$= \frac{t\theta f(K^*/\theta, 1) - w}{K^*} - g \quad \text{(by 12a, 16a, 8)}$$

$$= \frac{tf(K^*, \theta) - w}{K^*} - g \quad \text{(by CRTS property of 11a).}$$

Thus we see that for a fixed K^* (t, g) the profit rate is a function of w. To maximize the profit rate, with respect to w, we have, by setting $d\eta_K/dw = o$:

(18) $$tf_B = \frac{1}{\theta}, \quad \text{or}$$

$$tMPP_B = MC \quad \text{and} \quad MPP_B = MC \quad (\text{if } t = 1).$$

These equations illustrate the condition of maximization of profits at equality between MPP_Bt (the marginal value product of surplus labor in export production) and MC (the marginal cost of surplus labor in terms of imported consumer goods).

It should be recalled that any such equilibrium condition is relative to a fixed value of K^*, the factor endowment of the economy. Under our assumption that K_2^* (Figure 4c) represents the current value of K^*, the equilibrium condition shown in 18 can thus be represented by the "equilibrium rectangle" $S'SAC$, signifying the equality between MPP_B (at point C in Figure 4e) and MC (at point A in Figure 4f).

SECTION 4

Operation of Open Agrarianism

An understanding of the origin of profit which is at once the inducement to capital accumulation as well as the source of investment finance, throws considerable light on the internal logic of open agrarianism. First of all, the optimum (i.e., the maximized) rate of profit can be written as follows:

(19) optimum $\eta_K = \underline{MPP_K + \frac{x}{K^\Delta} - g}$ or $\eta_K + g = MPP_K + \frac{x}{K^\Delta}$

The proof is as follows:

$$\eta_K = \frac{f_K K^* + f_B\theta - w}{K^*} - g \quad \text{(by 17 and CRTS)}$$

$$= f_K + \frac{f_B - w/\theta}{K^*/\theta} - g$$

$$= f_K + \frac{\frac{1}{\theta'} - w/\theta}{K^\Delta} - g \quad \text{(by 18)}$$

$$= f_K + \frac{x}{K^\Delta} - g \quad \text{(by 10).}$$

Notice that "x" (the exploitation ratio) as introduced in 10—i.e., the vertical distance AB in Figure 4f—is equivalent to the modern definition of labor exploitation as given by Joan Robinson, "the deviation of the actual wage from the competitive level of the real wage." This we may verify as follows: we know that $wL/B = w/\theta = AC$ (i.e., the distance wB in Figure 4f) is the actual average wage cost (per unit of surplus labor), while the competitive wage cost is $MPP_B = MC$ (i.e., the distance wA in Figure 4f). Hence "x" (defined earlier as the exploitation ratio) represents the tax on (or subsidy of) surplus labor, and the term $x/K^\Delta = xB/K$ can be called exploitation per unit of capital. Notice that x can be negative as well as positive, i.e., labor can be subsidized as well as taxed. Referring to Figures 4d and 4f, we see that when the inducement function is elastic, $MC < AC$, and both x and x/K^Δ are negative, that is there is a subsidy of labor to the left of point G in Figure 4f. When the inducement function is inelastic, $MC > AC$, x and x/K^Δ are positive, i.e., there is a tax on labor to the right of point G.

We can now attempt an economic interpretation of 19. Referring to the underlined expression, we see that the term $MPP_K + x/K^\Delta$ is the "gross income" per unit of capital, which is the sum of the competitive income per unit of capital (MPP_K) and exploitation per unit of capital. On the other hand, the term $\eta_K + g$ is the "disposition of capitalist income." In the case of the equilibrium rectangle $S'SAC$ just described, x is negative, that is, labor is subsidized, and hence the profit rate η_K, which may be indicated by distance $S''M''$ (in Figure 4g), falls short of

the MPP_K by the amount $S''Z''$, which is the sum of consumption g and the subsidy per unit of capital x/K^{Δ}.[19]

Let us now suppose that the factor endowment of the economy as a whole changes in such a way that K^* increases from K_2^* to K_3^*—as represented by the upward shift of the corresponding rectangular hyperbola. The new optimum solution is now represented by the equilibrium rectangle $T'TGG'$ and the new rate of return to capital by the vertical distance $N''G''$ (Figure 4g). Notice that this is the special case when the inducement function (Figure 4d) is of unitary elasticity and the exploitation ratio is consequently zero (i.e., $x = o$ in Figure 4h). For this special case the profit rate is $MPP_K - g$. However, since we have assumed, for simplicity of exposition that $g = o$, the profit rate η_K coincides with MPP_K in Figure 4g. In like fashion, as increasing values of K^* are successively postulated (by a system of rectangular hyperbolas in Figure 4c), the successive equilibrium values of the profit rates η_K will generate a locus of points, such as the curve η_K in Figure 4g passing through the points Y'', S'', G'', V'' . . . as K^* increases.

Obviously there exist many different subcases of open agrarian economies in the real world—both on the contemporary scene and in the historical context. It is our hope that the analysis in Section 3, through the identification of the four economic functions required for execution in an open agrarian economy, will help to make possible the elucidation of subcases by (hopefully empirical) references to how these functions are, in fact, performed. It is then obvious that in accordance with the special characteristics of such subtypes, open agrarianism may exhibit a wide variety of behavior patterns in the process of growth. Specifically, the changes, in certain essential observable characteristics, that take place as the factor endowment of the economy changes (i.e., as K^* increases) may be in different directions. Our model (and Figure 4) has been designed to attempt an answer to only some of the problems that can arise, for example the problem of the impact of change of K^* on other observable characteristics. We shall now briefly indicate some of the comparative static results of our analysis—leaving all proofs to the appendix.

Referring to Figure 4d once again, we see that the two equilibrium rectangles indicated earlier—i.e., $S'SAC$ and $T'TGG'$—correspond to two special cases: where the point of inflexion of the inducement func-

[19] We are letting $g = o$ in Figure 4g. Notice that if $g > o$, point S'' will shift downward by the constant amount "g" and our entire analysis below will hold after suitable (easily accomplished) modification. We shall assume for now that $g = o$.

tion (point S) falls; and where the inducement function is unit-elastic, at point T. Corresponding to these two special "land-mark" cases, the points S and G divide the η_{v}-curve (in Figure 4g) into three segments: $Y''S''$ (corresponding to falling portion of the MC-curve in Figure 4f), $S''G''$ (portion of rising MC-curve that lies below the AC-curve), and the segment $G''V''$ (portion of the MC-curve that lies above the AC-curve). Keeping these landmark points in mind, we proceed to summarize our comparative static conclusions.

(1) As K^* increases, the value of w increases. This means that in case of over-all capital deepening (i.e., K^* increases), the w set to maximize profits and the inducement ratio always increase. Thus, in case the inducement function is positively sloped, the surplus labor ratio (θ) also increases. Figure 4b shows that the terms of trade (between food and imported goods, for example) tend to move against the entrepreneurs in the export sector.

(2) As K^* increases, the value of K^{Δ} will decrease (increase) if the inducement function is elastic (inelastic)—i.e., before (after) point S. This is shown in Figure 4g by the fact that the curve η_{K} moves to the left before and to the right after the point S''. The economic interpretation is that there will be capital shallowing in the export sector as long as surplus labor can be pried loose with ease from the subsistence agricultural sector. This turns to capital deepening once the inducement function becomes inelastic. It is intuitively obvious that as the "law of diminishing returns" takes effect in the labor acquisition process, making it increasingly difficult to acquire labor, capitalists will naturally be forced to use less labor per unit of capital in the export production sector.

(3) As K^* increases, η_{K} increases (decreases) if $x < o$ ($x > o$). This is indicated in Figure 4g by the fact that the curve η_{K} reaches maximum value at the point of crossing the MPP_{K} curve, signifying that the profit rate increases when labor is subsidized and declines when labor is taxed. This is further illustrated by the fact that the vertical gap between the curve MPP_{K} and the curve η_{K} shrinks to zero before the point G'', signifying that in the process of increasing export capital intensity, the diminishing need to subsidize labor more than compensates for the unfavorable effect of a lower MPP_{K} produced by the operation of the law of diminishing returns to capital. Conversely, when labor is taxed, the profit rate will decline after point G.

In the above, we have emphasized a reasonable behavioristic pattern of the inducement function as an illustration of the flexibility of our framework of analysis. Clearly other *a priori* hypotheses as to the slope of the inducement function are admissible and would lead to somewhat

different conclusions.[20] Moreover, other applications of our framework of analysis are possible; for example, we could identify the behavioral characteristics of the production functions more fully, or make "richer" assumptions in connection with the terms of trade or the value of g.

Let us now turn to the long-run prognosis for the open agrarian system and the requirements for its emergence into vigorous dualism.

SECTION 5

Prognosis for Open Agrarianism

We are now in a position to inquire about the long-run prospects for the type of open agrarian system we have tried to depict. To facilitate this, let us show a horizontal line mn in Figure 4g at the height of the population growth rate r in 15. Suppose the point of intersection of that curve with the η_K curve is at point v''. Then to the left of v'' there must be eventual capital deepening, i.e., a rising K^*, because the rate of growth of capital η_K exceeds the rate of growth of labor r. Similarly to the right of v'' there must be capital shallowing. With a stable equilibrium prevailing at v'', the long-run stationary value of K^* implies in turn long-run stationary values for all the essential economic magnitudes (e.g., $K\Delta$, MPP_K, MPP_L, θ, and w) with which we are concerned.

It should be noted that this conclusion is valid irrespective of the detailed framework presented earlier. In other words, the prospect for long-run stagnation is independent of the precise transitional stages through which the long-run stationary state is reached. All that is really essential is that the curve η_K (in Figure 4g) decline over the long run, a phenomenon which, as we have shown, can be traced to the fact that the inducement function becomes inelastic for higher values of w. Notice that the inelasticity of the inducement function at large values of w is compellingly reasonable since θ cannot exceed 1. In other words, the attempt by the foreign-oriented entrepreneurs to take advantage of the existing labor surplus in the open agrarian economy ultimately runs up against physical limitations. The stagnant p and c, inherited from the closed agrarian system, cannot be shaken off. The growth that does take place may be substantial, but as long as it is restricted to the export production sector as an enclave in an otherwise stagnant, but still preponderant, agricultural hinterland, the prospects are for ultimate stagna-

[20] S. Hymer has pointed out to us that the inducement function may, in fact, not exhibit any range of increasing returns.

tion. This conclusion can be avoided only when the opening up of the closed agrarian system brings with it additional dynamic benefits relating to the advent of technological change as a routinized behavioral pattern. The ability or inability to effect a successful implantation of such technological dynamism is, in fact, what distinguishes stagnant, open agrarianism from vigorous dualism.

In summary, there are a number of reasons why the structure of open agrarianism is closer to dualism than that of the closed variety. First and foremost among these is the advent, for the first time, of profit maximization as the propellant motive force, displacing feudal and kinship relationships. As Georgescu-Roegen put it "from the middle of the nineteenth century, if not before, these [agrarian] countries began . . . to receive the impact of Western capitalism. Increasing trade with the West revealed the existence of other economic patterns and at the same time opened up new desires for the landlords and new ambitions for the bureaucracy. Under this influence the feudal *contrat social* began to weaken." [21] Second, while surplus labor may have been employed to satisfy culturally or religiously important values, open agrarianism succeeds for the first time in making productive use of such labor in the modern sense, that is, commercializing it by mobilization via the price mechanism instead of by feudal edict. As labor mobility results in response to changes in the commodity flow, the foundations are laid for what could eventually develop into a full-blown, intersectoral labor and intersectoral commodity market in the dualistic setting. Third, physical capital formation makes its appearance for the first time in the social and economic overheads servicing the export sector and in the export producton sector proper. Finally, a new class of economic agents —acquisitive foreign entrepreneurs and their local counterparts with whom they form flexible alliances—gradually replaces a reluctant landed aristocracy in positions of economic and political power.

The environment has thus changed markedly under the impact of foreign trade and the workings of the profit-maximizing calculus. There nevertheless remains a considerable gap between the operation of open agrarianism and the workings of a vigorous dualistic system.[22] We have no more than to look about us to see that a considerable number of less developed countries remain trapped in the open agrarian situation.

[21] Georgescu-Roegen, "Economic Theory and Agrarian Economics," *Oxford Economic Papers*, February 1960, p. 33.

[22] As described, for example, by W. Arthur Lewis, "Development with Unlimited Supplies of Labor," *Manchester School*, Jan. 1958, & Fei and Ranis, *Development of the Labor Surplus Economy: Theory and Policy*, Homewood, Ill., 1964.

While the chances for transition into dualism are clearly and substantially enhanced, there remain a number of crucial factors that tend to keep the less developed economy in the grip of stagnation over the long term. Dominant among these is the failure of development in the export enclave to touch the life of the agricultural production sector in any really meaningful or pervasive fashion. Industrial capital formation in the sense of a dualistic or mature economy has not as yet put in an appearance. In this context the required routinized interaction between a small but relatively expanding industrial sector and a large but relatively shrinking agricultural sector has no chance to take hold. As a direct consequence, the ability to count on a dependable, routinized, innovation-inducement mechanism in both sectors (but especially agriculture), is missing. This mechanism is the most important single link in the chain of successful dualistic growth, the growth that has a chance to culminate in economic maturity. There is, as yet, no dualistic entrepreneur with one foot in each sector, making his investment-maximizing and innovative decisions so as to ensure balanced progress. As one observer has aptly put it, "technological change is, itself, one of the more difficult products for a country in the early stages of economic development to produce. In fact, it sometimes appears that an industrial economy is a prerequisite for technological change in the agricultural sector." [23]

The analysis in this paper is thus intended to shed some light on the reasons for the continuance of stagnation as a norm, as well as on the elements that must receive attention if departure from that norm is to be achieved. It will be clear to the reader that the transition to dualism has been substantially eased by the opening up of the closed agrarian economy. A more precise definition of what is needed—in terms of aid, trade, and the flow of technology—to translate open agrarianism, with its enhanced opportunities, into vigorous dualistic growth and ultimately economic maturity is clearly of the utmost importance and the authors hope to take up this matter in a future work.

[23] Vernon Ruttan, "Subsistence Agriculture and Economic Growth," Agricultural Development Council Seminar on Subsistence and Peasant Economies, East-West Center, Hawaii, p. 8. See also the contributions of Nicholls and of Tang, on this subject, including: W. Nicholls, "Industrialization Factor Markets & Agricultural Development," *Journal of Political Economy,* LXIX (1961), 340; and W. Nicholls & A. M. Tang, *Economic Development in the South Piedmont, 1860–1950: Its Importance for Agriculture,* Nashville, 1958.

APPENDIX

The model for the open agrarian economy may be summarized succinctly in the following six equations presented in the text:

(A1 a) $\theta = \theta(w)$ (8)

(b) $m = \dfrac{1}{\theta'(w)}$ (9b)

(c) $Q_E^{\Delta} = f(K^{\Delta}, 1)$ (12a)

(d) $K^{\Delta} = K^*/\theta$ (16a)

(e) $\eta_K = \dfrac{tf(K^*, \theta(w)) - w}{K^*} - g$ (17)

(f) $m = tf_B(K^{\Delta}, 1)$ (18),

which can be used to solve for the six unknowns, θ, w, m, Q_E^{Δ}, K^{Δ}, η_K, when K^* is given. Thus conceptually, for any fixed value of K^*, the optimum (i.e., maximized) values can be written as

(A2) $\bar{\theta} = \bar{\theta}(K^*)$; $\bar{m} = \bar{\theta}(K^*)$; $\bar{w} = \bar{w}(K^*)$, $\overline{Q_E^{\Delta}} = \overline{Q_E^{\Delta}}(K^*)$, $\bar{K}^{\Delta} = \bar{K}^{\Delta}(K^*)$, $\bar{\eta}_K = \bar{\eta}_K{}^{(K^*)}$.

This merely shows that the optimum values (indicated by the upper bar) are all functions of K^*. The comparative static conclusions relevant to open agrarianism and referred to in the paper are obtained by investigating the signs of the derivatives of the functions in A2. For purposes of the dynamic aspect of our model, we have the additional equation:

(A3) $\eta_{K^*} = \bar{\eta}_K - r = \phi(K^*)$ (by 13).

The notation $\phi(K^*)$ simply states that the rate of growth of K^* is a function of K^*. Thus A3 is a differential equation in K^*, the solution of which is the time path of K^*. When this is substituted in A2, the time paths of all the variables are determined. The theorem of long-run stagnation (Section 5) is dynamic and refers to the properties of these time paths. (Notice that in A1, 2, and 3, we have formulated the problem in such a way that only "ratios" are involved and that the absolute magnitudes K, L, Q_E, I, M, . . . are all dispensed with by taking advantage of the constant-returns-to-scale property of our model.)

The model structure defined above is similar, at least from a purely

mathematical point of view, to what may be called a socialist "maximum speed development model." [24]

Comment

W. ARTHUR LEWIS, PRINCETON UNIVERSITY

The object of this paper is to explain the stagnation of primitive agrarian economies. Stagnation is not defined as Malthus and the classical economists defined it, namely as a situation of zero population growth. On the contrary, it is defined as a situation with population increasing at a constant rate, productivity constant, and the ratio of farmers to population constant. Since the point of Malthus and the classicists was that a growing population and constant productivity were incompatible in primitive societies if the cultivated area was assumed to be constant, one must ask how our authors achieve their result.

They offer two alternatives. In the first, productivity grows exogenously. As productivity increases, consumption increases, so the rate of population growth increases. Land being fixed and intensively cultivated, average productivity falls endogenously as population grows, offsetting the exogenous rise. When the endogenous fall and the exogenous rise in productivity are exactly equal, we have equilibrium. Thus population can grow indefinitely by 3 per cent per annum if this produces an endogenous fall in productivity of 1 per cent per annum, exactly offset by an exogenous rise of 1 per cent.

The mathematics seems impeccable; it is the assumptions that are odd. Malthus warned that while population increases in a geometrical ratio, production increases only in an arithmetical progression. We laugh at this formulation, but translated into modern terms his warning is essentially that we should not fall into the trap of using a Cobb-Douglas function for large changes in the ratio of labor to land in agriculture, or into the worse trap of assuming a constant percentage growth rate of exogenous productivity. If population increased steadily by 3 per cent, endog-

[24] J. C. H. Fei and Alpha Chiang, "Maximum Speed Development through Austerity," in Adelman and Thorbecke, *op. cit.* Readers interested in detailed proofs of the equations in this appendix are referred to the appendix of this work.

enous productivity would not decline steadily by 1 per cent. What would happen is that the island would be reduced to a desert within a century, for population would multiply sixteen times. In their effort to survive, the people would first reduce the periods of fallow, then they would cut down all the seemingly useless trees and shrubs and turn over every inch of soil. Soon soil erosion would sweep much of the soil into the sea, and much of the island would become uninhabitable.

The other alternative offered us, to produce steadily rising population with constant productivity, is an adjustable rate of growth for exogenous productivity. Here we introduce landlords, who keep the farmers' consumption constant whatever may happen to productivity. This gives a constant rate of population growth, which again, via Cobb-Douglas, reduces productivity at a constant rate. The ratio of consumption per head to farmer productivity determines the ratio of farm to total population. Without exogenous growth of productivity the ratio of farm population would rise constantly, because productivity would fall endogenously; with exogenous growth of productivity exactly equal to the endogenous decline, the ratio is held constant; with still higher exogenous growth the ratio falls constantly. The authors invent a function that automatically brings the exogenous growth rate down to the right level, and so they get stability.

The authors are assuming that the cultivated area is constant. That population can grow with constant productivity if the cultivated area increases is not in dispute. Given a constant area, productivity per head can also be kept constant with rising population if there is also rising effort per head; this is the emphasis of Miss Boserup, who shows how rising population induces harder work and greater investment in land. Fei and Ranis assume both constant area and constant effort per head. In these circumstances, one can expect in primitive societies only very small increases in exogenous productivity, averaging perhaps 10 per cent per century. Therefore the sort of stability they are seeking would be compatible only with very slow population growth and a level of consumption barely above subsistence. If this is their world, they ought to add to their mathematical model constraints which keep all rates of increase fairly close to zero, and this would make it only minimally different from the model of Malthus.

In any case, I am prejudiced against all models that make the rate of population growth a direct function of consumption per head. They clearly do not apply to our times. Yet the authors offer their model as an explanation of the contemporary tropical world. Such models

were useful for Malthus's times and before, but they do not explain what is happening in the world today.

So far, we have been analyzing a closed economy. The remainder of the paper deals with an open economy. Now we have an export sector that grows relatively to a subsistence sector from which it is drawing labor and food. Ultimately equilibrium is reached because the local food terms of trade reach a level that gives the same rate of growth to population, farm population, capital per head in the export sector, profits, etc.

One must pay tribute to the geometrical ingenuity that makes it possible to bring so many variables into a stagnant equilibrium. But of course, the value of a model is in direct proportion to its relationship to reality.

Confronted with the stagnation to which the authors have brought their island, one asks, "Why don't the capitalists get out of the terms-of-trade trap by importing food?" The authors state that the external terms of trade are constant, so how can the local-food terms of trade move against the export sector? The answer has to be that food cannot be imported, or is much dearer on the foreign market than it is at home (in which case it should be exported). The assumption that food cannot be imported is contrary to historical fact, for very many export sectors have been developed on the basis of imported food. For that matter, many export sectors were developed on the basis of imported labor, this being the chief reason why there are so many Indians and Chinese all over the tropical world. Then too, there is the earlier forced migration of Africans. But if labor and food can be imported, and the terms of trade are fixed at a reasonable level, as the authors assume, then the only obstacle to export growth is land, which is oddly enough omitted from their production function for the export sector.

The capitalists are smarter than our authors allow. Having decided to develop some export sectors with imported labor, they also decided to build ports, roads, and railways in Burma, Thailand, and Indo-China. These countries soon brought forth a rice surplus and kept the food terms of trade in their favor. This rice was grown and sold by peasants, reminding us that the development of an export sector does not require capitalist plantations hiring labor. Our authors' model, in which exports are from plantations that can import neither labor nor food, is therefore a very special case.

It seems to me more fruitful to work with a model in which the local price of food is so closely tied to the world price as to be identifiable

with it. We then have a minimum of three products: food, the agrarian export (call it rubber), and the industrial import (call it steel). Let us assume that these are the only three commodities.

As our first operation we can reduce the number to two. If productivity is constant, as it was in the tropics most of the time up to the end of the Second World War, and if exports are only a small part of tropical agricultural output (also the case) then the prices of rubber and of food are tied to each other, whether these products are grown on plantations or on peasant farms. If the price of rubber exceeds the equilibrium, unlimited supplies of rubber will be put on the market, and if it falls below the equilibrium, rubber will disappear from the market. The terms of trade between rubber and steel therefore depend on the terms of trade between food and steel. Since tropical food production is relatively small, the tropical terms of trade depend on what happens to the terms of trade between food and steel in the developed world. Here is no mystery. The real price of food fell after 1873, as immigration, railways, and horse-driven machinery opened up the great wheat lands in central North America. Prices turned round and rose after 1900 as the American frontier closed. They fell again after 1920, as mechanical traction started a second agricultural revolution; they rose through the Second World War; and fell again in the 1950's as the third American agricultural revolution, based on chemistry and genetics, created new surpluses. The future is no more predictable now than it was in 1873, 1900, 1920, 1939, or 1950, or any other turning point. But what happens to the terms of trade between food and manufactures in the developed world will determine the terms of trade for tropical agricultural products.

Superimposed on this are the effects of changes in productivity in tropical agriculture. A rise in productivity in rubber merely reduces the price of rubber in terms of both food and steel, since if it did not, there would be an unlimited switch of tropical production from food to rubber. Therefore, a rise in productivity in rubber does not benefit the tropical countries. On the other hand, a rise in tropical food productivity would improve both the factoral and the commodity terms of trade for rubber, since a constant rubber yield would buy more food and therefore more steel. Historically, tropical food productivity has remained constant. The standard of living has been rising mainly because the relationship between food and exportable crops has been sufficiently favorable to bring forth ever increasing exports—admittedly more favorable in Asia and in Africa than in Latin America. The stagnation of export production that our authors are seeking to explain has not in fact existed.

One could wish that it did exist. For what we now have is a tropical world producing more and more cocoa, rubber, coffee, and sisal than the world may want, while beginning to mount up a large annual deficit of food. Policy changes that made it more profitable to grow food than to grow unwanted exports would be sound, especially if some tropical countries would grow food to export to other tropical countries that are already overpopulated. We could fruitfully spend much time discussing how to effect this transformation, but this would take us well outside the boundary of the paper before us.

Reply

JOHN C. FEI AND GUSTAV RANIS

Professor Lewis claims that the closed-economy section of our paper neither depicts the situation in contemporary less developed countries nor precisely duplicates the Malthusian theory of stagnation. We agree on both counts, but we never claimed otherwise. Our objective in the closed economy model is to try to understand the causes of stagnation over long historical time periods *before* such agrarian societies were decisively impacted by foreign trade. As we explicitly point out in several places in our paper, we believe that the contemporary less developed world is engaged in the attempt to move from open agrarianism to dualism, and that it is this open economy model that must be subjected to the test of real world relevance.

With respect to the second point, the proper meaning of stagnation over centuries of closed agrarianism, we think that the classical model narrowly defined (i.e., zero agricultural productivity increase and population growth) is, in fact, less relevant than a model that is capable of explaining low rates of productivity increase (not really exogenous, but some unknown function of "learning by doing" from generation to generation) accompanied by low rates of population increase over long centuries of human experience, e.g., in China, Japan, and parts of Western Europe.

Finally, in connection with the theory as to how the society arrives at our version of stagnation, we also are prejudiced against models that lean exclusively on the Malthusian population-response mechanism. It

was, in fact, a side objective of our paper [1] to modify what we call the Jorgenson-Classical thesis by proposing that it be married to another hypothesis, the allocation adjustment thesis, and that the combination of these two forces may have the observed long-term results for the closed agrarian system.

Turning now to Professor Lewis' discussion of our open economy model, his major criticism here seems to be that we have neglected the possibility of the capitalists' importing food and labor and thus vitiating our ultimately pessimistic predictions for the open agrarian system. But, we might ask in return, if things went so swimmingly in Lewis' tropical world of the nineteenth and early twentieth centuries, why do we have so many less developed countries to be concerned about at midcentury? The heart of our problem, in fact, is to show why the colonial pattern did not yield sustained development. If food imports—for which, incidentally, we do make allowance—were in fact empirically important, would this really obviate the necessity of involving the stagnant agricultural backyard in the growth process—a necessity that goes far beyond the provision of food and labor to the enclave export sector? We assume constancy of the external terms of trade only for convenience, but we see no reason, given the literature, to expect these to improve historically, thus negating the tendency towards stagnation. What we are trying to explain is not the (nonexistent) long-term stagnation of export production, as Lewis claims, but the (existent) long-term stagnation of economies whose agricultural hinterland has not been pulled into full participation via sustained increases in productivity.

[1] Also reflected in our earlier piece "Agrarianism, Dualism and Economic Development," in *The Theory and Design of Economic Development,* I. Adelman, Erik Thorbecke (ed.), Baltimore, 1966.