BALANCED GROWTH AND THE PROBLEM OF AGRICULTURE*

——with special reference to Asian peasant economy——

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I. *Introduction—the problem*

The recent literature of economic growth pays particular attention to the problem of "balanced growth". Two different phases of the problem are taken up, though they are interrelated with each other. One is a purely theoretical approach and its problem is to examine the existence and stability of balanced growth paths in a general equilibrium system under certain assumptions. The other concerns practical strategy for economic development as its objective, though in most cases it is given some sort of theoretical basis. There are two types among the second group,—"balanced growth doctrine" of the Nurkse-Rodan type[1] and that of the A. Lewis type[2]. The former advocates a plan of simultaneous investment for industrialization and mainly concerns the investment criterion *within* the modern sector, while the latter deals with balanced growth between various sectors of the economy, in particular, between industry and agriculture. I want to deal with the problem of agriculture in a general framework of balanced growth equilibrium, so that this paper concerns both theoretical and empirical phases of the problem, although the main interest lies in the practical problem of the Lewis type.

H. T. Oshima recently stressed the strategic importance of agricultural development as against industrialization-minded theories and policies with special reference to Asian economic developement problems.[3] Similar assertions can be found in the literature of agricultural economics,[4] but very few in the circle of general economists. A remarkable exception is Kaldor's paper, as far as I know.[5] I myself share with these opinions. The place and significance of the peasant economy, however, seems to remain not fully clarified

* I have benefited from discussions and comments from my colleagues at Hitotsubashi University and from the group of agricultural economists in Tokyo. I would like to thank all of them.

[1] P. N. Rosenstein-Rodan, "Industrialization of Eastern and South-eastern Europe, "*The Economic Journal*, 1943. Ragnar Nurkse, *Problems of Capital Formation in Underdeveloped Countries* (Oxford, 1953).

[2] Arthur Lewis, *The Theory of Economic Growth* (London, 1955). Albert O. Hirschman criticised this version of the balanced growth concept and said this is "essentially an exercise in retrospective comparative statics" in Chapter 4 of his book "*The Strategy of Economic Development*" (New Haven, 1959). In my impression, he seems to disregard entirely the problem of backward sectors, where almost no automatic incentives can be expected in the balancing adaptation process of the economy.

[3] Harry T. Oshima, "*A Strategy for Asian Development*", 1961, an unpublished paper.

[4] As a best example, we can quote William H. Nicholls' paper "*The place of Agriculture in Economic Development*", presented to the Gamagori Conference of I.E.A. in 1960.

[5] Nicholas Kaldor, Characteristics of Economic Development, in "*Essays on Economic Stability and Growth*" (London, 1960).

in the general framework of economic development possibilities. One of my aims is to give further clarification along this line.

Another aim is to determine the possibilities of farmers' "income parity" with urban workers in the course of sustained economic growth. This topic concerns almost all advanced countries, because the real situation is apt to be toward disparity unfavourable to farmer's side, and this problem is particularly important in a country like Japan, where the factor-proportion or man-land ratio is extremely unfavourable in agriculture. Eight years ago I proposed a concept of "disguised equilibrium growth", in which I tried to give a proof of possible existence of famer's income parity with industrial workers in the course of sustained growth.[6] Recent reflections, however, revealed shortcomings of my old setting, so that here I want to try to set it again in a more accurate form, in particular, in the light of general equilibrium of balanced growth.

The two aims can best be fulfilled by the common approach of a two-sector model, composed of capitalist sector and self-employed sector, because the process of economic development is that of enlarging the former and contracting the latter. Theoretical strictness will be sacrificed to some extent in order to weigh the practical considerations in meeting the real circumstances. I shall stress the importance of output balance, in particular that of food, the main output of the self-employed sector. Hence the discussions that follow depend upon the key assumption that food can be supplied only by the self-employed sector to meet the demand from both sectors. In my knowledge, this assumption is appropriate to most countries in Asia, including even Japan, and without placing this fact at the centre of theoretical formulation, no attempt can be successful in analysing the problem of economic development. Thus we arrived at a different conclusion from other authors' approaches. A. Lewis rightly treated this point, but did not elaborate it in connection with his general thesis of "unlimited supply of labor".[7] The concept of unlimited supply of labor or that of disguised unemployment, though they differ from each other, seem to deserve skepticism both in theoretical and practical application to the problem

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[6] K. Ohkawa, "*Nogyo no keizai bunseki*" (Economic Analysis of Agriculture) Tokyo, 1953. "Disguised" was used because of lack of better expression, in order to distinguish this kind of equilibrium from the ordinary one, with regard to its dual characteristics: this implies inequality of marginal productivity of labor between agriculture and the capitalist sector, and the fact that farmers proprietors consider the so-called mixed income (rent and other non-wage income as well as wage income together) they receive as if this were the compensation for their work.

By the way, my recent survey reveals that on average of many advanced countries the average per head income in agriculture is almost equal to the average wage earnings in the non-agricultural sector. This may be valid only in a broad sense, but does give us an empirical background for the concept of "disguised equilibrium". See K. Ohkawa, "Shotoku, Rodoryoku no Sangyokan Bunpai no Chokihenka" (Long-term Changes in the Industrial Distribution of Income and Labor Force) in the *Keizai Kenkyu*, Vol. 12, No. 3, July 1961.

[7] W. Arthur Lewis, "Economic Development with Unlimited Supply of Labor", *The Manchester School*, May 1954, and "Unlimited Labor: Further Notes", *The Manchester School*, January 1958. I benefited very much from these excellent papers, but I wonder why the interesting discussion on the output equilibrium between the capitalist sector and agricultural sector is entirely separated from the general thesis of unlimited supply of labor. Kenjiro Ara's two-sector model is very suggestive, being finely built by a strictly theoretical formulation, but he treats no condition with regard to the output equilibrium of food between the two sectors. See "Nijukozo no ichi mokei" (A Model of Dual Structure), *The Ikkyo Ronso*, Vol. 42, No. 5, November 1959.

of initial economic growth, when they are not backed up with food supply possibilities.

In the treatment of "income parity" problem in the course of sustained growth also, the foregoing condition of food suppy is not dispensable in determining the conditions required to maintain a balanced growth equilibrium. We arrived at a conclusion that the "disguised equilibrium" can be maintained with a possibility of a general balanced growth path subject to a certain condition. In this respect, we will conclude by stressing the strategic importance of government policy regarding agricultural technical development.

II. *Stationary state of two-sector equilibrium*

The economy is assumed to be composed of two sectors as mentioned above. Hereafter we call the former the "sector I", and the latter the "sector II".[8] (In the following suffix 1 stands for the capitalist sector, and 2 for self-employed sector). The basic assumption is that each sector is producing different things. The sector I produces both capital goods and consumption goods other than food, while the sector II produces food only. Of course this is a great simplification. In reality, the latter sector produces many kinds of consumption goods of the traditional type and even some capital goods, and some goods are supplied competitively by both sectors. Our assumption of no substitution of supplying food between the two sectors, however, may be a reasonable one in order to raise up the core of the problem. In fact, where the land value is too high because of excessive demand for it by peasants as a means of self-employment, the capitalist does not like to enter the production of basic food. We ignore the landlords and assume all the agricultural land is directly cultivated by self-employed tillers. In reality the negative role played by the landlords in economic developement deserves particular attention in most Asian countries, because the "surplus" produced in the sector II is apt to be spent by them on employing "non-productive" labor in the classical sense. It is not difficult to take this fact into consideration in our model, whenever necessary, without altering its basic nature. This is merely a first approximation in reply to our present problem.

We assume that the output of the sector I (Y_1) and that of the sector II (Y_2) can be measured by a common unit of one sort or another and we will treat them in real terms, without entering into the puzzle of index number problem. We assume that the existence of capital stock (K) in the sector I,, and that of land stock available to food production (L) in the sector II, in other words, that there is no land in the former, no capital in the latter. The unit of measuring capital stock is simply assumed to be common to that of output, mentioned above, and no differential quality or location of land is assumed, so that we can avoid the difficulties of measuring capital and land stock. There are a certain number of labor force population in the sector I (N_1) and in the csetor II (N_2) in terms of

[8] I tried a two-sector model of the capitalist sector and the non-capitalist sector in my earlier paper "Fukinto seicho to teii koyo" (Unequal growth and under-employment), in *"Nihonkeizai no bunseki"* (An Analysis of the Japanese Economy) Vol. II Edited by Tsuru and Ohkawa, Tokyo, 1955. The non-capitalist sector does include landlords as its essential element. Here we prefer the *self-employed* sector, which roughly corresponeds to the "subsistence sector" in Lewis' terminology. But I prefer "self-employed" rather than "subsistence" because this sector is not self-sufficient but has normal trades with the capitalist sector.

man-year labor of homogenous quality and we assume no technical difficulty in transferring labor force between the two sectors. The number of consuming population is assumed to correspond to these numbers N_1 and N_2.

Two production functions are given in a general form like $Y_1=F_1(K, N_1$ and $Y_2=F_2(L, N_2)$, where a decreasing return is assumed for both functions. As for distribution and expenditure of income, the followings are assumed for the sake of simplicity. Y_1 is distributed among capitalists and workers in the sector I, while in the sector II all the income produced is attributed to peasant proprieters. All the personal income distributed to the workers in the sector I and to the self-employees in the sector II will be consumed with no saving, and the capitalists will save all the profits they gain. Thus we have $Y_1-S=w N_1$, a definitional equation, where S and w stand for the amount of saving and wage rate, and w N_1+Y_2 is aggregate expenditure for consumption. All these quantities are measured in annual units to be consistent with the definition of labor unit. In these treatments, we have to ignore all the intermediate goods in order to avoid complexity. It may be, therefore, helpful to assume a constant ratio of net product to the gross product at least in the case of treating food production and agricultural income. Particular attention is paid for the ratio of food expenditure to the total consumption expenditure, which is denoted by f. This ratio is assumed constant for a certain range of per head income and is also assumed to have no difference between workers and self-employees. We do not intend to deny the well-known Engel's law, but merely want to represent the elastic demand for food with regards to the change in per head income of low levels (income elasticity=1.0), a fact which was revealed by several surveys about underdeveloped economies in Southeast Asia. We know that there is sometimes a significant difference of this ratio between urban workers and rural self-employees, but disregarding this difference may not be a serious misgiving for the purpose of this article.

Under these assumptions, we consider the conditions of equilibrium or balance as follows. First, in order to maintain a certain amount of capital stock (K), the capitalist is assumed to invest all the savings and the period of replacement (r) is assumed to be given by a relationship $K/r=S$. This is a greatest simplification of both the investment behaviour and the saving-investment equilibrium. Second, full employment is assumed, so that we have $N_1+N_2=N$, where N is the total number of labor force. We disregard differentials of both the wage rate (w) and the average productivity of labor or per head income in the sector II (Y_2/N_2). Therefore full employment means also no differentials of income in each sector. If there occurs some shortage of employment demand in the sector I, the residual labor force is assumed to be able to find jobs in the sector II without causing differentials of their income within this sector. Third, in the equilibrium state the wage in the sector I is equal to the average productivity in the sector II, that is $w=Y_2/Y_2$. This is a condition of fulfiling "income parity" in real terms. It goes without saying that this condition can permit us in giving certain allowances for the "differentials" of equilibrium income due to various non-economic factors, which operate differently between rural and urban lives. Fourth, it is of course necessary to balance demand for and supply of food, which balance is simply expressed as $(w N_1+Y_2)$ $f=Y_2$. Lastly, an equation $\partial Y / \partial N=w$ is introduced as the condition of maximizing profit rate of capitalist in the sector I.

We define the economy to be at the stationary state of balanced equilibrium when

all the conditions above mentioned are fulfilled and there is no endogenous movement to change from this routine path. In order to check the possibility of reaching such a state, we build a simple model as follows:

Model I:

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\begin{aligned}
&1) \quad Y_1=F_1(K,\ N_1)\\
&2) \quad Y_2=F_2(L,\ N_2)\\
&3) \quad K/r=S\\
&4) \quad Y_1-S=wN_1\\
&5) \quad N_1+N_2=N\\
&6) \quad w=Y_2/N_2\\
&7) \quad Y_2=f(wN_1+Y_2)\\
&8) \quad \partial Y_1/\partial N_1=w
\end{aligned}
$$

The number of variables in this model is eleven (Y_1, Y_2, N_1, N_2, N, K, L, r, S, w, f). If we assume that the stock of land, the number of labor force and the ratio of food expenditure are given as constants ($L=\bar{L}$, $N=\bar{N}$, $f=\bar{f}$,) this model will be consistently solved and we will be able to obtain an equilibrium distribution of labor force between the two sectors (N_1, N_2) that of output (Y_1, Y_2), and wage rate (w), saving (S), capital stock (K) and its period of replacement (r) in the sector I. As a matter of fact, the assumption of a fixed stock of land available to agriculture is almost accurate for most countries with already densely populated areas, and that of fixed ratio of food consumption expenditure may be permitted within a certain range of low income level as already touched upon. These are substantial assumptions, but the constant number of population is nothing but an artificial assumption for the sake of simple analysis. In this context, our system seems to be a stationary state of blanced equilibrium. The economic meaning of its mehanism can best be explained as follows.

Let us start with a certain amount of capital stock (K^*), an arbitrary choice, under the condition of a prevailing equilibrium wage rate (w, hereafter, no star notations will stand for equilibrium values). From the production function 1) and the profit rate-maximizing condition 8), the amount of employment (N_1^*) and the output (Y_1^*) for the sector I will be determined. The saving amount (S^*) and the replacement period (r^*) are to be fixed respectively from the definitional equation 4) and the equilibrium equation 3). On the other hand, the number of self-employees (N_2^*) will be obtained from the equation of full employment 5), and the amount of food output (Y_2^*) is to be determined accordingly from the production function 2). There remain two equations 6) and 7) still unused. We can obtain the amount of food demand from 7), using N_1^*, Y_2^* and K^* and w, which weas sumed at the very start. This amount of food demand is denoted by Y_2'. On the other hand, Y_2^* must be the amount of supply of food. There must be no balance between Y_2' and Y_2^*. Let us assume $Y_2'>Y_2^*$ or a state of over-demand. It is of course possible to consider an adjustment process toward an equilibrium by assuming an increase in the relative price of food, but this is not the process we would like to follow. The main reason for rejecting the role of price mechanism in this case is the recognized fact that in most underdeveloped countries the elasticities of food with regard to both supply and demand are very low so that the practical adjustment of disequilibrium state of supply and demand can only be effectively carried out by direct means of increasing supply or decreasing demand. Thus in our present case, we believe that the state of over-demand can best be adjusted

by eliminating the real cause, that is the over-existence of capital stock and in fact, this is proved as follows.

If K^* were larger than K, it follows $Y_1^* > N_1$. According to the assumed condition of decreasing return, $N_1^* > N_1$ is necessary by a larger degree than the above inequality. As for the sector II, $Y_2^* < Y_2$ is derived from $N_2^* < N_2$. The equation 7) thus leads to $Y_2' > Y_2^*$. This may be almost self-evident. We can say that the over-investment (this is corresponding to the over-existence of capital stock) will cause an increased demand for food on one hand and lead to a decreased supply of food on the other, thus resulting a disequilibrium of food balance. The reverse assumption will certainly lead us to a state of oversupply. Therefore between them there must be a certain amount of capital stock, which can exactly correspond to a state of supply-demand balance of food. In other words, this reveals a mechanism, where the food supply is a limiting factor to capital accumulation.

This is not the end of our story of the stationary state. There remains equation 6), the mechanism of which is to be explained. Usually the meaning of an equilibrium equation of this kind has simply been explained by assuming workers' direct behaviour of moving in and out between the two sectors, the incentive for which being assumed to be a magnitude of differentials of per head income to be received by them. The parameter of labor force movement is income differentials. This is not a mistake, but tells us only one side of the real working mechanism. The so-called "job opportunity" theory reveals the other side of the mechanism, which concerns the capitalist's behaviour. But this theory apts to disregard workers' behaviour. In our present case, the mechanism of labor movement can best be explained in the following way.

Contrary to the former case of starting arbitrary capital stock, let us assume first an arbitrary level of prevailing wage (w^+), under the state of capital stock of an equilibrium value (K). If the chosen wage rate is higher than the equilibrium one, namely $w^+ > w$, the production function tells us that N_1^+ will be smaller than the equilibrium number and this will lead to an inequality $N_2^+ > N_2$ for the sector II, according to the assumption of full employment. The overemployment in this sector will cause a lower average productivity, thus making a differential between the wage rate in the sector I and the per head income in the sector II. The existence of "cheaper" labor in the self-employed sector will give capitalist an incentive to expand his business and there will occur more "job opportunities" in the sector I and some of the self-employed will be hired in the sector I. This will cause a falling level of wages, which will continue to the point where the income differentials between the two sectors completely disappear, reaching the equilibrium wage rate. In the reverse case of $w^+ < w$, there is no difficulty of giving another explanation.

Thus we can give a fairly general explanation of the mechanism of our simple model without sacrificing any economic meaning of human behaviour. Of course, these two mechanisms caused by equations 6) and 7) should be understood simultaneously, affecting each other. The above explanations are obliged to be partial in order to avoid complexity.

III. *Implications of our model for the theories of economic development*

The implications of our model will be developed in relation to the theories of economic

development. I want to make clear in the discussions that follow the main differences between the well-known theories or concepts and ours.

First, it is to be noted that the concept of "subsistence level of living" or the like was not used in our model approach. The modern economics has often been obliged to borrow this vague concept from classical thought, when it has dealt with problems of the initial stage of economic development. It is of course desirable to avoid such a vague concept if possible. Some authors, myself included, proposed a more positive concept, for example, the average productivity of agriculture in the self-employed sector[9]. But in order to be logically consistent along these lines, we need a theory of subjective equilibrium of the farm-household, because under the given condition of production function, a certain level of average productivity must be determined as an equilibrium value. This is why such a device as marginal valuation curve of labor input has been tried. In our medel, only a single condition of income parity was introduced, without elaborating specific conditions required for setting the behaviour equilibrium of farm-household, and we succeeded in giving a proof of the existence of "disguised equilibrium" *within* the general mechanism of the system.

This may appear, however, to be the same in principle as the classical explanation that an equilibrium wage rate is determined by the subsistence level. One may say that the only difference is a replacement of subsistence level by the average productivity of agricultural labor. This is not so. The basic difference can best be illustrated by the following. If the wage rate is *determined* directly by the level of Y_2/N_2, we can build a simple branch model as follows:

Model Ia :

$$1)\quad Y_2=F_2(\bar{L},\ N_2)$$
$$2)\quad N_1+N_2=\bar{N}$$
$$3)\quad \bar{f}=N_2/\bar{N}$$

The equation 3) is a combination of 6) and 7) of Model I on the consideration of $w=Y_2/N_2$. In the model Ia, the variables are Y_2, N_1, N_2, and these can be solved by these three relationships. It is to be noted that the two equilibrium conditions concerning food and labor force are fulfilled regardless of the amount of Y_2 and that Y_2, N_1, N_2 are all determined irrespective of other variables which appeared in Model I. Thus Model Ia gives a stationary state of equilibrium of the sector II, and this determines the wage level of the sector I. There is no room for the operation of the "marginal principle" and the "residual principle" of determining profit is definitely valid in this case. There is no doubt that the residual principle of determining profit is not inherent in the concept of subsistence level wages, but is inherent in the assumption of *self-determining mechanism* of sector II.[10]

[9] See Lewis' paper op. cit., and K. Ohkawa, "Seikatsu suijun to sono sayo" (Standard of Living and its Function) in "*Nihonkeizai no bunseki*". (Analysis of the Japanese Economy) Vol. I, Tokyo, 1953. It should be admitted that if the major portion of land is cultivated by tenants the concept of subsistence level of living is not dispensed with in order to explain an equilibrium state. But we think the average productivity of owner-tillers can be taken as the standard in most real cases.

[10] With regard to the effect of population increase, the classical thesis can be expressed in our system something like an equation $N_2=F\ (Y_2/N_2-A)$, where A stands for the subsistence level of living and subject to the condition $Y_2/N_2 \geqslant A$. If we put this equation into Model I, the system will give us an equilibrium value of N in a formal sense. But note that the assumption of constant N or of constant A does give us no substantial difference. By the way, note that it is possible to assume a given amount of K instead of N without altering the basic nature of Model I.

It seems to me that these principles and concepts of the traditional type often build implicitly the background of development policies and strategies for economic development of underdeveloped areas. Therefore, the implication of our model may shed some light not only on the theoretical problem but also on the practical issues involved in this respect. What we made clear in the foregoing discussion is the point that it may not be wise to assume a certain level of subsistence more or less rigidly, without taking into account the productivity effect both in the capitalistic sector and the self-employed sector.

Second, our discussion will bring about some challenge both to the doctrine of unlimited supply of labor and the concept of disguised unemployment, with regards to development policies. Among the latter, Nurkse's formulation may be a typical one. It is quite open and free to assume that the marginal productivity of labor is zero or nearly zero at the stationary state of our model. But I have doubt about such an assumption as far as the development strategy is concerned, because of two reasons. First, the marginal productivity of labor in reality may not be so small and the reduction of labor force in agriculture will eventually bring about trouble, reducing food production, so long as the production method and organization remain unchanged.[11] Second, in reality of initial economic development, the supply of labor will be increased by the natural increase of population, so that the key problem is not the possible reduction of the present number of the rural population, but how to utilize the newcomer to the labor market.

In order to increase food output, the shift of agricultural production function is a pre-requisite, because without improvement of productivity, even by simple methods, one can not expect an increase of food supply. Without an increase of food supply, there can be no increase of labor availability in sector I.

Let us suppose that the production function F_1 had an upward shift in our model. Y_1 will become larger. The capital accumulation would be accelerated, because of a larger S with unchanged w and N_1. It still needs, however, the same number of labor force (N_2) to produce food, if there is no upward shift of production function F_2. No labor force can be released from sector II. Therefore a tendency to increase capital intensity is inevitable and this will reach sooner or later again a stationary state. This gives another explanation why the technical progress of food production is called "pre-requisite" or "pre-condition" for economic development at the initial stage.

The doctrine of unlimited supply of labor seems not entirely depend upon the existence of disguised unemployment. A. Lewis' formulation of this concept is careful. However, it still seems to have a common doubtful background with the concept of disguised unemployment in the sense that the hypothesis of "unlimited supply" is generally built, irrespective of the possible incerase of food supply. Lewis rightly touched upon the importance of food supply,but he failed to integrate this point into his whole system. Our model revealed the relationships that the possible supply of labor from the sector II to the sector I is "limited" by several conditions, the given number of labor force, the given production function and the given ratio of food consumption expenditure. In order to create an unlimited supply of labor in the sense that the demand price of labor proposed by capital-

[11] In this respect, I agree with Rao's opinion. See, V.K.R.V. Rao, "Investment, Income and the Multiplier in an Underdeveloped Economy", *The Indian Economic Review*, February 1953. During World War I, Japan's agriculture experienced a shortage of labor because of a moderately accelerated increase in the out-flow of rural labor force to the prosperous urban industries.

ists is always higher than the supply price of labor in the sector II, we certainly need an important assumption that the rate of increase of capital formation is always smaller than that of labor force. This again requires an explanation of why this is so.

I wonder that there may be three stages of economic development. At the first stage economic development is "limited by food supply" because the supply of labor is limited by food supply. At the second stage, "unlimited supply" of labor will really come into force because of a possible emancipation from the "limited supply" of food. Toward the third stage the supply of labor will again become "limited" because of the relatively decelerated rate of population growth. I think that the doctrine of unlimited supply of labor is useful in explaining the cause of high rate of growth in a country like Japan, which is just at the second stage of economic development, but it is not useful and sometimes even misleading, when applied to the case of underdeveloped economies, where land resources are limited because of a dense population.

Third, we want to pay a particular attention to the existence of the two conflicting forces which are necessarily caused by the progress of agricultural techniques. The progress of productivity will certainly contribute to increasing food supply and accordingly will accelerate the rate of capital accumulation, if other conditions remain unchanged. However, on the other hand, it also leads to a higher income for both workers and the self-employed under equilibrium conditions. If we apply a method of comparative statics to Model I, this fact will be apparent. This effect, contrary to the above effect, will certainly operate as a brake to capital accumulation. Therefore, the "output effect" and the "income effect" are destined to be conflicting to each other.

A. Lewis has drawn attention to this dual effect from the standpoint of changes in terms of trade between industry and agriculture. We try to explain it by using our model in terms of technical progress.

Let us suppose that the production function F_2 had a shift upward as a result of technical progress of agricultural production. This will be followed by an upward shift of average productivity of agriculture and that of the wage level. Since there can be no change in the number of N_2 due to the assumption of constant f, saving must decrease as a result of wage increase, and this will lead to a smaller rate of capital accumulation. In reality, the assumption of constant ratio of food expenditure is too rigid, and if we replace it by a constant elasticity of food demand with regard to income increase (η), then the income effect of technical progress will be expressed in a more elastic way. Suppose η is 0.7 (I think this is more or less close to the real figures in most countries in Southeast Asia), the residual 0.3 does represent the output effect. The number of agricultural labor force can be reduced accordingly to this extent. In the case of 0.5, both effects are even, but we can not expect such a low value for underdeveloped stage.

This simple illustration gives us an explanation why the capitalists are not necessarily serious in encouraging technical progress of agriculture. It is self-evident that without increasing food output, capitalist sector must remain in a stationary state. On the other hand, however, the results of raising agricultural output act against capital accumulation by increasing income much more than output. Landlords sometimes play an intermediary role between capitalists and peasants in lessening the income effect. We had such an example in the early stage of economic development in Japan. Any way, this is one of the real difficulties for the strategy of economic development, because foreign trade can

not be an easy substitute for an increasing supply of food.[12]

IV. *A process of balanced growth*

Starting from the stationary state of Model I, I would like to give a simple growth model. Both technical progress and increase in population are taken into consideration, and the income elasticity of food demand (η) is introduced. All the other variables are given time element (t) and are denoted like $N(t)=N(0)\,e^{\lambda t}$, where λ stands for the rate of increase of labor force population. The production functions F_1 and F_2 are given shift variables α_1 and α_2 respectively. I am aware of an increased importance of the capital and investment in agriculture in discussing a growth model, particularly in relation to the technical progress in this sector. For the sake of simplicity, however, the non-capital assumption is still kept for this sector.

Model II :

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\begin{aligned}
&1)\quad Y_1(t)=F_1[(K(t),\ N_1(t))]+\alpha_1(t)\\
&2)\quad Y_2(t)=F_2[L(t),\ N_2(t)]+\alpha_2(t)\\
&3)\quad S(t)=dK/dt\\
&4)\quad w(t)\ N_1(t)=Y_1(t)-S(t)\\
&5)\quad N_1(t)+N_2(t)=N(t)\\
&6)\quad w(t)=Y_2(t)/N_2(t)\\
&7)\quad G_2=\eta\omega+\lambda\\
&8)\quad \frac{\partial Y_1}{\partial N_1}(t)=w(t),
\end{aligned}
$$

where $G_2=\dfrac{dY^2}{dt}\cdot\dfrac{1}{Y_2(t)}$ and $\omega=\dfrac{dw}{dt}\cdot\dfrac{1}{w(t)}$.

The variables are Y_1, Y_2, N_1, N_2, K, L, w, S, η, λ, α_1, α_2, totaling 12. In order to arrive at a consistent solution of this model, we have to give four more relationships or variables from outside. It may be most natural and practical to assume a constant stock of land ($L=\bar{L}$), a constant rate of population increase ($\bar{\lambda}$) and a constant income elasticity of food demand ($\bar{\eta}$). In addition to these three, if we introduce another exogenous factor with regard to one of the technical shift veriables, then we can solve this system. The five equilibrium conditions—3), 5), 6), 7), 8) will be fulfilled continuously in the course of growth. This can be a process of balanced growth equilibrium at least in a formal sense.[13]

A special attention, however, is required to the shift variables of production functions in both sectors. The technical progress or the flow of technical knowledge has usually been considered to be given from outside the economic system. In our case, however, one of the two shift variables is to be determined within the system, if a balanced growth has to be maintained. Of course we have no empirical evidence for determining which is

[12] We should be careful not to make a too-much generalization in this respect. There are rice exporting countries like Thailand and Burma, in which the man-land ratio are relatively favourable by the standards of Southeast Asia.

[13] Mitsuharu Inage's model is an excellent suggestion for us in this respect, though his conclusion is not the same as mine. See his paper "Keizai Seicho to Nogyo" (Economic Growth and Agriculture), *Keizai Kenkyu* (*The Economic Review*) Vol. 12, No.1, January 1961.

exogenous or endogenous of the two shift variables. However, as far as the spontaneous nature of technical innovations is concerned, it may be natural to assume that the shift variable of the capitalist sector (α_1) is responsible. If this is taken for granted, a balanced growth can be expected only when α_1 is given. In this case another condition is still required that α_2 can be adjusted to meet the conditions of balanced growth.

In this respect a few words on a possibility of maintaining balanced growth paths will be needed from the viewpoint of agricultural policy. In most countries, the government plays an important role in encouraging technical progress of agriculture, and in particular, in the countries where peasant economy is dominant in agriculture, this is of strategic importance for economic development. Suppose that the shift variable of production function in the sector I is given or projected. The government's policy can be expected to lead the rate of technical progress in the sector II in order to make approximation to a balanced growth, of which the balance in which we are most interested is the maintenance of income parity between the self-employed in agriculture and the workers in the capitalist sector. Such an interpretation, however, will change the nature of our model and we should call it a *policy* model in this context. But it is to be noted that the policy model of this kind is backed up with the proved existence of a balanced growth.

The nature of technical progress thus required under the condition of constant stock of land available to agriculture must be land-saving. If the number of labor force in agriculture is assumed to be kept unchanged throughout the growth process as in Japan's historical experience, it should be also labor-saving by the same degree. If that number is to be decreased in order to accelerate the supply of labor to the capitalistic sector, the improvement of agricultural technique should be more labor-saving than in the former case. Suppose that α_2^* represents such a rate of technical progress under the condition of constant labor force in the sector II (this is assumed for simplicity), from equation 2) we can get a very simple relationship $G_2=\alpha_2^*$, and from equation 7) we can obtain another simple equation $\alpha_2^*=\lambda(1-\eta)$, considering $\omega=G_2$, the condition of maintaining "disguised equilibrium".

In this context, the problem of transition from the second to the third stage of economic development requires particular attention. Unlike the first and second stage, this transition process requires a reduction of labor force from sector II, because the rate of increase in the labor force is to be assumed slowed down while the rate of capital accumulation has to be accelerated by absorbing the self-employed labor force hitherto occupied in sector II. It is worthwhile to elaborate the nature of the agricultural production function here. An increase of output combined with a decrease of labor is required at the stage under consideration, apart from depending on a larger amount of food import. As far as the usual static production analysis is concerned, an increase of output combined with a decrease of labor means a pre-existence of a minus marginal productivity of labor. This interpretation, however, is not valid in our case. In our Models I and II we discussed the production functions in quite a general form throughout the whole process. During long-run economic growth, however, the agricultural production function must have significant changes due to the improvement of the farmer's management ability as well as of his desire to expand. During the first stage of economic development, because of the low level of these qualifications, a decrease of labor in agriculture would cause a decrease of total output, labor productivity being kept unchanged. In other words, we can not expect the economies

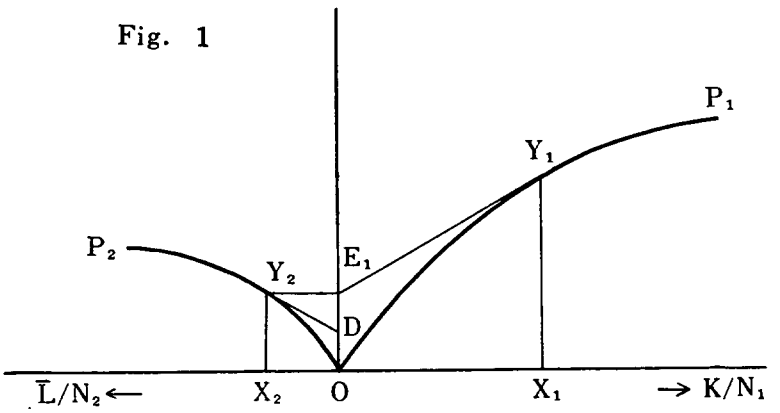
of scale at such a stage. Towards the later stage, however, economies of scale can come to be considered even in sector II.

Thus we take up a particular form of production function (productivity function) as follows:

$$\frac{Y_2}{N_2}=P_2\left(\frac{\bar{L}}{N_2}\right),\ P_2'>0, P_2''<0. \frac{Y_1}{N_1}=P_1\left(\frac{K}{N_1}\right),\ P_1'>0,\ P_1''<0.$$

Fig. 1 may serve to illustrate the nature of this form of productivity function of agriculture in relation to its counterpart in the capitalist sector.

Fig. 1

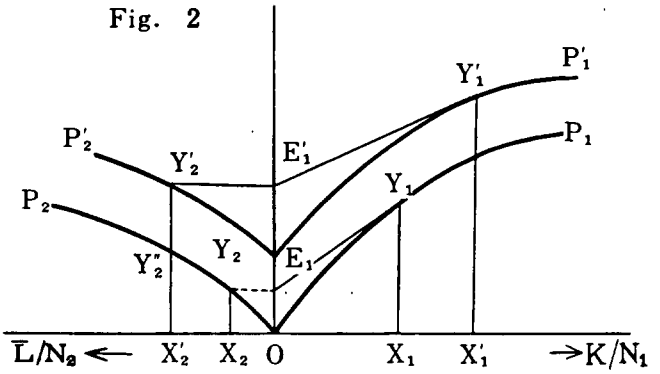


On the horizontial axis from the origin K/N_1 is measured to the right of the origin and $\bar{L}/N_2$ to the left. Suppose that at a certain period, K/N_1 is at X_1 and L/N_2 at X_2. On the vertical axis the productivity is measured. Suppose that the average productivity in the sector I is X_1Y_1, and that of the sector II, X_2Y_2 at the period above mentioned. A straight line tangential to P_1 at Y_1 determines a point E_1 and OE_1 gives the marginal productivity of labor in the sector I. Likewise we get OD for sector II. $X_1Y_1>X_2Y_2$ and $OE_1>OD$ because of the basic assumption of our two-sector model.

The condition of maximizing the rate of profit will be satisfied when OE_1 is equal to the prevailing wage. The condition of disguised equilibrium will be satisfied if X_2Y_2 (or OE_1) is equal to the prevailing wage. We can suppose that an equilibrium wage determined by Model II satisfies these conditions at the same time.

Next Fig. 2 gives an illustration of a growth process with shifts of productivity functions, from P_1 to P_1' and from P_2 to P_2'. Let us first suppose a change of an increase of K/N_1 combined with an increase of N_1 in the sector I as a result of labor force shift from the sector II. This is shown by a shift from X_1 to X_1' on the horizontal axis. In this case the marginal productivity of labor $OE_1\rightarrow OE_1'$ and the demand wage rate will be increased. But if the productivity function in the sector II remains unchanged, two unbalances will occur. One is the disparity of income, and the other the unbalance of demand and supply of food. The average productivity can increase from X_2Y_2 to $X_2'Y_2''$ as a result of reducing the number of labor force, but not enough to be equal to OE_1', so that a shift from P_2 to P_2' is needed in order to reach $X_2'Y_2'=OE_1'$. The shift of agricultural

Fig. 2



production function of this kind was the case in the previous discussion of the policy model.[14] We can not be sure that such a specific shift as illustrated here will meet the food balance condition. This balance is to be given by the whole system of Model II. What we can say by this illustration is that at this stage the food supply can be increased concurrently with a reduction of labor force in agriculture.

[14] Here we are obliged to assume a "neutral" technical progress because of the fact that we already introduced shift variables in Model II. This is done merely for simplifying the explanation. This assumption is of course not necessary for keeping a balanced equilibrim of the system.