CHOICE OF TECHNIQUE IN LABOUR SURPLUS ECONOMY

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I. INTRODUCTION

On the high development and dual economy of Japan, the interpretation of Mr. Miyohei Shinohara is known quite well. It is generally called capital concentration[1] and is offered as the explanation of dual structure. It can be said briefly as follows. Japanese Economy has been expanded rapidly, initiated by big business, and it was the very capital concentrative system that made this possible. The concentrative input of capital into important parts such as strategic sectors, or big business, brought a rapid economic development as a whole. There appeared such a phenomenon of dual structure today caused by such a rapid and biased development. Of course, it is natural in many countries that there coexist more or less developed sectors and underdeveloped sectors. It is only in most advanced nation, England, that such a phenomenon is scarecely seen. The countries who began to develop later than England, even in America or Germany, have a dual structure in some sense. So the dual structure is not seen only in Japan, but it is true that it appears very extreme in our country.

The process that capital concentration brings dual structure will be shown as follows.[2] Concentrative input of capital to big business—difference of physical productivity—difference of value added productivity—difference of payable ability—wage difference.

Difference of physical productivity brings difference of value added productivity according to the condition that the commodity market is imperfect. In the same way, wage difference depends on imperfectness of labour-market, and capital concentrative system itself means imperfection of capital market.

Seeing from causal relation, it is important in this case that capital concentration is the cause and wage difference is the effect. While, we know well the static theory of factor proportion. If the cause and effect are in reverse, wage difference and difference of interest rate will decide the factor proportion in these two sectors and bring difference of capital intensity. Such an interpretation rather agrees with the traditional theory. The remarkable point made by Mr. Shinohara is the very relation of the cause (namely, capital concentration) and the effect (namely, wage difference). In Japan over supply of labour and low wage had existed till quite recently. On the other hand,

1) Miyohei Shinohara, *Sangyokōzō* (Industrial Structure), Shunjūsha, 1959.
2) Shinohara, *Keizaiseichō no Kōzō* (The Structure of Economic Growth), chapter 4.

capital had not been accumulated sufficiently, compared with advanced nations, so a high rate of interest had prevailed. Therefore according to the usual static analysis, it is more profitable to adopt labour intensive technique. When a certain big business tries to adopt the capital intensive technique, what reason does it depends on? This is a very important problem on the strategy of economic development in backward countries as well as in Japan.

As the explanation of these arguments, we intend to offer problems below and examine them in this paper.

1. Why do they adopt more the capital intensive technique in an economy with a labour-surplus and low wage? In what way can its rationality be explained with traditional static analysis?

2. When capital funds are sufficient, more sectors can carry out capital intensification. But if capital accumulation is insufficient and availability of capital is restricted, is it more profitable to concentrate capital to a particular sector?

3. Generally speaking, if the capital intensive technique is adopted in a labour surplus economy, is it possible to reduce the surplus of labour?

4. Now suppose that the surplus of labour is reduced and there occurs a labour shortage, which seems to be a reason to reduce the dual structure. What kinds of problems will happen?

Let's examine these four problems.

II. CAPITAL INTENSITY IN A LABOUR SURPLUS ECONOMY

According to the static analysis of the Neo-Classical School, capital intensity is determined by factor proportion. There must be labour intensive under the economy of labour surplus (=low wage) and capital shortage (=high rate of interest). It is not always profitable for economic development to adopt labour intensive technique in every sector. For example, in the economic development of Japan till quite recent every sector was not always labour intensive. How then can the capital intensive technique be adopted? There are two approaches to this problem: one is to regard a business behavior as a dynamic and overtime one and formulate it, and the other is to analize it according to a usual static theory.

It is doubtless that first approach is more suitable to explain its practical process. Let's examine an overtime business behavior. If it is analized with a new theoretical tool as an expansion of the Neo-Classical Theory to a dynamic one, an adaptation not to depend on present factor cost but expected future factor cost comes to be a problem. If the wage rate continues to rise in the future, it is acceptable to adopt the capital intensive technique at this time. But when there exist so much labour-surplus, and there is shortage of capital

accumulation, and a high rate of interest, it is very doubtful if a firm will adopt the capital intensive technique with an estimation of high wage and a low rate of interest in the future. In dynamic analysis the problem of capital accumulation cannot be ignored. It is rather difficult for us to explain capital accumulation of individual firms in connection with the choice of technique. In this paper we will make clear this problem mainly with a static approach.

Now suppose only one production-function is given, a degree of capital intensity will be determined by the one and only factor proportion. But actually when a backward country trys to catch with up an advanced nation, a technique may be chosen not as having a factor combination under the present production-function but among plural production-functions involving techniques already prevailing in advanced nations.

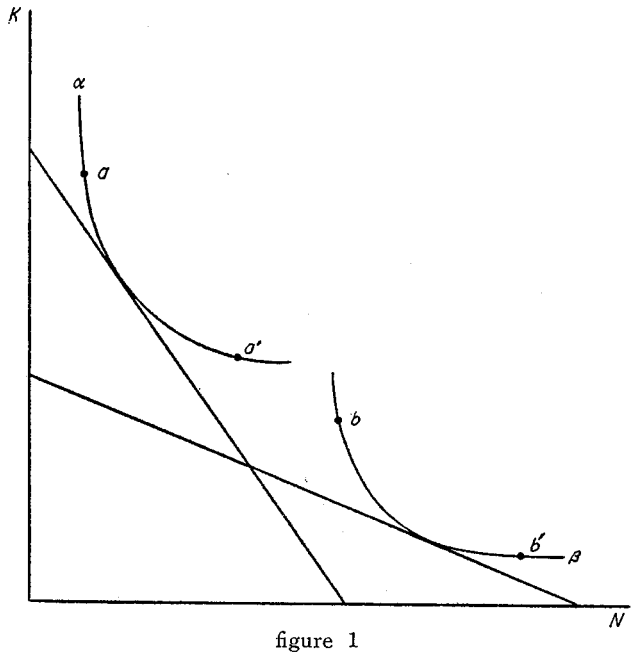

figure 1

Each isoquant curve, namely α and β, represents the same amount of products. Technique β is more profitable obviously in an economy of low wage and on the contrary in economy of high wage technique α is more profitable. Now suppose that the co-ordinate of capital and labour can exist only on a range of aa' and bb', and α is a capital intensive technique. No reason is shown for using the capital intensive technique in a low wage economy.

It is very difficult for us to make clear the problem by formal analitical tools. In general, in order to try to catch up with an advanced nation rapidly,

a backward country is willing to introduce techniques used in advanced nations and the factor proportion is made light of. When these techniques are adopted, a backward country may introduce and imitate the very process of advanced nations as well as techniques enbodied in machinery. The process was determined by the influence of the factor proportion in advanced nations. Considering these factors, we will push this static analysis forward. A traditional theory on production-function is based on complete factor substitutability. However, factor is less substitutable when a backward country introduces these techniques. The reason is as follows.

On production-function, Johansen's assumption of ex-ante substitutable and ex-post fixed factor proportion is realistic.[3] Under such a condition in a backward country, a fixed technical coefficient is given indifferently to the factor price by the adoption of productive process that has already adopted in advanced nations.

Without production-function of Johansen's type, the hypothesis of fixed technical coefficient seems to be appropriate with the condition of imitation of productive process in advanced nations.[4] The relation between introduced technique and factor proportion is shown in figure 2.

When occasion demands, the adoption of such a technique may be unprofitable according to wage levels, comparing with adaptation to factor cost under existing technique.

In figure 3, α represents existing technique in a backward country

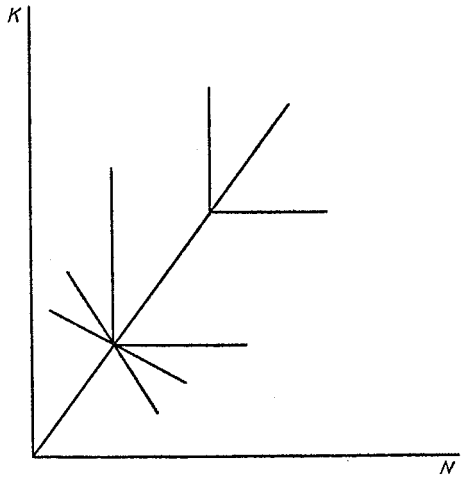

figure 2

3) L. Johansen, "Substitution versus Fixed Production Coefficient in the Theory of Economic Growth," Economica, April, 1959.

4) Refer Eckaus, "Factor Proportions in Underdeveloped Area," American Economic Review, March, 1955.

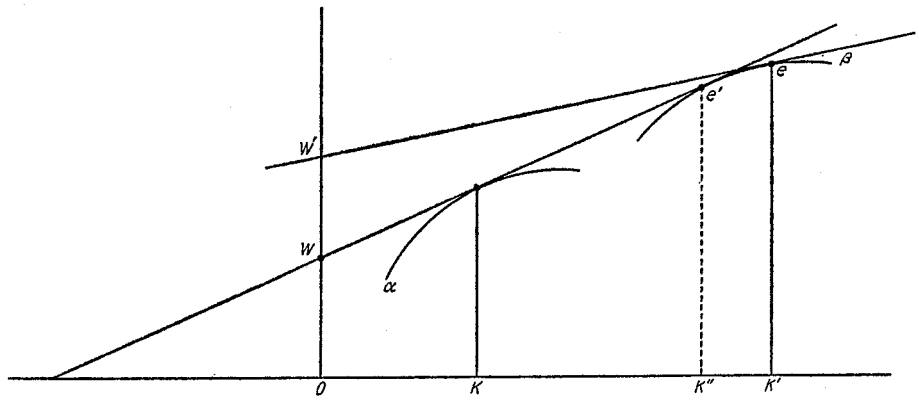

figure 3

and β represents technique of an advanced nation. OW is wage level of a backward country and OW' is that of an advanced nation. Each decline of tangent line from W and W' to α and β represents each rate of profit. k', which is obtained by a perpendicular from e, represents capital intensity with wage OW, its rate of profit will rather fall, but it is kept as it is in the case of capital intensity k''. But we know now that fixed capital intensity is given in a backward country. Therefore it makes rate of profit lower to adopt β than α.

Now, let's revert to factor proportion problem again. In low wage economy, existing technique may have possibility to be more profitable

In figure 4, each pair such as x_1 & x_1', x_2 & x_2' and x_3 & x_3' repre-

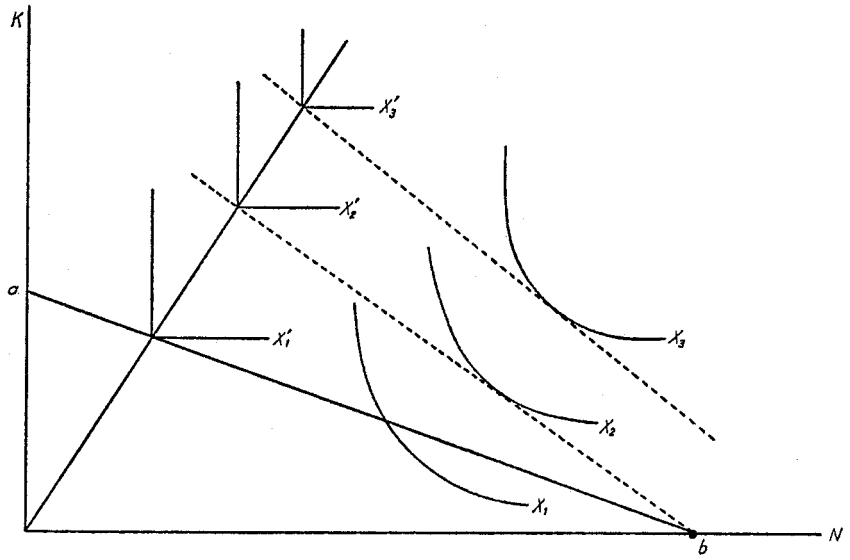

figure 4

sents the same amount of products. A straight line *ab* represents an equal spending line. We can notice here clearly the superiority of existing substitutable technology. If the rate of interest falls with a fixed wage rate an equal spending line is *a'b*, it is indifferent to choose anyone. Then we will naturally use the technology of a more advanced nation. According to the degree of the falling rate of interest, the technology of an advanced nation can be superior even under a low wage economy. Such a falling rate of interest can be carried out as a policy. In the case of shortage of capital accumulation, however, this policy may bring about a vicious inflation. Then, under the restricted capital stock there can occur a phenomenon that a capital may be concentrated at low interest rate only to particular sectors or firms according to a financiary differential policy. As the result only particular sectors can use the capital intensive technique.

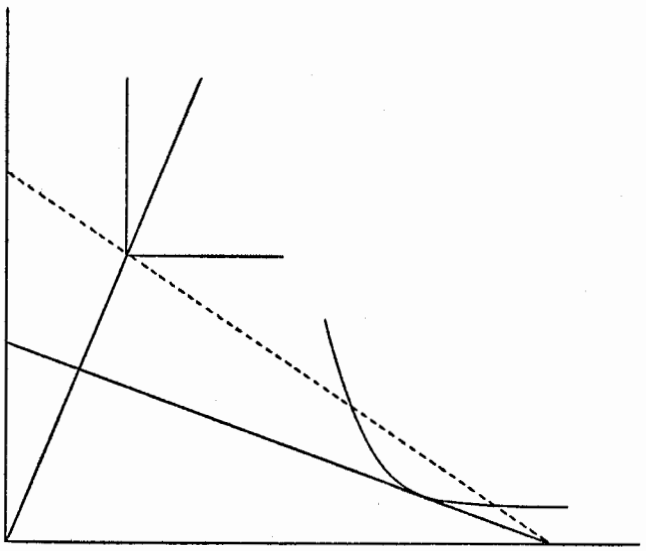

figure 5

Now let's devide the economy into two sectors. There exists an explanation on development and dual structure of Japanese Economy. That is to say, a new technology can be adopted by concentrating restricted capital into a strategic sector. On the other side, small business that is unhappy to use capital rationaly can adapt for itself by using low wage labours.[5] In this case it is possible to say that new technology has higher productivity these firms,

[5] The devision of those two sectors depend on neither concept of capitalistic sector and non-capitalistic sector nor investment goods sector and consumer goods sector, but big business or strategic industries which adopt new technique and small business or industries to which they belong, depending on existing technique.

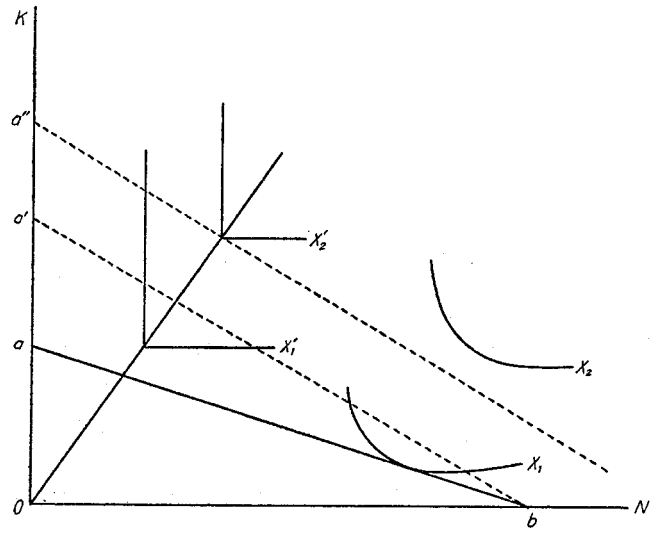

figure 6

however, cannot adopt such techniques because of the shortage of capital. So it may be more realistic to concentrate capital into a particular sector. Therefore, the figure 4 will have to be improved as follows. x_1 & x_1' and x_2 & x_2' show the same amount of products. Now suppose available sum of finance in each business is M yen involving wage funds. When the financing cost of a small business is P_k, we can get $oa=\frac{M}{P_k}$. In comparison with this if big business can use capital with lower financing cost P_k' through differencial finance, we will get $oa'=\frac{M}{P_k'}$. Moreover, if big business can use the capital $P_k'oa'$ at one time through capital concentration, the amount of products may expand to x_2'. That is to say, to use more capital with less financing cost may bring higher development by adopting capital intensive and more a productive technique in spite of low wage.

We can approve that small business developed as highly as possible through adoption of labour intensive technique which made good use of low wage under such condition as capital shortage in place of unability to use capital. Thus the economic development as a whole could be pushed forward.

III. BIASED DISTRIBUTION OF CAPITAL IN EACH SECTOR AND ECONOMIC GROWTH

In the previous chapter I have mentioned an capital intensity under labour surplus economy through static analysis. In this chapter let's examine the difference between the rate of capital accumulation and the rate of growth

through biased and equalized distribution of capital.[6] Here we set preconditions as follows. First, the capital intensive technique has higher productivity and bring a higher profit rate under the same wage rate. Secondly, the rate of capital accumulation relys on the rate of profit. Thirdly, the high rate of capital accumulation brings a higher rate of growth. These are the basic conditions and yet seem to be proper in the light of the actual. Besides, with the subsistence level of wage under a labour surplus, independent from capital intensive rate, the capital intensive technique is always more profitable. But there exists another condition. It is, if all the firms adopt the capital intensive technique with restricted capital for each period, a large number of labourers will become idle. In consideration of only manufacturing, various firms exist according to requirements by community. All of them cannot be supposed to be able to adopt the capital intensive technique. Then we can divide them into two groups: namely, big business's that use capital concentratively and small business's that depend upon low wage. You can see the relation of these two groups with figure 7.

Now suppose that the existing technique is α, the new one is β and the wage level is fixed as ow in both sectors because of labour surplus[7], then the techniques in the northeast area of point e_1 are all capital intensive and

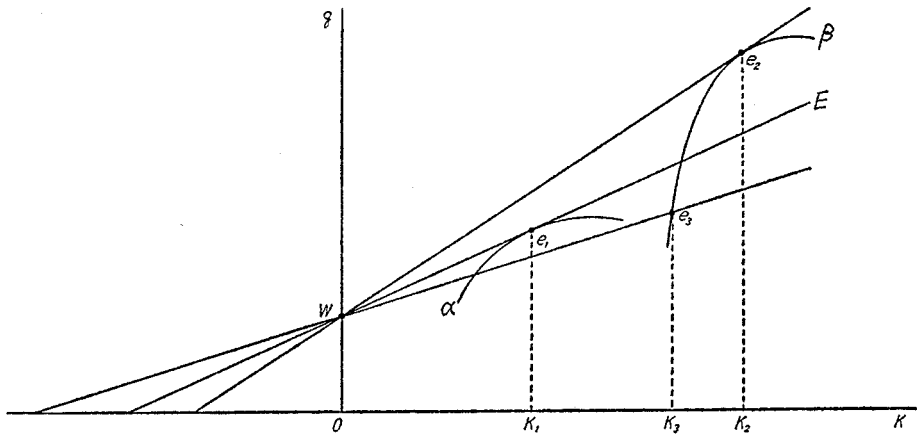

figure 7

6) These problemes are examined in the study of the development of a backward country. For example, M. Dobb, *On Economic Theory and Socialism*, 1955, chapter 7. In this book, Dobb says that the adoption of capital intensive technique of higher prodictivities brings higher development and more employment than that of labour intensive technique of lower productivities in labour surplus economy.

7) When we intend to analize the dual economy, it seems wrong to assume that the wage level is same in the two sectors. But wage difference is nothing but the result and then we must start from the point that the adoption of capital intensive technique brings higher productivities. Therefore we can suppose the wage level is constant over the whole industries.

have high productivities. The profit rate, however, can rise only when technical choice has been done in upward part of line wE. In figure 7, technique e_2 brings higher rate of profit and capital intensity is k_2. Capital stock $k\overline{N}$ is necessary to employ the existing labour force $\overline{N}$ fully by capital intensity of k_2. But if the available capital stock $\overline{K}$ at this moment is restricted and $\overline{K}<k_2\overline{N}$, capital intensity to employ $\overline{N}$ fully should be fallen. With $\overline{K}/\overline{N}=k_3$, capital intensity comes to k_3 when capital stock is destributed equally to all the firms. In this case the profit rate is the decline we_3 and it is lower than that under the existing technique. Therefore, it seems to be unprofitable to distribute capital equally.

Now in this argument we assume that capital intensity which enable us to use $\overline{N}$ and $\overline{K}$ fully is k_3. According to this, capital stock will be idle in the case of adoption of capital intensity k_1. This is so unacceptable as the discription of the economy with labour-surplus and capital-shortage. Then we put away the assumption of full employment and set the assumption always to use capital stock fully in that place. Let's suppose the existence of employment N_m that cannot be lower than it is from a social requirement even if the capital intensity is very high. Now if full employment of $\overline{N}$ is possible when capital intensity is k_1, some labourers will be idle in the case of k_3. The amount of the idle labourers is $\overline{N}-N_m$. If every firms were willing to keep k_2, the total amount of employment will be less than N_m. With the usage of k_1 and k_2 together, in other words, the biased choice of techniques, there also occurs unemployments. And we cannot say generally if the rate of unemployment is more or less than that under the equal distribution of capital. But in this case rate of profit of economy as a whole is high and in consequence both rate of capital accumulation and rate of growth are high, so the amount of unemployment may soon decrease. Here, the problem is the comparison of growth rate between the case of equal distribution of capital and inequal one. In figure 7, you can notice easily that it is clearly higher under inequal distribution.

In figure 8, α is a existing technique, each β and γ is a new technique and its technical coefficient is fixed indifferent to the proportion of factor price. Capital intensity of β and γ are k_2 and k_3, productivity are q_2 and q_3, and both of them has higher productivity and profit rate than existing technique. Capital intensity of industry by equal distribution of capital is k_3 under the condition of the restricted capital stock just as before. Which brings a higher profit rate, equal or inequal distribution of capital? In other words, which of them can bring higher accumulation and higher growth rate? That is the question here.

The group of big business wishing to adopt modern techniques can be called sector II and represented by suffix 2. At the same time the group of

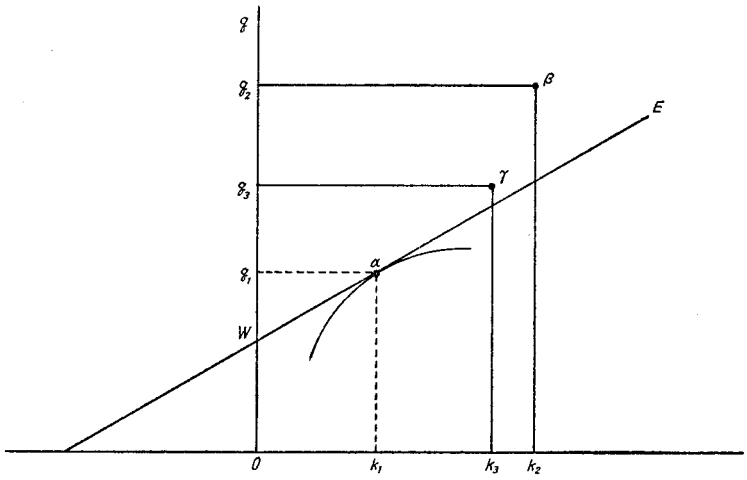

figure 8

small business in sector I and suffix 1. The amount of employment of both sectors are

$$N = N_1 + N_2$$

The capital stock K_0 equals the total sum of capital stock of both sectors.

$$K_0 = K_1 + K_2$$

Capital intensity of economy as a whole is k_0, and that of each sector is k_1 and k_2.

$$\frac{K_0}{N} = k_0, \qquad \frac{K_1}{N_1} = k_1, \qquad \frac{K_2}{N_2} = k_2$$

The total output and productivity of a country and of each sector are

$$Q_0 = Q_1 + Q_2$$

$$q_0, \qquad q_1, \qquad q_2$$

Wage rate is $\bar{w}$ and fixed. Profit rate of each sector is

$$r_1 = \frac{q_1 - \bar{w}}{k_1}$$

$$r_2 = \frac{q_2 - \bar{w}}{k_2}$$

$$r_0 = \frac{r_1 K_1 + r_2 K_2}{K_0} = r_1 \frac{K_1}{K_0} + r_2 \frac{K_2}{K_0}$$

The growth rate of the country depends on r_0, which is the total sum of the products of profit rates r_1, r_2 and rate of capital distribution in each sector.

When $r_2 > r_1$; it is quite natural that one to give much to K_2 is more profitable. But too much inclination to K_2 may lead the decrease of employment to be under N_m. Therefore $N \geq N_m$ is a limiting condition. The more $\frac{K_1}{K_0}$ becomes, the less N becomes. That is, r_0 becomes the largest when $N = N_m$.

Under equal distribution of capital, capital intensity, productivity and the profit rate is each k_3, q_3 and r_3.

$$k_3 = \frac{K_0}{N_m}$$

$$k_1 < k_3 < k_2$$

$$q_1 < q_3 < q_2$$

$$r_1 < r_3 < r_2$$

If $r_0 > r_3$, it is more profitable to adopt inequal distribution. In what case is it so?

$$r_0 = r_1 \frac{K_1}{K_0} + r_2 \frac{K_2}{K_0} > r_3$$

$$r_2 \frac{K_2}{K_0} > r_3 - r_1 \frac{K_1}{K_0}$$

$$\frac{K_1}{K_0} = 1 - \frac{K_2}{K_0}$$

$$r_2 \frac{K_2}{K_0} > r_3 - r_1 \left(1 - \frac{K_2}{K_0}\right)$$

$$r_2 \frac{K_2}{K_0} - r_1 \frac{K_2}{K_0} > r_3 - r_1$$

$$\frac{K_2}{K_0}(r_2 - r_1) > r_3 - r_1$$

Hence

$$\frac{K_2}{K_0} > \frac{r_3 - r_1}{r_2 - r_1}$$

The distribution of capital to the sector II must be larger than the ratio when the profit rate under the new two techniques come over that under old technique. Moreover, too large $\frac{K_2}{K_0}$ must not bring $N < N_m$.

$$r_2 > r_3 > r_1$$

Then

$$r_2 - r_1 > r_3 - r_1$$

Thus

$$0<\frac{r_3-r_1}{r_2-r_1}<1$$

While

$$0<\frac{K_2}{K_0}<1$$

Suppose that the difference between r_2 and r_3 is a,

$$\frac{r_3-r_1}{r_2-r_1}=\frac{r_3-r_1}{a+r_3-r_1}$$

When a is larger, the distrubution to K_2 will be more or less effective and has less probability to be under N_m. When a is smaller, the effect of inequal distribution will be less and an extremely unballanced distribution may bring $N<N_m$.

IV. EXPANSION OF EMPLOYMENT AND REDUCEMENT OF DUAL ECONOMY

The adoption of the capital intensive technique temporarily decreases the amount of employment in comparison with that of the labour intensive technique. But from the viewpoint of the future is it possible to approach to full employment? The answer is the problem of this chapter.[8]

If k_2 has been adopted once and unchangable in the long run, N_2 will expand by the same rate as the capital accumulation, but here the rate of capital accumulation is defined as sr_2, $s\cdots$ constant. In this case, the amount of employment temporarily decreases at first when capital intensity k_2 is selected and after that it clearly increases. Besides, if sr_2 is larger than the population growth rate, it will soon approach to full employment and may bring relative decreases of N_1 and absolute decrease, too. This means the modernization of all industries. Capital intensity, however, increases continuously. On this process the movement of N_2 is opened to discuss.

The movement of the amount of employment on the process of a continuous rise of capital intensity is decided by the direction of changing rate of profit accompanied with its rise. Marx said that the falling rate of profit followed by the higher development of Organic Composition of Capital. It may be possible to regard that this Organic Composition of Capital corresponds to

8) About this problem, see Kinzō Saitō, *Economic Growth and Labour Surplus, the Economic Studies Quarterly*, November, 1965 and Kinzo Saito, 'Shihon Chikuseki to Sangyō Yobigun' (Capital Accumulation and Reserved Army), *Keizai Kenkyu*, April, 1968. R. Minami, 'Economic Growth and Labour Supply', *Oxford Economic Papers*, July, 1964, as the same kind of analysis.

the degree of capital intensity. If a rise of capital intensity brings a fall of profit, the rate of capital accumulation will fall, so that the demand of labour will also decrease. Moreover, a decrease in the demand of labour will be accelerated according to increase of capital intensity. When the growth rate of demand of labour is under that of the labour force, labour surplus are not reduced but rather are increased. As long as the growth of demand of labour is over that of the labour force, labour surplus will soon be able to be reduced even when the rate of capital intensity rises.

If the growth rate of demand of labour in the modernized sector is over that of the labour force, soon or later the relative surplus of labour will be induced into this sector, and dual economy will be also reduced. Now suppose the growth rate of labour force is λ, it is necessary for us to examine the relation between λ and the rate of growth of the amount of employment in the second sector. The amount of employment is

$$N_2 = \frac{K_2}{k_2}$$

Let's assume that the profit of a sector never fails to be put into saving of its own sector, with the constant propensity to save s, the rate of accumulation in second sector will be

$$\frac{\dot{K}_2}{K_2} = sr_2$$

The time rate of change of the amount of employment depends on both that of capital stock and the capital intensity.

$$\frac{\dot{N}_2}{N_2} = \frac{\dot{K}_2}{K_2} - \frac{\dot{k}_2}{k_2} = sr_2 - \frac{\dot{k}_2}{k_2}$$

In order that the amount of employment in the second sector is positive at least, the rate of capital accumulation must be over the increasing rate of capital intensity. When the profit rate is a function of the capital intensity, the higher rate of capital intensity is chosen simply to bring a higher profit rate.

$$r = f(k), \qquad f' > 0$$

As a rise of capital intensive rate brings a rise of profit rate, it brings an increasing rate of capiatal stock, namely capital accumulative ratio, will naturally rise. Therefore, even if the level of $\frac{\dot{K}_2}{K_2}$ is lower than $\frac{\dot{k}_2}{k_2}$, the amount of employment will soon increase with sr which become longer according to the rise of k_2.

$\frac{\dot{N}_2}{N_2}$ must be over growth rate of labour force for the reducement of relative surplus of labour. Now the growth rate of labour force is λ,

$$\frac{\dot{N}_2}{N_2}-\lambda>0$$

Hence

$$sr_2-\frac{\dot{k}_2}{k_2}-\lambda>0$$

is its condition.

$$sr_2>\frac{\dot{k}_2}{k_2}+\lambda$$

$$r_2>\frac{\dot{k}_2}{sk_2}+\frac{\lambda}{s}$$

It is logical that only with the continuous capital accumulation at this rate, all the labour forces can be employed by modern sectors.

When $f'>0$, $\frac{\dot{N}}{N}>0$

When $f'>\frac{\lambda}{s}$, all the labour forces can be employed by modern sectors.

Previous examination are based on a condition that the profit of the sector are put into savings of the very sectors without leakage. But if modern sectors are much expanded by differencial finance, the demand of labour in modern sectors will naturally increase. Then in what way can the new capital over sr_2K_2 be financed? The sources are nothing but these two; namely, profit of another sectors and individual saving. Labourers cannot afford to save only with the wages of subsistence level. But if taxes are put on them and actually financed to big business through public sector or financed at a certain extent through creation of credits of banks, big business can invest over sr_2K_2.

Now suppose that the degree of dependence on external finance is α per cent of self finance, rate of capital accumulation will be

$$(1+\alpha)sf(k_2)$$

Hence you can see that the rate of expansion of modern sector is more than self accumulative rate. If $f(k_2)>\frac{\lambda}{(1+\alpha)s}$, relative surplus of labour will be able to be induced into modern sectors. In our country the ratio is very high and this condition may be said to accelerate the increase of demand of labour in modern sectors.

V. THE PROBLEM IN THE PROCESS OF REDUCEMENT OF DUAL ECONOMY

As I mentioned the preferential expansion of modern sector with differential finance seems to make N_2 increase and soon bring the movement of labours from N_1 to N_2, and finally to reduce dual economy. Though the wage rates of both sectors have been regarded as the same until now, an increase of r_2 has the wage of second sector possible to rise and will bring the difference with wage rate of first sector at the subsistence level. The movement from N_1 to N_2 will soon induce the rising of wages in the first sector.

Here the movement of the first sector in a dual economy should be clear. Capital intensification is brought about essentially by differential finance. So it is impossible to modernize only by saving. If the modernization depends on only differential finance, the first sector of usual low wage will be checked to modernize, and the modernization itself will be impossible. An increase in the demand of labour will include the relative surplus of labour and rise the wage level. In this case higher capital intensive technique will be required. But the self-accumulative rate is too small to do so. Moreover, the first sector involves the important parts of economic activities, so a conversion to the second sector is not possible. It can be said that the most important problem in the process of reducement of dual economy is the modernization of disadvanced sectors.