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(Revised)

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by Ryoshin Minami*

This paper attempts to discover at what point in her long process of economic development Japan ceased to have available unlimited supplies of labor. This point has been labeled in some economic development models -- the turning point.[1] This is a controversial issue: W. A. Lewis, who originally set forth the concept and the theory of the turning point, suggested that Japan would reach the turning point sometime in the 1950's [9, p. 29]. J.C.H. Fei and G. Ranis, developing a more refined version of Lewis' theory, applied it to the Japanese economy and concluded that the turning point was already reached by the end of World War I [2, p. 263]. These findings were criticized by D. W. Jorgenson, however, who claimed that unlimited supplies of labor defined in the Lewis sense were not found in even the pre-World War I period [6, pp. 59-60]. On the other hand, among Japanese economists, K. Ohkawa in particular [21, p. 484], the view seems to be dominant that the turning point has occured only since the end of World War II. Usually cited in support of such a view are: 1) the recent unprecedented changes in the labor market; 2) the absolute decrease

*The author is assistant professor of economics at Hitotsubashi University in Tokyo, Japan. This article was prepared while he was at the Economic Growth Center, Yale University for the academic year 1966-1967. He has been obliged to some colleagues in Hitotsubashi and Yale Universities. Thanks in the first place are due to Professor Kazushi Ohkawa. This work stems from earlier collaborations with Ohkawa, and some discussions appearing in this article are based on notes prepared jointly by Ohkawa and the writer. The analyses and conclusions contained here, however, are the sole responsibility of the present writer. Also he is very much indebted to the comments by Professors Albert Berry, Donald L. Huddle, Hiromitsu Kaneda, Hugh T. Patrick, and Mataji Umemura. And grateful acknowledgement is due to Mr. Gary Saxonhouse for discussions and editing the English in this article.

[1] This is called 'commercialization point' by Fei and Ranis [2, p. 202].

in the number of agricultural laborers, 3) the decrease in the wage differentials between manufacture and agriculture and between the large and small scale factories in manufacture, and so forth. However, no systematic attempt has been made to conclusively date the Japanese turning point. In Section I of this paper, by theoretically examining the concept, I will stylize some features of the economic transition around the turning point. This is an indispensable procedure in finding the turning point in the process of economic development. This stylization will be contrasted with available empirical evidence[2] in Section II. The last part of this paper (Section III) will be devoted to summarizing the discussions in Section II. Some critical comments will also be made on the statistical findings by Fei, Ranis and Jorgenson.

I. Concept and Features of the Turning Point

A. What Is the Turning Point

The turning point is defined as the point of time in the process of economic development[3], which demarcates the boundaries of the stages of unlimited and limited supplies of labor. To explain what is meant by unlimited and limited supplies of labor,[4] we set forth a model which includes two sectors, the capitalist sector and the subsistence sector. In the former sector, capitalists, using the available capital stock and labor force, carry out the production process so as to maximize their individual profit rates. Equilibrium is attained, following the familiar marginal productivity of labor.

[2] Almost all statistical data used in this article are taken from the results of the Hitotsubashi project of estimating long-term economic statistics in Japan sponsored by the Rockefeller Foundation. These results are being published as the Chōki Keizai Tōkei (Estimates of Long-Term Economic Statistics of Japan since 1868) in thirteen volumes. (E.g., [11], [24], [25] and [34].)

[3] The turning point is defined theoretically as a point of time. In reality, however, it should be regarded as a period of some years.

[4] This was fully discussed by Ohkawa and the present writer [22].

On the other hand the subsistence sector is characterized with the classical wage theory; the wage rate here is institutionally determined as some subsistence level.[5] This in turn means that entrepreneurs in the capitalist sector can employ the labor force at the constant wage rate. (The residual labor force is absorbed in the subsistence sector.)[6] Assuming for simplicity, that the whole labor force is originally supplied from the subsistence sector, the supply function of labor force facing the capitalist sector is given by the subsistence level.[7] Mathematically the elasticity of the labor supply with respect to the wage rate is infinite. This is the precise expression of the unlimited supplies of labor condition. It is important to note that this manner of wage determination will last only so long as the marginal productivity of labor in the subsistence sector is lower than the subsistence level.[8]

On the other hand, once the marginal productivity is equal to or rises above the subsistence level, the former determines the wage rate in what was

[5]It should be noted that we don't need at all the assumption of zero marginal productivity of labor. The marginal productivity can be positive, zero and negative. The only assumption needed is that it be lower than the subsistence level. In this sense the concept of unlimited supplies of labor is quite different from the concept of disguised unemployment as established by R. Nurkse.

[6]Thus when discussing the labor surplus economy there is no need to talk of Keynesian type unemployment, because the unemployment occuring in the capitalist sector in a depression is absorbed in the subsistence sector.

[7]The subsistence level may be defined as the minimum price of labor supply, in the sense that laborers don't want to work if their wages are less than this level. Lewis' notion of the subsistence level is not identical with the concept used by the classical economists: Population increase is possible in the former case, and it is impossible in the latter case, if actual wages are equal to the subsistence level. In this sense, a Lewis-type theory of economic development is closer to Marxian theories than to classical economics. (Lewisian theory as well as Marxian theory deny the population principle. This principle is one of the most fundamental assumptions in the classical economics.)

[8]To make the model more realistic a differential between the subsistence sector and capitalist sector wages may be assumed. This wage differential serves as the incentive continually drawing labor from the subsistence sector to the capitalist sector.

once the subsistence sector. In this case and under the assumption that all labor is supplied from the subsistence sector, the marginal productivity of labor function in this sector forms the supply function of labor to the capitalist sector. Labor supply, in our sense,of course, is no longer unlimited. It is limited in the sense that capitalists can no longer employ any desired number of workers at a constant wage rate. In a word, the elasticity of labor supply is now between zero and infinity.

In the above we assume that the subsistence level is constant over time. This level is historically and institutionally determined by the cost of living. In cases where the standard of living increases in accordance with certain changes in institutional framework, the subsistence may rise.[9] As long as we assume, however, that the subsistence level increases independently of the increase in productivity in the subsistence sector, the above theory stands unaltered.[10] The labor supply curves for the stages of unlimited and limited supplies will still have infinite and less than infinite elasticities respectively.

Next, we ask how can the economy move from the stage of unlimited supplies to the stage of limited supplies. The necessary condition for this is an increase in the marginal productivity of labor in the subsistence sector. The latter may be realized in two ways: The first way involves upward shifts in

[9]The increasing subsistence level was admitted even by classical economists: Ricardo, whose theory makes use of the Malthusian population principle, claimed that the natural price of labor was dependent on "the quantity of food, necessaries and conveniences essential to him from habit" [29, p. 93]. The quantity of necessaries and conveniences increases in the course of cultural development. (Concerning this, the writer is obliged to Professor Ryozaburo Minami.)

[10]This point was strongly stressed by Ohkawa and the present writer [22, Sections I and II].

the marginal productivity curve, caused by an increase in inputs other than labor and/or the shifts in the production function (this may be called technological progress). The second is through a decrease in the number of laborers in this sector. The decrease may be due to demographic factors and/or to the increase in the outflow of labor to the other sector. The latter is dependent upon increase in the demand for labor in the capitalist sector. In any event, as soon as the marginal productivity exceeds the subsistence level; i.e., the turning point is passed, the wage rate in the subsistence sector begins to rise steadily. The elasticity of labor supply will now decrease.[11]

B. How to Find the Turning Point

The above is a most simple and sketchy formulation of the Lewis-type theory of economic development with the turning point. In confronting the theory with the real world we must examine certain aspects of the process of economic development around the turning point.

1. Changes in Real Marginal Productivity of the Subsistence Sector

The turning point cannot be realized without a steady increase (exceeding the increase in the subsistence level) in the marginal labor productivity of the subsistence sector (MP_s). Therefore we find it reasonable to expect that the real marginal productivity in this sector will be comparatively stagnant in the stage before the turning point with a large increase occurring about the time of the turning point. That the path of real marginal productivity will have this pattern, however, is not a strict implication of the theory of the turning point.

2. Changes in Real Wage Rate of the Subsistence Sector

The real wage rate in the subsistence sector (W_s) is expected to be quite

[11] See 10, Section III.

stable before the turning point, after which time it may be expected to show a large increase. In this respect, however, recall that the subsistence level is not constant. One of the difficulties of trying to identify the stage of unlimited supplies of labor as a historical period, as opposed to a theoretical entity, is now apparent. When there is an increasing tendency in real wage rate, we cannot ascertain straightforwardly whether that increase comes from a change in the marginal productivity of labor or from an increase in the subsistence level itself. Rather than ignore wage data entirely we will assume, in examining what evidence we have at our disposal, that while small increases in the real wage rate (W_S) over time may be the result of changes in the level of subsistence, persistent large changes quite likely mean that the stage of unlimited supplies has already ended.

3. Relationship between Real Wage Rate and Real Marginal Productivity of the Subsistence Sector

In the stage prior to the turning point, the real wage rate has no relation with the real marginal productivity of labor in the subsistence sector. Therefore, in estimating the linear equation below,

$$W_s = a + b\ MP_s,$$

coefficient 'b' is expected to be zero. On the other hand, in the succeeding stage, with W_s is equal to MP_s, the equation above should show a good fit. Constant 'a' should be zero; coefficient 'b' should be unity.[12]

These are strict tests of the subsistence wage theory and the marginal productivity theory. However, these tests might be too rigid for our purposes. In the first place, W_s and MP_s increase, as stated above, even in the stage of unlimited supplies of labor. Hence, in our time series data we might expect some correlation between them. Secondly, in the stage of limited supplies of labor,

[12]This test was applied to Egyptian agriculture by B. Hansen [7].

wage increases may lag somewhat behind productivity increases. Hence, even if they are not equal to each other ($a \neq 0$ and $b \neq 1$), marginal principle can hardly be rejected when there is a good correlation between them. Thirdly, there are the data problems. One problem involves the difficulty of estimating MP_s. MP_s is a product of the real average productivity (AP_s) and the output elasticity of labor in the subsistence sector. The former is rather easily obtained. But it is difficult to estimate the output elasticity. In some cases, therefore, one cannot help but assume a constant output elasticity over time. One other difficulty involves the measurement of W_s and MP_s in comparable flow units. This problem arises because of the lack of reliable data on working days, working hours and so forth. Taking into consideration all these problems it seems that to use a criteria which purported to make a very fine discrimination would be misleading. Hence, if we should find below that the correlation coefficient between W_s and MP_s is much higher in a later period than in an earlier period, we will call the former period a stage of limited supplies of labor and the latter period a stage of unlimited supplies of labor (assuming, of course, that our other evidence is consistent with this determination).

4. Elasticity of Labor Supply to the Capitalist Sector

Our formulation of Lewis' theory indicates that the elasticity of labor supply to the capitalist sector (η) is infinite before the turning point and becomes smaller thereafter. The elasticity is defined as below:

$$\eta \equiv \frac{\frac{dL_c}{L_c}}{\frac{dW_c}{W_c}},$$

where L_c and W_c denote respectively the size of the labor force and the real wage rate in capitalist sector. Here recall the assumption that the whole labor force is supplied from the subsistence sector. In reality, however, there is some labor in the capitalist sector supplied from its own resources. Under this condition, η does not show the elasticity of labor supply from the subsistence sector to the capitalist one. The true elasticity (η') should take the form of

$$\eta' \equiv \frac{\frac{dL_c'}{L_c'}}{\frac{dW_c'}{W_c'}}$$

L_c' is the number of laborers, originally supplied from the subsistence sector to the capitalist one, and dL_c' is the net outflow of labor force from the subsistence sector, call dL_c', M. L_c' is the sum of M for the period from the beginning of the capitalist sector to the present time. W_c' is the real supply price of subsistence sector labor relevant for the capitalist sector. Here, let us assume, supply price (W_c') is equivalent to (or changes proportionately to) wage rate in the subsistence sector (W_s).[13] Now η' may be rewritten as follows;

$$\eta' \equiv \frac{\frac{M}{L_c'}}{\frac{dW_s}{W_s}} .$$

The average elasticity may be obtained by estimating the following equation;[14]

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[13] See footnote 8.

[14] Strictly speaking, the estimate of η' in this equation is not necessarily the elasticity of labor supply. That is, the equation cannot be always identified as the supply function. Under the assumption that the supply function is more stable than the demand function, however, the estimate for η' can be regarded as the elasticity of labor supply. Owing to the effect of ongoing capital formation and technological change on the demand for labor function, it would seem that this assumption is appropriate.

$$L_c' = A\, W_s^{\eta'},$$

or

$$\log L_c' = \log A + \eta' \log W_s,$$

where A is a constant term. Examining the changes in such estimates of η' might enable one to locate the turning point. Here again, however, there is a problem; as mentioned above, a part of the increase in W_s is caused by the increasing subsistence level. Therefore the safest approach again may be to look for a large decline in η'. Quite likely a large decline means that the economy is passing the turning point.

5. Changes in Employment Structure

In item 1, a large increase in the marginal productivity of labor in the subsistence sector was taken as one of the features of the turning point. The large increase comes from the shifts in the labor productivity schedule, and/or the declines in the number of laborers in this sector. We will consider large, sustained decreases in the subsistence sector labor force as additional evidence that the economy is approaching or has passed the turning point.

II. Statistical Tests on the Turning Point

In this section we will attempt to find the turning point in the Japanese economic development. In Japan, the subsistence sector comprises almost the entire agricultural sector as well as most small scale enterprises in non-agricultural industries. Unfortunately statistics on the latter are quite poor. For this reason, we consider agriculture (or primary industry) as a proxy for the subsistence sector. Our tests will be attempted in the order and manner described in the previous section.

A. Changes in Real Marginal Productivity in Agriculture

In Table 1 and Chart 1, the figures for real labor productivities in agriculture, both average and marginal, are shown.[15] (The method by which these figures were estimated is summarized in the footnote to the table.) It will be noticed that the marginal productivity moves in parallel with the average productivity for the prewar years [owing to our assumption, (not theoretical but statistical), of constant output elasticity of labor], in the postwar period it grows somewhat more rapidly. We should remark on two things here. First, from our data it appears that after around 1916 the growth rate of the marginal productivity of labor slowed down considerably. We calculate the annual compound rates of growth by fitting a function, $\log MP_s = a + b\ t$ to annual statistics. 1.9 percent and .75 percent are the rates respectively for the periods 1874-1916 and 1917-1940.

Table 2 gives the figures for the capital-labor ratio and the fertilizer input per capita in agriculture. The annual compound rates of growth of the former are .27 percent and .31 percent respectively for 1878-1882 and 1913-1917 and for 1938-1942. For the latter, they are calculated as .72 percent and .88 percent respectively for the two periods. Growth rates in the input ratios are rather higher in the years after 1913-1917. This means that the sharp kink in around 1916 cannot be explained by changes in the input ratios. However, either of the following two factors might explain it. First, our series of agricultural output may be biased downward. This series was constructed relying mostly on the official statistics for agricultural output. According to J. Nakamura, these statistics are very much under-enumerated in the early years

[15] Labor productivity should be measured in terms of labor hours or labor days. As we have no reliable statistics for working days covering both pre and postwar periods, we must use man-years in our denominator.

Table 1: Average and Marginal Productivity in Agriculture; 1934-1936 Prices

(Unit : Yen)

Year	Average Productivity[a]	Marginal Productivity[b]
1874	73	18
1880	86	21
1885	103	25
1890	112	27
1895	119	29
1900	123	30
1905	118	28
1910	140	34
1915	168	40
1920	179	43
1925	181	43
1930	191	46
1935	181	43
1940	196	47
1950	152	58
1955	202	93
1960	236	127
1963	256	162

[a] The ratio of value added gross of depreciation in agriculture[16] deflated by agricultural price index (1934-1936 = 1) to the size of agricultural labor force.

[b] Average productivity multiplied by the output elasticity of labor in agriculture.

[16] While net value added might be better for our purpose, we use gross value added figures, because of the deficiencies in the estimation of depreciation.

Table 1: Average and Marginal Productivity in Agriculture; 1934-1936 Prices

Sources

Gross Value Added and Agricultural Price Index: Yamada's estimates (linked index) [34, pp. 164-182].

Labor Force: The writer's estimates [12, p. 278].

Output Elasticity of Labor, Prewar Period: A constant figure (.240), the estimate made by K. Ohkawa [19], is assumed for the entire period.[17] This is the weighted average of output elasticities in rice production (.234) and in barley, wheat and rye production (.299). Weights used are values of rice, barley, wheat and rye production. The former elasticity is the average of the figures for 1937-1939, and the latter, for 1940-1941. Cross-sectional data were used by Ohkawa to fit the Cobb-Douglas production function from which the elasticity estimates were taken.[18]

Output Elasticity of Labor, Postwar Period: The following is an estimate of the output elasticities of labor by Y. Yuize [37, pp. 17-22]. He obtained these by using cross-sectional data to estimate Cobb-Douglas functions.

	A	B
1952	.4118[19]	.5618
1958	.5110	.6972
1960	.5396	.6977
1962	.6018	.6478

Figures in Column A are the estimates, when the size of labor force is used as labor input. Figures in Column B, the estimates when labor hours are used.[20] In this paper estimates A are adopted, because our concept of average productivity is defined in terms of the size of the labor force. For the years 1953-1957 and 1959-1961, output elasticities are estimated by the method of linear interpolation. For the years 1950-1951 and 1963, they are obtained by extrapolation.

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[17] The assumption of constant output elasticity is simply the result of our having only one cross-section estimate of the production function of prewar agriculture. As there was little change in the organization of agricultural production for the prewar years [27, p. 67], our assumption may, in part, be justified.

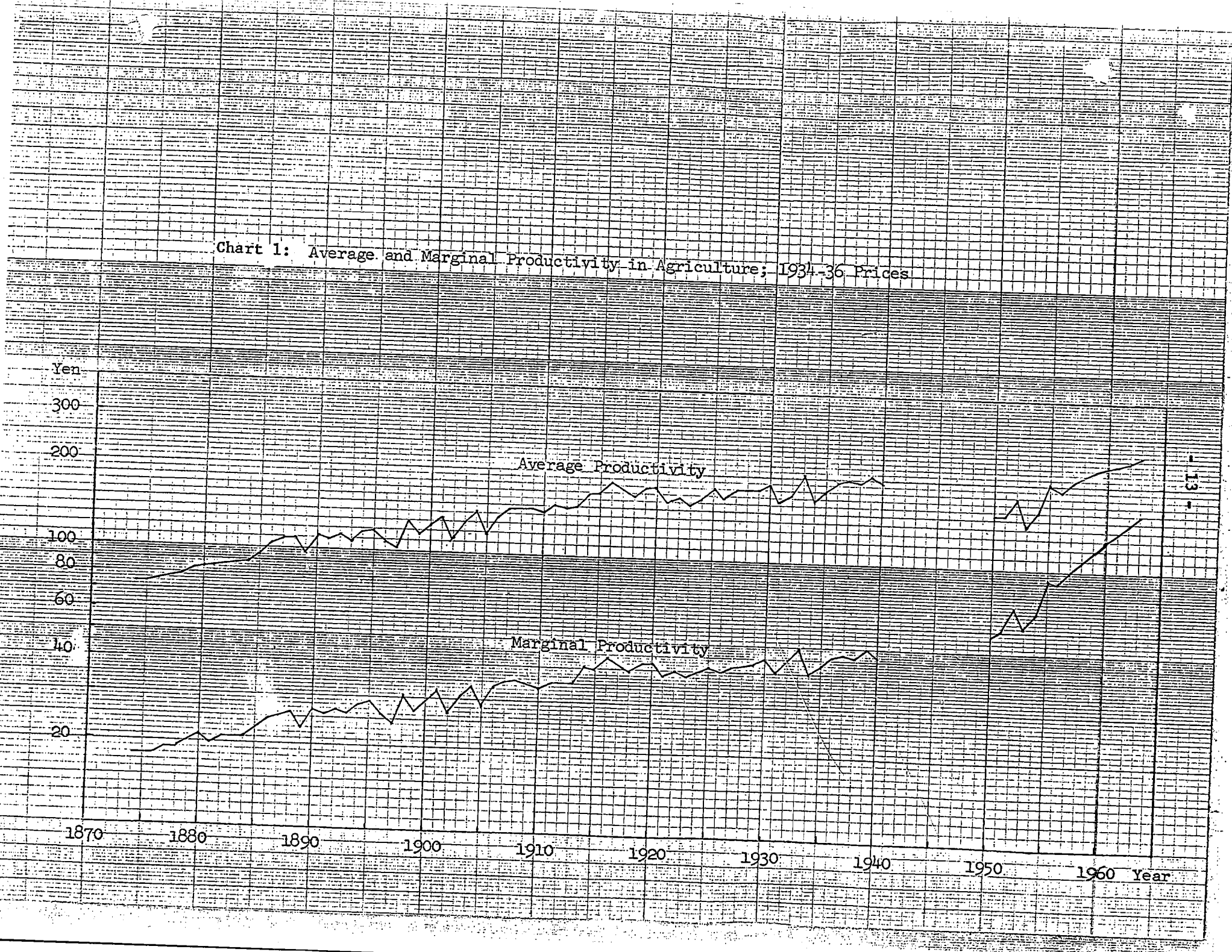
[18] The other inputs in this estimation are land and capital. The output elasticities of land and capital are respectively .562 and .183 for rice production. (They are the averages of the estimates for 1937-1939.) For barley, wheat and rye, they are respectively .335 and .389 (the averages of the estimates for 1940-1941). Therefore, the sums of the output elasticities for labor, land and capital are .979 and 1.023 respectively for rice production and barley, wheat and rye production.

[19] The original estimate by Yuize for this year is .6906 [36, p. 17]. In comparing this estimate with the estimates for other years in Column A and the estimates in B, it seems that this estimate is not reasonable. Therefore, as a substitute for this, the figure .4118, being estimated by linking it with the figures in Column B; that is,

$$.5110 \times \frac{.5618}{.6972} = .4118,$$

is used in this paper.

Chart 1: Average and Marginal Productivity in Agriculture; 1934-36 Prices



[17, Chapters 2-4].[21] If this is true, the contrast between the two periods is far less striking. Second, and more important, food imports from Taiwan and Korea expanded in the 1920's. These food imports, which satisfied most of the increase in demand for agricultural products after 1920, were supposed to have had an unfavorable impact on Japanese agriculture.[22] This factor has been stressed by K. Ohkawa and H. Rosovsky [26, Section VI] and B. Johnston [5, pp. 242-43].

Since the end of World War II we find a spurt in the rate of growth of the marginal productivity of agricultural labor. The annual compound rate of growth when calculated is 8.2 percent.[23] This is about 4 and 11 times the growth rates respectively for the years before and after 1916. This spurt is the consequence, in part, of the unprecedented decrease in the number of agricultural laborers; as is stated later, this remarkable decrease began only in the 1950's. Another important factor has been the relative increase in non-labor inputs in agricultural production. Capital intensity and fertilizer input per capita as we see in Table 2 have shown remarkable increases in the postwar years; the annual compound rates of growth for them are respectively 2.1 percent and 4.5 percent for 1948-1952 and 1958-1962. Comparable prewar growth rates are 1/8 to 1/6 times as large. As far as the technological progress is

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[20]The inputs are land and capital. The sums of output elasticities for labor, land and capital are as follows:

	A	B
1952	1.0098	1.1498
1958	1.2626	1.2003
1960	1.0750	1.1973
1962	1.1697	1.2057

[21]Nakamura has made new estimates of real agricultural output, depending on three alternative assumptions on paddy rice yields [17, Chapter 5]. However, the assumptions are quite arbitrary, so the results of estimation do not seem to be good enough for use in analysis. Also see footnote 51.

[22]The relation between retardation in agricultural productivity and food imports is, of course, not quite so simple: The former is a cause as well as a consequence of the latter.

[23]The annual compound rates of growth in average productivity of labor are 1.9 percent, .75 percent and 4.5 percent respectively for 1874-1916, 1917-1940 and 1950-1963.

Table 2: Capital-Labor Ratio and Fertilizer Input Per Capita in Agriculture

(Unit : Yen)

Year	Capital-Labor Ratio[a]	Fertilizer Input Per Capita[b]
1878-1882	315	17.9
1883-1887	321	18.5
1888-1892	328	18.8
1893-1897	339	20.3
1898-1902	346	21.9
1903-1907	358	23.4
1908-1912	378	28.4
1913-1917	392	31.9
1918-1922	402	35.8
1923-1927	411	40.4
1928-1932	430	45.0
1933-1937	444	48.9
1938-1942	451	52.8
1948-1952	382	45.0
1953-1957	455	82.1
1958-1962	621	126.3

[a]Gross capital in 1934-1936 prices divided by the size of labor force.

[b]Fertilizer input in 1934-1936 prices divided by the size of the labor force.

Sources: Gross Capital Stock: Umemura and Yamada's estimates [24, pp. 154-55].

Fertilizer Input: Hayami's estimates [34, pp. 186-87].

Labor Force: See Table 1.

concerned, the spurt may be found again in the postwar period. H. Ueno and S. Kinoshita's analysis shows that rates of technological progress in agriculture are .4 percent and 3.0 percent respectively for the pre and postwar periods [32, p. 44].[24] The spurts in capital intensity, fertilizer input per capita, and technological progress for the postwar years may well explain the spurt in labor productivity. The large increase in the marginal productivity for the postwar years, especially after 1953, suggests that the turning point can be found in some span of postwar years.

B. Changes in Real Wage Rate in Agriculture

As a substitute for wages in subsistence sector, W_s, we use here wage rate or the daily wages for daily workers in agriculture. Takamatsu's estimates which we use are based on the Nōshōmu Tōkei (Agricultural and Commercial Statistics) and the Nosaki Yatoi Chingin Hyō (Statistics of Agricultural Employment) for the prewar, and the Nōson Bukka Chingin Chōsa (Survey on Prices and Wages in Agriculture and Forestry) for the postwar. This necessity creates some problems. What is the reliability of these statistics? For the postwar years there is a good relationship between the data we plan to use and data calculated from other official statistics.[25] No such supplementary data are available for

[24] H. Kaneda calculated the rate of neutral technological progress in agricultural production for 1952-1960 by size of operation of farm households. The average is about 3 percent [8, p. 169]. This is very similar to the results of the Ueno and Kinoshita's estimation.

[25] The following are the ratios of the wages per day for male daily agricultural workers to the hourly wages for temporary agricultural workers, which are calculated from the Nōka Keizai Chōsa.

1952	20	1958	21
1953	19	1959	22
1954	21	1960	20
1955	21	1961	21
1956	20	1962	21
1957	22	1963	19

Ratios are quite stable for the entire period. (The latter wage data was obtained by dividing annual wage payments by labor hours per year for temporary workers.)

the prewar period.[26] Hence, we must assume on the basis of our experience a modicum of reliabiiity for our data and use them anyway. Another problem is the appropriateness of this data for the problem at hand. In Japan the majority of agricultural workers are unpaid family workers. Wage workers, with whom these data are concerned, are only a small proportion of this labor force. We feel we can use this data, however, as we are ready to make the necessary assumption that the implicit wages which unpaid family workers receive are equal to or are invariably a constant proportion of the wages of daily workers. In Table 3, the quinquennial figures for the wage rate for male workers deflated by two kinds of deflators, (consumer price index and agricultural price index), are shown. Chart 2 shows the annual figures for them. We use data for male workers only because 1) wage rates by sex are highly correlated with one another and 2) in the writer's opinion the data are much better for male wages.

Let us examine first, the changes and the trend in the wage rate deflated by the consumer price index.[27] As far as the prewar years are concerned, the most striking change is a big wave for the years from 1917 to 1931. A spurt for 1917-1818 was caused by an increase in demand for labor, the result of the accelerated increase in economic activities. The years from 1919 to 1931 on the other hand, were the longest period of declining general prices in the modern Japanese economic experience. Nonetheless, as a result of downward rigidity in nominal wages[28] combined with declining prices the decrease in the real wage

[26] It is not impossible to estimate labor income in agriculture as a residual from total agricultural income and to check our wage data with it. As is stated in Section III, the estimation for labor income is confounded with many problems.

[27] For a test of the subsistence wage theory, the consumer price index is a more appropriate deflator of the wage rate than the agricultural price index.

[28] It seems to be very difficult to acknowledge the downward rigidity in nominal wages in the labor surplus economy. In the writer's opinion, however, the rigidity is not inconsistent with the hypothesis of unlimited supplies of labor.

Table 3: Daily Wages in Agriculture; 1934-1936 Prices

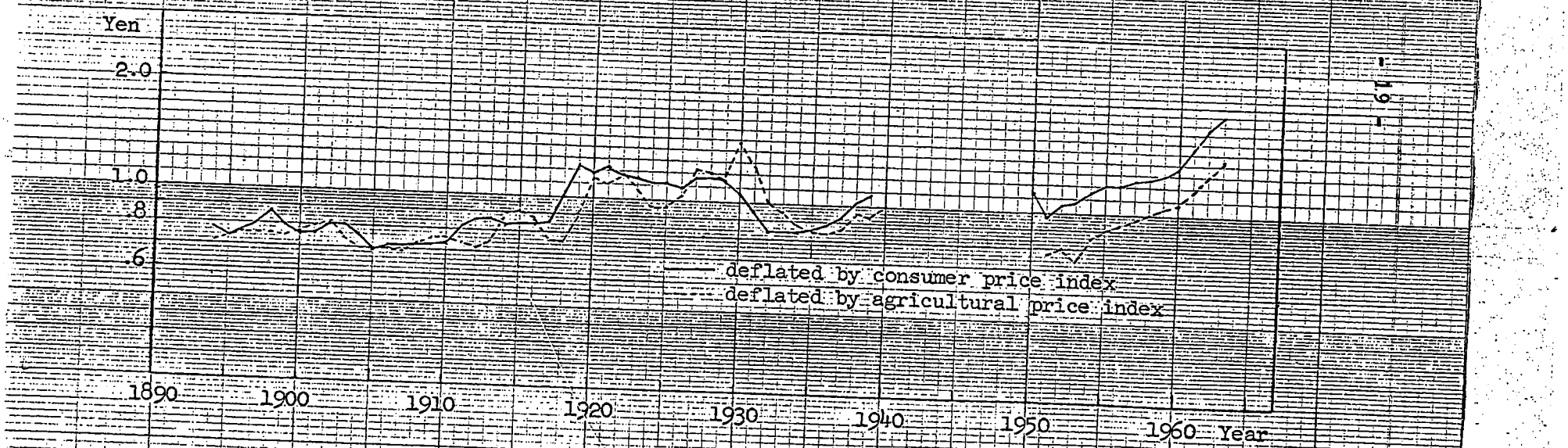
(Unit : Yen)

Year	Daily Wages [a] Deflated by Consumer Price Index	Daily Wages [a] Deflated by Agricultural Price Index
1895	.74	.74
1900	.75	.77
1905	.69	.70
1910	.73	.76
1915	.83	.91
1920	1.18	1.12
1925	1.11	.97
1930	1.06	1.49
1935	.86	.85
1940		1.00
1950	1.13	.97
1955	1.20	.90
1960	1.34	1.07
1963	1.90	1.46

[a]For daily workers in agriculture. For male only.

Sources: Wage Rate: Takamatsu's estimates [25].
Consumer Price Index: Yamada's estimates [25].
Agricultural Price Index: See Table 1.

Chart 2: Real Wage Rate in Agriculture; 1934-36 Prices



Source; Table 3.

rate was not remarkable until 1930. Remarkable declines in real wage ratio did occur in the years after 1930. (As a result of this big decline, the level of the real wage rate in 1932 is almost the same as the 1916 level.) If we exclude the price declining years (1919-1932) as an exceptional period of Japanese economic development, we find a pretty constant trend in the real wage rate for the prewar years. By fitting a semi-log equation of the wage rate and time element, we obtain an average annual compound rate of growth of .52 percent.

On the other hand, for the postwar years, the reader will see at a glance a steady and remarkable increase in the real wage rate, especially after 1953. The annual compound rate of growth for the years from 1953 to 1963 is 5.0 percent. (For 1951-1963, it is 4.2 percent.) This is about ten times the growth rate for the prewar period. More important, from the point of view of pre-postwar comparisons, the real wage rate for the postwar shows an increasing trend even in the recession years after 1961. This is not the case for prewar years, where the real wage rate declined during such price declining years. The same observations may be made for the wage rate series which has been deflated by the agricultural price index. Again the increase is small for the prewar period and remarkable for the postwar period, especially after 1953.[29] Following our criteria outlined earlier, a big increase in the real wage rate in agriculture since the end of World War II suggests that the turning point has been passed only in the postwar years.

In concluding this section, two problems remain to be answered. The first problem concerns the large upward swing in real wages during 1917-1919. Does

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[29]The annual compound rates of growth in the wage rate in agriculture deflated by agricultural price index are .54 percent and 5.7 percent respectively for 1894-1940 excluding 1919-1932, and for 1953-1963. (For 1951-1963, 4.1 percent.)

this mean the turning point was reached during these years? I doubt it. In the extraordinary two-three year boom during and after World War I, it is quite correct to say that labor supply became somewhat less than infinitely elastic. But a situation approximating the phase of unlimited supplies returned with the subsequent downward phase of economic growth. Recall here that the turning point is not a swing phenomenon, but a long term historical event in the process of economic development. Hence, we do not believe that we can consider the turning point as having been passed in the 1917-1919 period. On the other hand, we do believe that the recent sharp increase in wages does constitute evidences that the turning point was passed in the postwar period: The sharp increase even in the recession years suggests that it is undoubtedly a trend phenomenon.[30]

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[30] Here it may be of use to refer to the changes in wage differentials between agriculture and manufacture. For the prewar period, as has been fully discussed by K. Taira [30, Section II], the ratio of manufacturing to agricultural wages increased and decreased respectively in the downward (1919-1931) and the upward swings (since 1932) of economic fluctuations. For the postwar, however, it has continued to decrease even in the recession years since 1961, after a rather constant trend for 1951-1960. This is a new experience for Japan. (This point was called to the writer's attention by K. Ohkawa.) In connection with this, the changes in the wage differential among enterprises by scale are also suggestive. In the ratio of total cash wage earnings for the manufacturing factories with 5-29 workers to the wage bill of factories with 500 or more workers;

1958	43.6
1959	44.3
1960	46.3
1961	49.3
1962	57.0
1963	58.1,

one can see a steady increasing trend for the entire period including recession years. (Data is from the Maigetsu Kinrō Tōkei (Monthly Labor Statistics) [15, p. 328]). The continuous decrease in the wage differentials between two sectors as well as among enterprises by scale may suggest that surplus labor in the subsistence sector has been disappearing. (Ohkawa expressed the same opinion [21, p. 484]).

C. Relationship between Real Wage Rate and Real Marginal Productivity in Agriculture

The large increase in the real wage rate in agriculture since the end of the war corresponds to the increase in the marginal productivity of labor in this sector. This correspondence suggests the applicability of the marginal productivity theory to postwar Japanese agriculture. Let us examine the relationship in more detail. For this purpose the wage rate deflated by the agricultural price index is a better index that the wage rate deflated by the consumer price index. The relationship between the real wage rate and the marginal productivity of labor[31] is plotted in Chart 3. For the prewar years no good relation exists. Regressing linearly the real wage rate on the marginal productivity, a coefficient of determination adjusted by degree of freedom, $\bar{r}^2$, is calculated as .32. Excluding price declining years, 1919-1931, $\bar{r}^2$ becomes .56. Does this correlation mean that Japanese agriculture was already capitalized even for the prewar period? Let us examine the correlation for the postwar period. The estimate of $\bar{r}^2$ is .94 for the period 1951-1962.[32] This is extremely high compared with the estimate for the prewar years. This difference in the degree of correlation suggests, following the discussions in the previous section, that the turning point was passed in the postwar years.[33]

D. Elasticity of Labor Supply from Primary to Non-Primary Industries

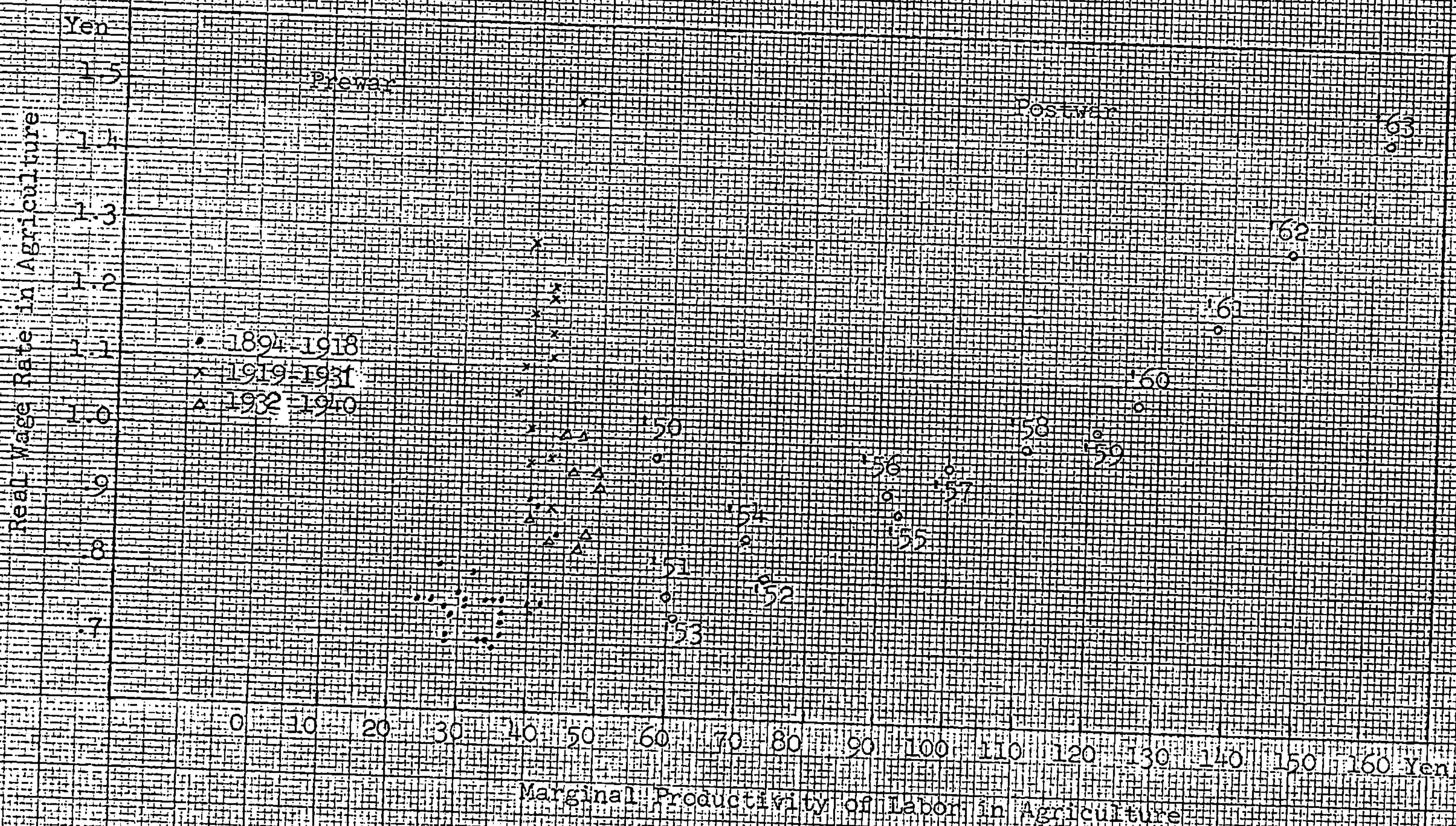
In this section we substitute primary and non-primary industries respectively for the subsistence and capitalist sectors. That is, M, in the definition equation of η' established in the previous section, is now the annual net outflow of labor

[31] See footnote 14.

[32] The year 1950 was omitted in this estimation, because the point for this year is far away from the regression line for the succeeding years.

[33] A cross-sectional test of the marginal productivity theory will be attempted in Appendix A.

Chart 3: Relation between Real Wage Rate and Marginal Productivity in Agriculture



Sources: Tables 1 and 3.

force from primary industry; L_c' is the non-primary labor force originally supplied from primary industry, and W_s is the wage rate in agriculture deflated by consumer price index. Figures for M are given in Table 5. With the aid of these figures estimates for L_c' are obtained.[34] In Chart 4 log L_c' is regressed on log W_s. The slope of this regression, elasticity of labor supply from primary to non-primary sector, is not constant over the entire period covering the pre- and postwar years: The prewar years may be divided into some sub-periods. The first sub-period is from 1894 to 1903, in which no significant relationship is found. For the second period, 1904-1918, the elasticity is calculated as .65. For the third period, 1919-1931, the elasticity is negative. Declining prices and the downward rigidity of nominal wage rate accounts for this. The fourth sub-period, 1932-1939, shows a positive elasticity. Strictly speaking this period should be divided in two, 1932-1936 and 1937-1939. The elasticity for the former period is 1.2. For the latter it is much smaller than this. For the postwar year a kink in this regression occurs in 1960. Elasticities are 1.2 and .32 respectively for 1951 -1960[35] and for 1961-1963. Excluding the periods 1919-1931 and 1937-1939 as exceptional, the former is a price declining period and the latter is a war time period, the elasticity for 1961-1963 contrasts with the estimates, from .65 to 1.2, before 1960. This kink may reflect the structural changes in the economy or the modernization of agriculture both of which began in the postwar years and have been in progress up to the present day.

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[34] It should be noted that the estimates for $L_c'(t)$ are tentative ones. In the first place, the figures for $L_c'(0)$ and M(t) do not seem to be free from biases, especially for the postwar (see Chart 4 and footnote 46). In the second, we didn't subtract the deaths from $L_c'(0) + M(t)$, because we had no data which were needed in the estimation of the deaths of migrants. But even if we estimate $L_c'(0)$ and M(t) under the alternative assumptions and even if we subtract the number of deaths, I am sure that the conclusion above will not be much changed.

[35] See footnote 32.

Chart 4: Relation between the Number of Non-Primary Laborers Originally Supplied from Primary Industry and Real Wage Rate in Agriculture

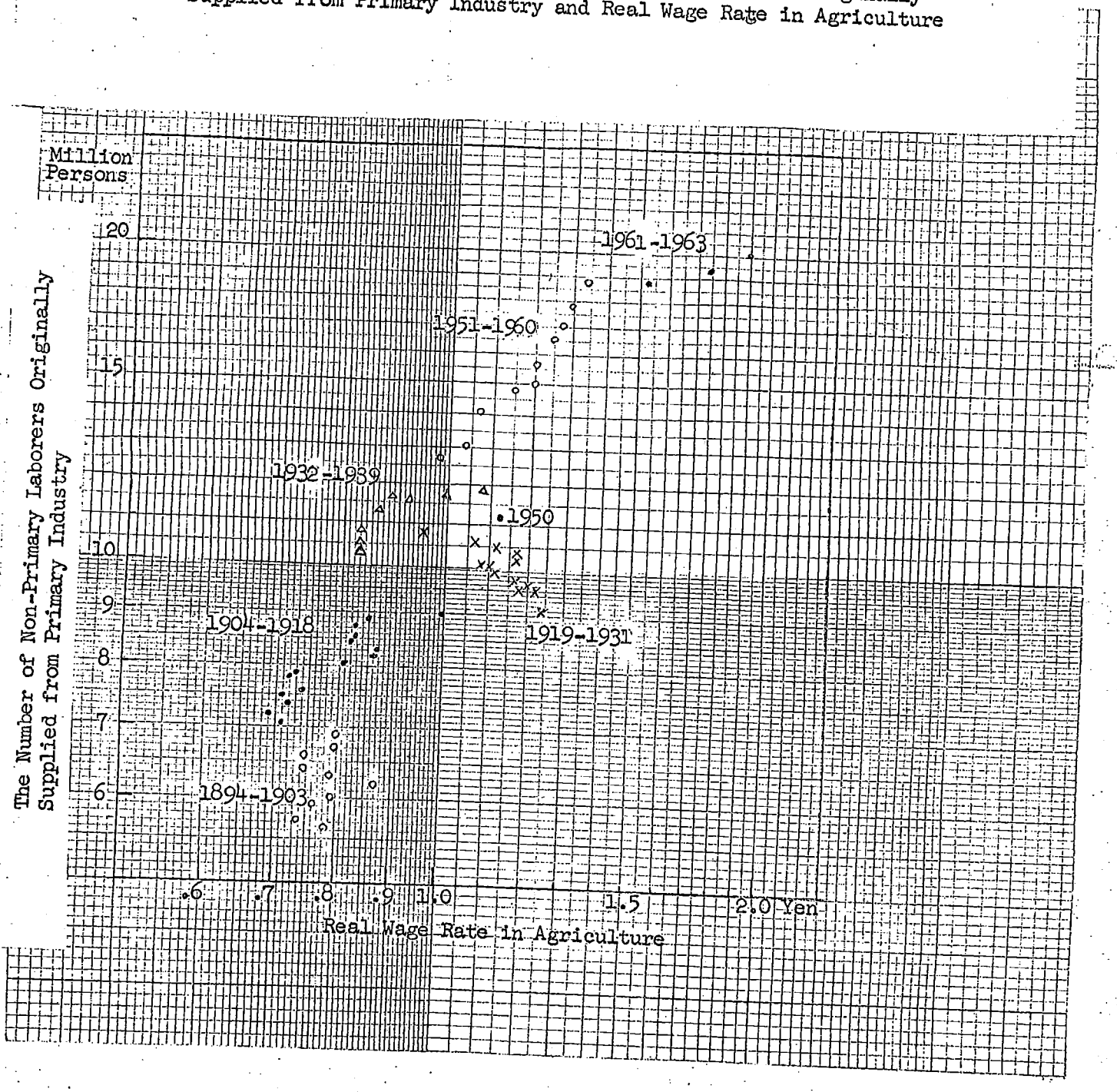

Chart 4

Relation between the Number of Non-Primary Laborers Originally Supplied from Primary Industry and Real Wage Rate in Agriculture

(continued)

Sources: Real Wage Rate in Agriculture: Table 5.
Non-Primary Laborers Originally Supplied from Primary Industry: Obtained by substituting $L_c'(t)$ and $M(t)$ for 1879-1940 and 1949-1964 into the equation below:

$$L_c'(t) = L_c'(0) + \sum_{t=1}^{t} M(t).$$

Annual net outflow of primary labor force, $M(t)$, is taken from Table 5. $L_c'(0)$ is the figure for 1878 and for 1948 respectively. The former is assumed to be equal to total non-primary labor force; i.e., we assume non-primary laborers in this point of time were all supplied from the primary sector. The latter figure is assumed as 69 percent of the non-primary labor force in this year. The ratio is that of non-primary laborers originally supplied from primary sector to total laborers in 1940. Considering the great changes in employment structure since the end of the war (1945), the estimation of $L_c'(0)$ for 1948 is the weakest point in our estimation of $L_c'(t)$.

E. Changes in Employment

Again we use number of laborers in primary industry as a proxy for the subsistence sector labor force. The numbers shown in Table 4 indicate this labor force was strikingly stable for the prewar years. Annual compound rates of growth are -.04 percent and -.05 percent respectively for the periods 1880-1910 and 1910-1940. Remarkable decrease began only during the postwar years: The rates of growth are -.6 percent and -1.1 percent respectively for 1950-1955 and 1955-1960 if we rely on the Kokusei Chōsa (Population Census) figures. Making use of a different series available from the Rōdōryoku Chōsa (Labor Force Survey) on an annual basis since 1948, it seems the decline in the primary industry labor force first began in 1951.[36] The main factor in these declines is the increase in the shift of labor from primary to non-primary industries. According to the writer's estimates in Table 5, the net outflow of primary labor force in the postwar period is more than four times as large as in the prewar years; the net outflow volumes are on the average 150 and 670 thousands, respectively, for the pre- and postwar periods.[37] This difference in the net outflow between the pre- and postwar periods is largely explained by the difference in the degree of economic activity in the non-primary industries.[38] For example the annual compound rates

[36] The labor force in primary industry expanded by a large amount just after the end of the war because of a great outflowing of population back to rural areas. These workers began returning to the urban areas in large numbers, thus accounting for the initial decline beginning around 1951 in the subsistence sector labor force.

[37] Our estimates for net outflow of agricultural labor force seem to be biased upward for the postwar years. The net outflow of farm household population, estimated by the writer, shows a much smaller difference between the pre- and postwar periods; the net outflow volumes are 360 and 800 thousands, and the net outflow rates are 1.1 percent and 2.0 percent respectively for the pre- and postwar periods [14, p. 186]. The reason for the over-estimation of net outflow of agricultural laborers for the postwar period comes from our assumption that the natural rate of increase of labor force is the same for all sectors. Perhaps for the postwar period, it should be much lower in agriculture than in other sectors.

[38] The relation between the population migration away from agriculture and the economic activity was fully analyzed by the writer [14].

Table 4: Labor Force in Primary Industry

(Unit: Thousands Persons)

Year	Population Census and Estimates	Year	Labor Force Survey[a]
1880	15,103	1948	16,950
1890	14,798	1950	18,055
1900	14,800	1952	16,890
1910	14,678	1954	16,190
1920	14,442	1956	16,150
1930	14,490	1958	15,200
1940	14,192	1960	13,910
1950	17,208	1962	13,690
1955	16,111	1964	12,510
1960	14,237		

[2]For 1948-1956, fourteen or more years old. Since 1958, fifteen years or more years old.

Sources: Population Census and Estimates, before 1920: Agriculture and forestry; the writer's estimates (see Table 1). Fishery; Hijikata's estimates [36, p. 152]. Hijikata estimated fishery laborers since 1872. But the estimates for 1920 is larger than the census figure for this year by 38 percent. Therefore the writer has discounted all his pre-1920 estimates by 38 percent.

Population Census and Estimates, since 1920: Figures from the Kokusei Chōsa [1, p. 53].

Labor Force Survey: [16, p. 23].

Table 5: Net Outflow of Primary Labor Force

Period	Net Outflow[a]	
	Volume (thousands)	Rate (percent)
1881-1885	155	1.03
1886-1890	156	1.05
1891-1895	155	1.04
1896-1900	140	.95
1901-1905	154	1.04
1906-1910	140	.95
1911-1915	137	.94
1916-1920	178	1.21
1921-1925	131	.89
1926-1930	125	.85
1931-1935	183	1.25
1936-1940	152	1.40
1951-1955	760	4.58
1956-1960	752	5.10
1961-1964	492	3.78

[a] Annual averages for quinquennial years.

Sources: Estimates by the writer. Net outflow of primary labor force, M, is the difference of the natural increase, N, from the actual increase, ΔL, in primary industry.

$$M \equiv N - \Delta L.$$

Now denoting the rate of natural increase in this sector as r; that is

$$r \equiv \frac{N}{L},$$

we obtain the relation

$$M \equiv rL - \Delta L,$$

$$\equiv L\left(r - \frac{\Delta L}{L}\right).$$

Under the assumption that the rates of natural increase of labor force are equal among industries, r is equivalent to the rate of change of the total labor force. Substituting the figures for r, ΔL and L into the equation above, we can estimate the net outflow rate. Data used for the number of laborers is as follows: For the prewar period; the writer's estimates for primary labor force (see Table 4), and the Hijikata's estimates for non-primary industries [23a, p. 145]. For the postwar; the figures from the Rōdōryoku Chōsa [16, p. 23].

of growth of real value added in these industries are about 2.1 percent and 4.6 percent respectively for the years 1910-1940 and 1950-1960.[39]

Business proprietors and family workers can be taken as an alternative proxy for the subsistence sector labor force. Series for these categories are presented in Table 6. Most business proprietors are, in fact, self-employed operators of farms of small scale enterprises and hence can be considered to belong to the subsistence sector. Family workers also are distributed mainly within the subsistence sector. According to the Kokusei Chōsa business proprietors increased and decreased respectively for 1920-1930 and 1930-1940. Through these periods, however, they were pretty constant. And for the postwar they increased to some extent. Annual compound rates of growth are -.10 percent and .18 percent respectively for 1920-1940 and 1950-1960. With Rōdōryoku Chōsa we find a slightly increasing trend before 1957 and a decreasing trend thereafter. On the other hand, the Kokusei Chōsa data indicate the number of family workers increased somewhat for the prewar period, declining then for the postwar years. Rates of growth are .03 percent and -.66 percent respectively for 1920-1940 and 1950-1960. The Rōdōryoku Chōsa series, however, does not show a decreasing trend until 1956.

In any case it may be conclusively stated that the labor force in the subsistence sector began to decrease remarkably in the 1950's. This decrease, the result of a large increase in the demand for labor by the capitalist sector, is doubtlessly one of the major factors explaining the large increase in

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[39] For the postwar: National income by industry; Estimates by the Economic Planning Agency [1, pp. 44-45]. Wholesale price index; Estimates by the Bank of Japan [1, p. 77].

Table 6: Business Proprietors and Family Workers

(Unit: Thousands Persons)

Year	Business Proprietors	Family Workers
	Population Census	
1920	8,845	10,113
1930	9,584	10,247
1940	8,445	10,268
1950	9,297	12,248
1955	9,395	11,894
1960	9,688	10,509
	Labor Force Survey[a]	
1948	9,420	12,430
1950	10,110	12,970
1952	10,120	12,950
1954	10,140	13,540
1956	10,480	13,240
1958	10,310	12,410
1960	10,330	11,510
1962	9,810	10,940
1964	9,750	10,250

[a] See footnote of Table 4.

Sources: Population Census: Report on Population Census for each year.

Labor Force Survey: 16, pp. 22-23.

the marginal productivity of the subsistence sector labor since the end of the war.[40]

III. Concluding Remarks

The statistical examinations in the previous section perhaps suggest that (1) Both the marginal productivity of labor and the real wage rate in the subsistence sector have shown large increases since the end of World War II. Moreover the correlation between them is seen to be quite close for this period. (2) The large increase in labor productivity since the end of the war seems to be the result of accelerated shifts in the productivity schedule and unprecedented declines in the number of laborers in the subsistence sector. (3) The shifts in the productivity schedule are caused by the increase in inputs other than labor and/or the technological progress. (4) The decline in the labor force is on the whole due to accelerated shifts of labor out of the subsistence sector. This shift has been motivated by a large increase in the demand for labor in the capitalist sector. (5) The elasticity of labor supply from the subsistence sector to the capitalist sector appears to decline sharply around 1960.

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[40] One may argue that the unprecedented decline in the birth rate since the end of the war might also have contributed to the decrease in surplus labor (e.g., 9, p. 29). The decline in the death rate since the war, however, has kept the rate of natural increase of population in the 1940's and 1950's as high as in the prewar period; the rate of natural increase is on the average 1.0 percent, 1.2 percent, 1.3 percent and .9 percent respectively for 1881-1910, 1911-1939, 1951-1955, and 1956-1960 [1, pp. 12-13]. As an index of labor supply to the whole economy, the production age population, the 19-59 year old population, is superior to total population. This group's annual rate of growth has been 1.1 percent, 1.5 percent, 2.1 percent and 1.9 percent respectively for 1880-1910, 1910 -1940, 1950-1955, and 1955-1960 [23, p. 127 and 1, p. 16]. Note that the largest rate of increase is recorded for the postwar period! Clearly, structural changes in employment or the decline in surplus labor for the postwar years cannot be explained by the changes in total labor supply. The increasing demand for labor which has resulted from the unprecedented growth of the Japanese economy for these years is almost indubitably the proper explanation. In the near future, at which time the growth rate of production age population is expected to decrease, the demographic factor will first begin to have an important role in the modernization of the Japanese labor market.

From these results the writer inclines towards the conclusion that the turning point, as rigorously defined in the first section, was passed sometime during the postwar years. We cannot offer, however, a definite date for the turning point: One may observe it is around 1954, because the real wage rate and the marginal productivity in the subsistence sector are thought to have begun to rise steadily in that year. Another may insist that it is 1961, because the elasticity of labor supply kinks in 1960. Obviously neither date can be shown to be exclusively correct. In a sense this is quite natural, because the turning point, once put in historical perspective, is not a point of time; a certain day or a year, but rather should be defined as a span of some years.[41] All we can say therefore, is that the turning point did not occur in the prewar years.

How does our conclusion relate to other work on this question? Fei and Ranis assert that the turning point was reached around 1918. They support their conclusion, in part, with a real wage rate in manufacturing series worked out by Umemura. This series shows a sharp rise in real wages beginning in 1918 [2, pp. 263-64]. This sharp rise since 1918 is confirmed by new estimates (by nine industry groups and by sexes) made by the writer [13]. The average wage for all manufacturing and for both sexes deflated by consumer price index shows an upward trend from 1905 until 1921. During this period, the upward trend accelerated as time passed on. The increase was conspicuous for a number of years after 1916. The real wage stopped rising rapidly in 1921. Slight increases were registered after that year. The postwar years, however, again show steady increases. In the writer's opinion, however, this data by itself is not sufficient to determine the date of the turning point. The data

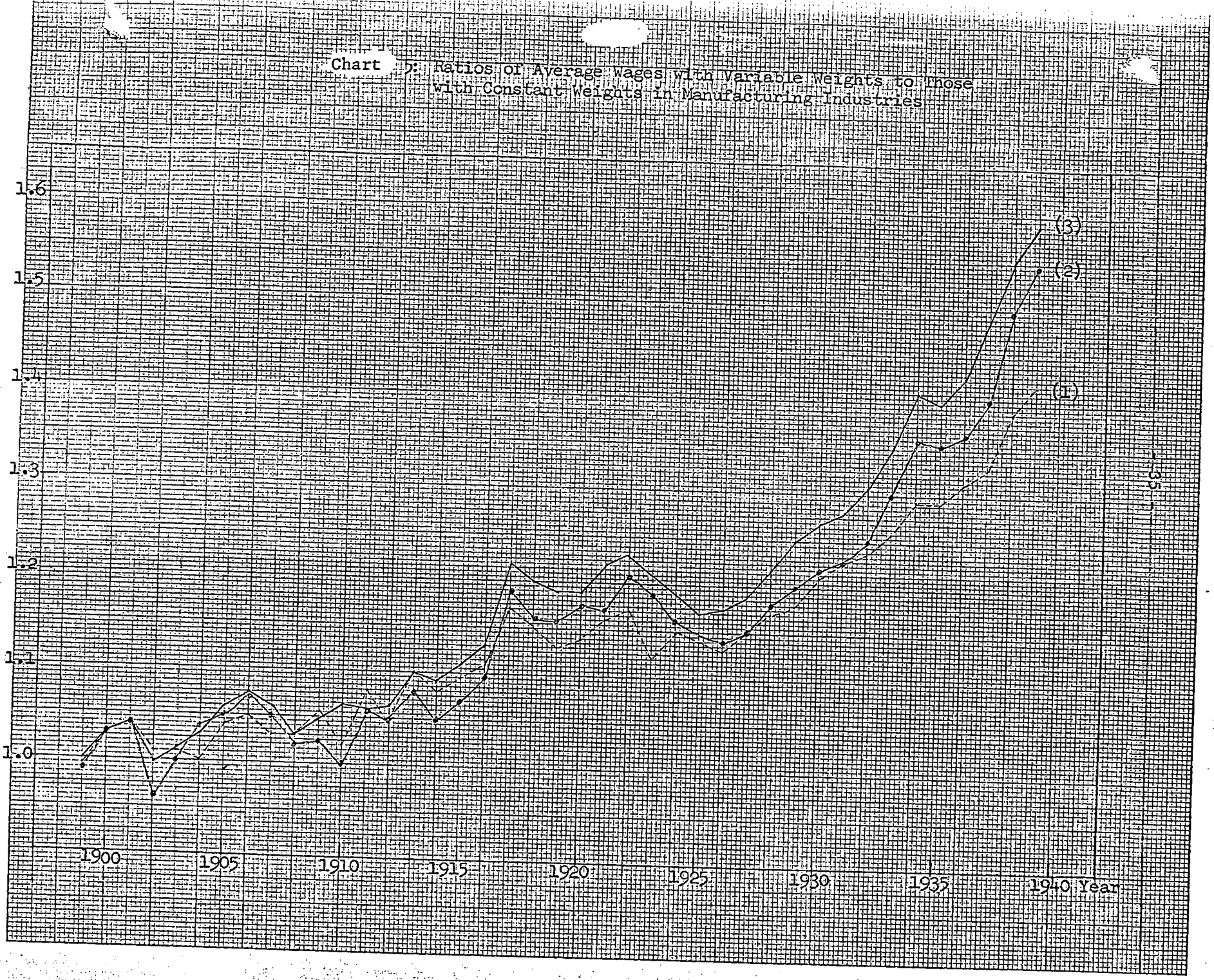
[41] See footnote 3.

are averages of figures for male and female for many industries. Examine the three curves in Chart 5. These curves represent the ratios of average wage rates for both sexes and for all manufacturing industries calculated with variable weights to average wage calculated under three alternative weighting assumptions. For Curve (1), the male and female average wage rate figures are calculated with variable industry weights. These two series are then tied together using 1909 male-female weights. The resulting series is then used as the denominator in our ratio. For Curve (2), the series for the denominator is obtained by calculating a series of wages for each of the industry groups using variable sex weights and thence tying these nine series together using 1909 industry weights. The series for the denominator used for the third curve makes use of 1909 weights for both sex and industry groupings. Curves (1) and (2), and therefore Curve (3), show upward trends for the decade of 1910's and for the years since 1926. During these periods average wages for both sexes and all industries remarkably increased. This increase in average wages for both sexes and for all industries is partly the result of the structural changes of the labor force between sexes and among industry groups.

Here we should pay special attention to the changes in industrial structure. The manufacturing industry in Japan can be considered as composed of three groups:[42] The first group is small scale enterprise which may be classified as the subsistence sector. The second and third groups belong to the capitalist sector by our definition. These two sub-sectors of the capitalist

[42]This has been stressed by Ohkawa [21, p. 483].

Chart): Ratios of Average Wages with Variable Weights to Those with Constant Weights in Manufacturing Industries



sector may be distinguished from one another, in part, by their respective relationships with the subsistence sector. The second group has a close relationship with this sector, in the sense that laborers move smoothly between them. As a result there is a tendency for wage rates to equalize between them. Capitalists in this sub-sector, taking the institutionally determined wage rate as given, select the most profitable input ratios. On the other hand, the third group does not have this close relationship; labor does not move from subsistence sector to this sector, and the wage level is determined almost independently of the subsistence wage, which is so dominant in the other sectors. Technology, in this sector mainly borrowed from developed countries, is most modern and the level of productivity is very high. The first and the second enterprise group played an important role in the early stages of economic development in Japan. (The first group is not covered in our series of wages; the wages are for the factories with 30 or more workers.) The third group has grown since the end of World War I. Such changes in industrial structure may explain the upward trend in Curves (2) and (3), and at the same time show how dangerous it is to attempt to find the turning point by using the average wages for all manufacturing industries.[43]

[43] Another problem is using the average wages for all manufacturing industries for this purpose comes from the more than proportional increase in skilled laborers: Their wages tend to increase faster than the subsistence wage. The concept of unlimited supplies of labor extends only to unskilled workers. The effect of changing composition of workers by age groups on the changes in average wages should also be considered. We do not have, however, sufficient data for wage rates by age groups covering long periods of the prewar. The data from the Rōdō Tōkei Jitchi Chōsa (Survey of Labor Statistics) are the exception. These data show that the nominal wage rate did decrease for all age groups and for all industry groups for the depression periods, 1924-1927 and 1927-1930. During the former period, the average figure for all groups increased by 1.4 percent per year [18, pp. 296-97].

Fei and Ranis consider their finding that the capital-labor ratio ceased to show a decreasing trend since the end of World War I as additional evidence for a 1918 dating of the turning point [2,pp. 129-31]. Some years ago E.P. Reubens made comprehensive comments on this aspect of Fei and Ranis' work [28].[44] (Also see the comments by T. Watanabe [34, footnote 6].) He gave alternative estimates for the capital stock which indicated that no capital shallowing occurred between 1888 and 1928 [28, p. 1056]. In replying to this comment, Fei and Ranis revised their original estimates of the capital stock. In this new series the turning point from capital shallowing to capital deepening appeared once again: This time, somewhat earlier, in the decade from 1893 to 1903 [3, p. 1064]. The method of estimation used by Fei and Ranis, however, is too simple; they obtained their capital stock data by subtracting or adding as appropriate, annual investment as, estimated by H. Rosovsky, from a benchmark capital stock figure obtained from the Kokufu Chōsa [National Wealth Survey) in 1930. Rosovsky's figures as a whole had first been deflated by them using Ohkawa's non-agricultural price index. On the other hand, the capital intensity in non-primary industry figures shown in Table 7 depends on new estimates of capital stock by S. Ishiwata. These are rather comprehensive estimates covering many specific items of the capital stock. According to this series, no capital shallowing occurred in any period save the exception of 1883-1887 to 1888-1892. These data include, however, tertiary industry, in

[44] Shallowing in capital intensity in the capitalist sector is not a necessary implication of the theory of unlimited supplies of labor. (In equation (1) of Appendix B, the growth rate of capital-labor ratio, G(K/L), can be positive, zero and negative depending on the sign of H_L.) (In this respect Fei and Ranis and Reubens all agree [3, p. 1063, and 28, p. 1053]). For this reason we did not examine changes in capital intensity in non-agriculture when we attempted to find the turning point.

Table 7: Capital-Labor Ratio in Non-Primary and Horse-Power of Prime Movers per Worker in Manufacturing Industries

	Capital-Labor Ratio[a] (Non-Primary)	Horse-Power per Worker[b] (Manufacturing)
	Yen	10^{-3} Horse Power
1878-1882	575	
1883-1887	590	
1888-1892	572	10
1893-1897	634	20
1898-1902	720	20
1903-1907	786	36
1908-1912	949	77
1913-1917	1,148	136
1918-1922	1,462	284
1923-1927	1,681	459
1928-1932	1,937	588
1933-1937	2,124	801

[a]Gross capital stock in 1934-1936 prices divided by the size of labor force. Residential construction is excluded in capital stock.

[b]Horse-power of prime movers divided by the size of labor force.

Sources: Gross Capital Stock: Ishiwata's estimates [24, pp. 160 and 162].

Horse-Power: The writer's estimates [11, p. 223].

Labor Force for Non-Primary and Manufacturing Industries: Hijikata's estimates [23a, p. 145].

which subsistence enterprises are dominant. We have no data for manufacturing industry alone.[45] As a substitute for them, however, horse-power of prime movers per worker in this industry is calculated in the same table. This series shows an upward trend, not decreasing in any period. To my mind, therefore, capital intensity in capitalist sector as a whole has continued to increase throughout the process of economic development in Japan. Is this upward trend consistent with our hypothesis that the turning point has occurred only since the end of World War II? The answer is yes. Recall that the highly modernized manufacturing enterprises, used a technology borrowed from outside the economy. Hence, the Japanese capital-labor ratio was determined largely independently of its own relative factor prices. Moreover, the increase in the subsistence wage itself should have contributed to the increase in the capital-labor ratio.[46]

Now we turn to the examination of Jorgenson's statistical findings. Jorgenson, developing two kinds of theories of economic development, classical and neo-classical, introduced the following hypotheses [6, pp. 54-58]:[47] In the classical theory,

(1) the real wage in agriculture remains constant,

(2) the agricultural labor force declines absolutely,

(3) the labor productivity remains constant in non-agriculture,

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[45] S. Ishiwata has also presented a provisional estimate for the capital stock manufacturing industry. Although Watanabe has used this estimate [35, p. 296], the assumptions by which Ishiwata has derived these figures from his estimates for non-primary industry as a whole are so untenable as to render the former estimates unacceptable for use in this paper.

[46] In addition to this, a continuously increasingly tight labor market for skilled workers may be in part responsible for the rising capital-labor ratio.

[47] Before examining these hypotheses, Jorgenson surveyed and criticized the statistical work on the existence of zero marginal productivity of labor attempted by other scholars [6, pp. 48-52]. This discussion is not really relevant for the question of the appropriateness or inappropriateness of the unlimited supplies of labor concept. (See footnote 5.)

(4) the rates of growth in output and employment increase in non-agriculture, and (5) the capital-output ratio falls in non-agriculture.

In the writer's opinion, however, these hypotheses, with the exception of (1), are not strict implications of the theory of unlimited supplies of labor.[48] Therefore, in this article, we will examine the statistical test on hypothesis (1) only. Jorgenson estimated real labor income per capita on agriculture by deducting rents for tenants from total agricultural income. Having found that income per capita tended to increase from 1878-1882 until 1913-1917 [6, p. 54][49], he criticized the Fei and Ranis hypothesis, while asserting that in the prewar years [6, p. 60].[50] Prior to Jorgenson's work, M. Umemura attempted the same estimation

[48] For hypothesis (2): The direction of changes in agricultural labor force depends on many variables; the natural rate of increase of population, the rates of technological progress in agriculture and non-agriculture, the propensity to save in both sectors, and so forth. For hypothesis (4): This is not independent from the assumption of a constant rate of technological progress: The rates of growth of output and employment in non-agriculture can remain constant or decrease depending on the changes in the rate of technological progress. For hypotheses (3) and (5): These come from the special production function assumed by Jorgenson, i.e., the Cobb-Douglas function with the neutral technological progress. (See Appendix B).

[49] The real disposable income per worker in agriculture estimated by A. H. Gleason shows a steady increase since 1883-1887 up to 1933-1937. He obtained the disposable income figures by subtracting direct taxes on agriculture and gross agricultural investment from net income produced in agriculture [4, p. 414]. Note, however, in the first place that his figures arenot a direct index for labor income as they contain incomes from rents and interests. (The disposable income per capita is equal to the labor income per capita onlyif the labor income is all consumed and the incomes from rents and interests are all saved and invested.) Moreover, once again the agricultural output statistics on which Gleason bases his estimates may be downward biased. (See footnote 51.)

[50] In support of this one might suggest the well-known violent competition for workers in cotton spinning industry in the late Meiji and early Taisho periods. This competition was, however, for trained workers and resulted from temporary regional disequilibria caused by lack of information [31, p. 74]. A. R. Tussing, who comprehensively studied the labor force and wages for this industry in Yamanashi Prefecture for these periods, concluded that the supply of labor to non-agriculture was elastic [31, p. 79].

pending on economic situations, they could be positive or negative. Labor income per capita may be a good index in the sense that it covers all agricultural workers including unpaid family workers. Considering, however, that we have no reliable data for profits, interests and so forth, I am sure that agricultural wage rate, which was used in our analysis, is superior.

Appendix A: CROSS-SECTIONAL TEST OF THE MARGINAL PRODUCTIVITY THEORY

The subsistency level not being constant over time is one of the problems associated with the test utilizing time-series which was attempted in Section II, Item C. If we use cross-sectional data we may free ourselves to some extent from this problem. Cross-sectional data are available from the Nōka Keizai Chōsa for the postwar period: Following the method adopted by H. Kaneda [8, p. 165], the daily wages for temporary workers are obtained as the annual wage payments divided by the working days per year multiplied by eight, the assumed figure for working hours per day. The average productivity of labor is calculated by dividing gross value added per year by total labor input per year in terms of adult-man-day equivalent in agricultural production. These statistics are calculated for ten agricultural regions[53] and for six scales of operation of farm household;[54] under .3, .3-.5, .5-1.0, 1.0-1.5, 1.5-2.0 and over 2.0 chō[55] for every other year since 1952. Therefore we have 10 x 6 = 60 (10 x 5 = 50, for 1952-1956) samples for each year. Dividing these samples into two groups;

[53] The Nōka Keizai Chōsa gives the statistics by eleven agricultural districts. Of them, the northern-most Hokkaido, characterized by the relatively large farms and substantially different agricultural enterprises in comparison with other districts [8, footnote 7], is excluded in our analysis.

[54] For the years 1952-1956, the data is tabulated by five scales of operation; under .5, .5-1.0, 1.0-1.5, 1.5-2.0 and over 2.0 chō.

[55] One chō is 2.45 acres.

A, the farms of under 1.0 chō and B, the farms of over 1.0 chō, and regressing the wage rate for temporary workers, under the assumption that it is equivalent to that for permanent workers, on the average productivity of labor, we obtain the coefficients of determination adjusted by the degree of freedom as follows:[56]

	A	B
1952	.179*	.251**
1954	.054	.232**
1956	.164*	.421**
1958	.405**	.611**
1960	.310**	.689**
1962	.170*	.593**

Note firstly, that all coefficients are statistically significant at the 5 percent level with the exception of the figure for A in 1954. Secondly, coefficients are larger for B than for A in every year. Thirdly, there is an increasing trend in the figures for B. Fourthly, the trend in B seems to be influenced by economic fluctuations; for the boom years of 1952 and 1960, the coefficients of determination are at peaks and for the recession years of 1954 and 1962 they reach troughs. Now, if we assume that the output elasticity of labor is constant among regions and over scale for each year, we may deduce from these findings the following conclusions: The wage rate in postwar agriculture has been determined according to the level of marginal productivity. The relationship is, however, much clearer in the large scale farms than in the small scale ones, and has been becoming tighter gradually. In other words, the modernization of agriculture has begun in the large scale farms and is steadily progressing. Modernization, on the other hand, has been delayed on small farms. Next, the correspondence of the wage rate to marginal productivity is much closer in the boom-time than in recession periods. This implies that labor supply tends to become less elastic when the demand for labor increases rapidly and vice versa.

[56] One and two asterisks mean that the coefficients of determination are significant at the 5 percent and 1 percent significance levels respectively.

Appendix B: MATHEMATICAL EXAMINATIONS INTO THE CHANGES IN CAPITAL-LABOR RATIO, LABOR PRODUCTIVITY AND CAPITAL-OUTPUT RATIO

Assume a general production function in non-agriculture, which satisfies the conditions of the constant returns to scale and the diminishing returns to all inputs;

$$Q = f(K, L, t),$$

where Q, K, L and t denote total output, capital stock, labor force and time. From this function Fei and Ranis obtained the following equations:

$$G(Q) = \phi_K G(K) + \phi_L G(L) + J \qquad [2, p. 88]$$

$$G(f_L) = \varepsilon_{LL} G(K/L) + H_L \qquad [2, p. 110],$$

where G( ) is the growth rate of a variable in parenthesis, ϕ_K and ϕ_L are the output elasticities to capital and labor respectively ($f_K K/f$ and $f_L L/f$), J is the intensity of innovation (f_t/f), f_L and f_K are the marginal productivities of capital and labor respectively, ε_{LL} is the elasticity of f_L with respect to labor ($-f_{LL}\, L/f_L$), and H_L is the time rate increase of f_L(f_{LT}/f_L). Assuming that the wage rate is constant over time[57] and equal to the marginal productivity of labor; say, $w = \bar{w} = f_L$, from the two equations above are the following relations obtained:

$$(1) \quad G(K/L) = -\frac{H_L}{\varepsilon_{LL}}$$

$$G(Q/L) = -\frac{H_L}{\varepsilon_{LL}} \phi_K + J.$$

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[57] A general presentation of the unlimited supplies of labor is $G(w) = \bar{G}(w)$, where $\bar{G}(w)$ is an exogenous variable. The condition, $w = \bar{w}$, or $\bar{G}(w) = 0$, in the text is the special case.

Denoting the elasticity of substitution ($\frac{f_K f_L}{f f_{LK}}$) [6, p. 62] as σ, the last equation can be rewritten as follows:

$$(2) \quad G(Q/L) = - \sigma H_L + J.^{58}$$

Subtracting (2) from (1), we get

$$(3) \quad G(K/Q) = (\sigma - \frac{1}{\varepsilon_{LL}}) H_L - J.$$

Equations (1), (2) and (3) show the conditions of the changes in capital-labor ratio (K/L), average productivity of labor (Q/L) and capital-output ratio (K/Q). If we specify the production function into the Cobb-Douglas type ($\sigma = 1$) with neutral technological progress ($H_L = J$),[59] these equations become

$$(1)' \quad G(K/L) = - \frac{J}{\varepsilon_{LL}}$$

$$(2)' \quad G(Q/L) = 0$$

$$(3)' \quad G(K/Q) = - \frac{J}{\varepsilon_{LL}} .$$

This is the basis of Jorgenson's assertion that the capital-labor ratio and the capital-output ratio decrease[60], while average labor productivity remains constant in the classical model [6, pp. 54-58].

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[58] S. A. Marglin introduced the equation of G(Q/L) under the assumption of the neutral technological progress [6, pp. 65-66]. Our mathematical development here is much more general in the sense that we don't assume neutrality in technological progress.

[59] The neutral technological progress in Hicksian sense is expressed as

$$H_L = H_K,$$

where H_K is the time rate of increase of f_K. Substituting this into the relation,

$$J = \phi_L \ H_L + \phi_K \ H_K,$$

which was obtained by computing f_t from $Q = f_K K + f_L L$ [2, p. 109], we get

$$J = H_L = H_K.$$

[60] In equations (1)' and (3)', $J > 0$ and $\varepsilon_{LL} > 0$ (because of the assumption of decreasing returns to labor; $f_{LL} < 0$). The growth rate of the capital-labor ratio is equal to that of the capital-output ratio in the Jorgenson model. (This is the reason why he called the decreasing capital-output ratio as capital shallowing, which was originally defined as the decreasing capital-labor ratio by Fei and Ranis.) Under the general assumptions, however, this is not true. (See equations (1) and (3) in the text.)

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