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CHANGE IN AGRICULTURAL SURPLUS LABOR AND THE ECONOMIC DEVELOPMENT OF JAPAN: SOME COMPARISONS WITH THE CASES OF THAILAND, CHINA AND TAIWAN

By MITOSHI YAMAGUCHI AND KAZUHIRO TANAKA

The beginning of any economic development records high surplus labor. Japan was in the same situation, and there was much surplus labor until the beginning of 1960. The purpose of this paper is to measure the change in the surplus labor of Japan in each decade from 1880 to 1970. By calculating these values, we calculated how the decrease in surplus labor contributed to the agricultural and economic development of Japan using the General Equilibrium Growth Accounting Method. After calculating these values, we estimated by regression analysis what kind of factors decide these changes in surplus labor. Especially, the effects of population growth and technical change in agriculture and non-agriculture on the change in agricultural surplus labor are calculated.

1. Introduction

It is well-known that there is a large surplus labor in the beginning of economic development. Japan used to be in the same situation and there was a large surplus labor until the beginning of 1960. In this paper, an attempt is made to measure the decrease or increase in surplus labor in each decade from 1880 to 1970. By calculating these values, we calculated how these changes in surplus labor contributed to the agricultural and economic development of Japan. After calculating these values, we estimated by regression analysis that what kind of factors decide these decreases or increases in the surplus labor. Especially, the effects of population growth and technical change in agriculture and non-agriculture on the decrease or increase of agricultural surplus labor are focused on.

2. General Equilibrium Growth Accounting for the Japanese Economy

The histogram of FIGURE 1 shows the historical average growth rates of 8 endogenous variables as the sum of all the contributions of each exogenous variable in each decade. We have 9 exogenous variables but only 5 principal exogenous variables (Sectoral technical change T_i, total capital K, total labor L, and population Q) are shown in FIGURE 1 to avoid complicating the picture (In the main histograms such as agricultural output, nonagricultural output, agricultural labor, nonagricultural labor, and per capita income, we also showed the contribution of two kinds of imperfect competition, m_1 and m_w which we discuss later). First, observe the calculated results of FIGURE 1 very briefly. It is seen that with respect to agricultural output, the largest contribution is agricultural technical change with total labor,

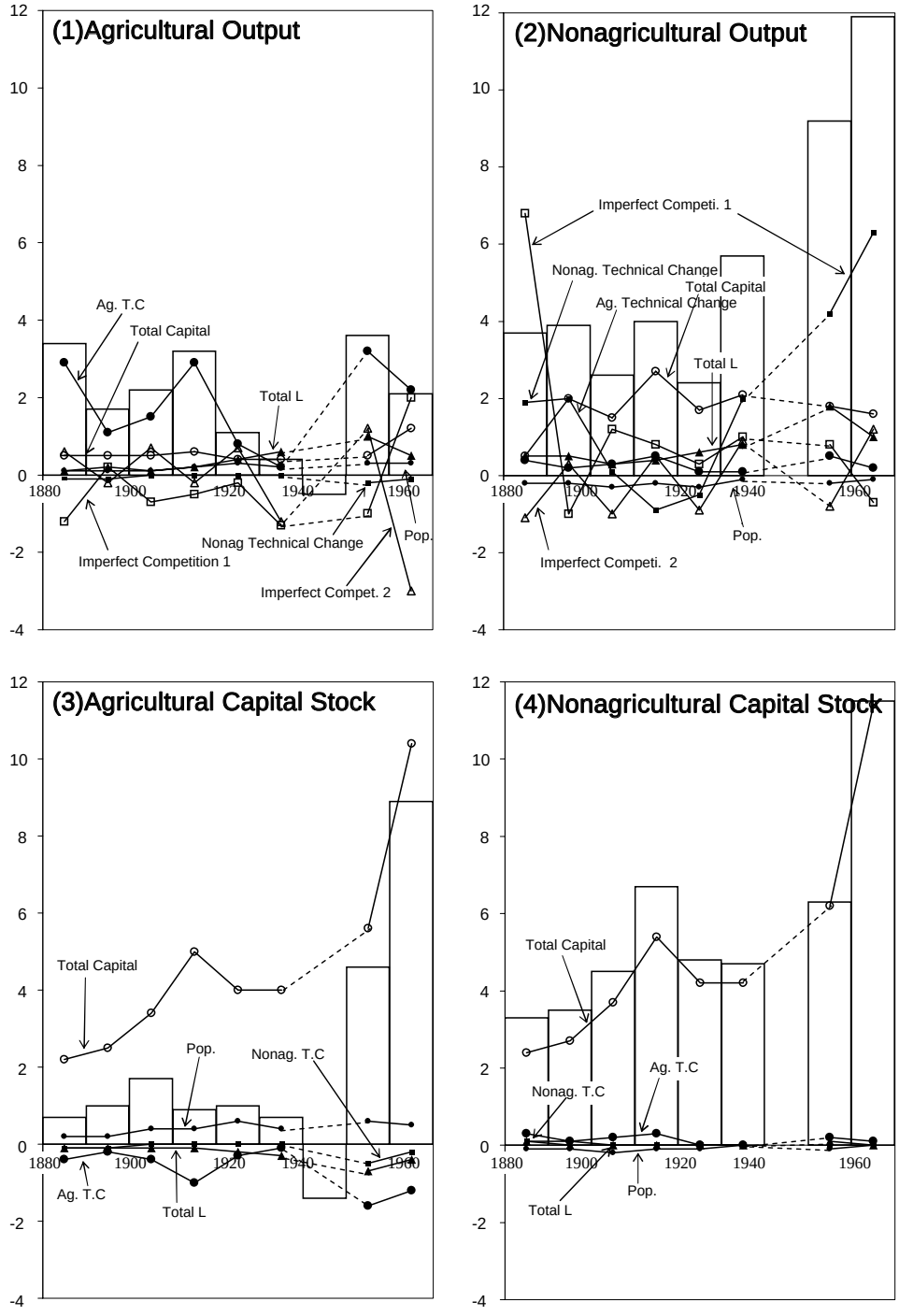
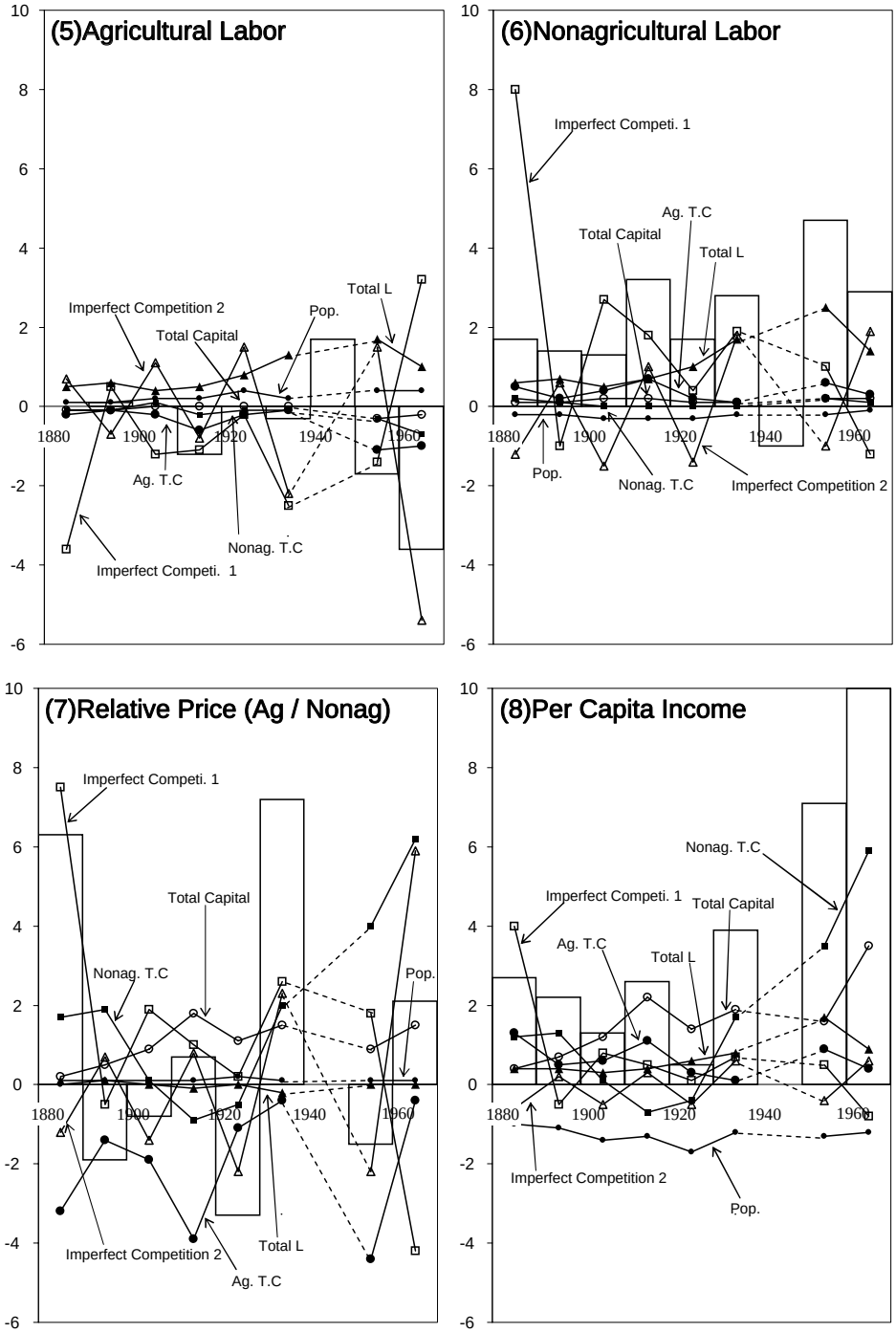


FIGURE 1. Growth Accounting



for the Japanese Economy

total capital and population following in sequence of importance. The contribution of nonagricultural technical change has a zero or negative value in each decade.

Note that population growth makes a positive contribution. For nonagricultural output, nonagricultural technical change makes the largest contribution, but the contribution varies widely. Total capital, total labor and agricultural technical change follow in sequence of importance. Population growth makes a small negative contribution. Agricultural technical change tends to push resources out of agriculture (Agricultural technical change makes a negative contribution to agricultural labor and a positive contribution to nonagricultural labor), while nonagricultural technical change tends to pull resources into non-agriculture (Nonagricultural technical change makes a negative contribution to agricultural labor and a positive contribution to nonagricultural labor). The asymmetrical effect of technical change is due to the low price and income elasticities for agricultural goods. Therefore, agricultural technical change makes a positive contribution to the growth of nonagricultural output, especially in the 1910's and 1920's when agricultural technical change makes a larger contribution than nonagricultural technical change, this in contrast to the negative contribution of nonagricultural technical change to the agricultural output.

For agricultural capital stock, the largest contributor is, of course, total capital. Other contributions are fairly small (Here, population has a small positive contribution). The effect (GRM) and the contributions of technical change in both sectors are negative. As stated above, technical change pushes and pulls agricultural factor inputs to the nonagricultural sector. For nonagricultural capital stock, the largest effect and contributor is, of course, total capital. Agricultural technical change, nonagricultural technical change and total labor follow in markedly smaller contributions. Finally population has a negative effect making an opposite contribution as compared with technical change. For agricultural labor, total labor makes the largest contribution (and effect) followed by population. The rest of the variables have a negative effect and push and pull agricultural labor to the nonagricultural sector. For nonagricultural labor, total labor again has the largest effect and contribution. Agricultural technical change, total capital and nonagricultural technical change follow in importance. This also corresponds to the pushing and pulling effect of technical change. Population obviously has a positive effect and contribution for agricultural inputs as stated above. For relative price (Ag. price/nonag. price), nonagricultural technical change has the largest positive effect and contribution. Agricultural technical change has the largest negative effect and contribution. The contributions of the other variables are very small except for the fairly large contribution of total capital (see H.G. Johnson [1966]).

For per capita income, nonagricultural technical change has the largest effect and contribution as a whole. However, its contribution depends on the decade and shows large variation. On the other hand, the contribution of agricultural technical change is fairly stable and almost the same size as the contribution of total labor on average. Also the contribution of agricultural technical change is relatively larger in the early stages of economic development in Japan. The contribution of capital is somewhat larger than that of labor. Population has, of

course, a negative effect on per capita income. However, the net contribution of population, which is the sum of the contributions of population and of labor, has a much smaller negative value. In the ordinary model which treats labor and population together, we can only obtain the net contribution of population. However, this model allows us to evaluate the contributions of population and labor independently and see the effect of the labor participation rate as well.

3. Calculation of Agricultural Surplus Labor and Economic Development

In this section, two methods are used to measure the change of surplus labor in Japanese agriculture. The first method is calculated as follows. Denote m_1 as the difference between the value of marginal product of agricultural labor ($VMPL_1$) and the wage rate in agriculture (w_1). If we express this in an equation, it is expressed as $m_1=w_1/VMPL_1$. The second method is calculated as follows. Define m_w as the ratio between wage rates in agriculture and non-agriculture (w_2). If we express this in an equation, $m_w = w_1/w_2$. TABLE 1 shows the calculated values of $\dot{m}_1$ ($=\Delta m_1/m_1$) and $\dot{m}_w$ ($=\Delta m_w/m_w$).

Judging from the previous studies, the value of marginal product of agricultural labor is smaller than the wage rate in agriculture. Therefore, m_1 is larger than 1 (i.e., $m_1>1$). From the equation $m_w = w_1/w_2$, the wage differential between w_1 and w_2 becomes larger when the value of m_w is negative, because w_1 is usually smaller than w_2. TABLE 1 shows that in the 1880's, 1900's, 1920's and 1950's the wage differentials are widening. On the other hand, the differentials between w_1 and $VMPL_1$, i.e., m_1, decrease when m_1 is negative. In other words, the $VMPL_1$ approaches the wage rate in agriculture and the surplus labor defined in this way

TABLE 1. Degree of Surplus Labor in Agriculture

	(1)	(2)	(3)=(1)-(2)	(4)					(5)=(1)-(4)				
	$\dot{w}_1$	$\dot{w}_2$	$\dot{m}_w$	$\dot{VMPL}_1$					$\dot{m}_1$				
				(A)	(B)	(C)	(D)	(E)	(A)	(B)	(C)	(D)	(E)
1880-1890	-6.4	-4.4	-2.0	4.8	-	3.1	2.4	5.3	-11.2	-	-9.5	-8.8	-11.7
1890-1900	8.3	7.4	0.9	7.0	-	6.1	6.5	6.9	1.3	-	2.2	1.8	1.4
1900-1910	2.0	4.8	-2.8	5.1	-	4.3	4.3	10.0	-3.1	-	-2.3	-2.3	-8.0
1910-1920	15.9	14.1	1.8	18.3	17.3	17.3	17.1	19.2	-2.4	-1.4	-1.4	-1.2	-3.3
1920-1930	-3.2	0.2	-3.4	-2.9	-3.5	-4.3	-3.2	-4.1	-0.3	0.3	1.1	0	0.9
1930-1940	6.8	2.2	4.6	11.9	18.8	11.2	10.2	13.0	-5.1	-12.0	-4.4	-3.4	-6.2
1940-1950	77.6	-	-	-	-	-	-	-	-	-	-	-	-
1950-1960	6.1	9.2	-3.1	8.6	-	8.2	8.6	6.9	-2.5	-	-2.1	-2.5	-0.8
1960-1970	19.8	11.1	8.7	13.8	-	12.7	13.8	10.6	6.0	-	7.1	6.0	9.2

Column (4) and (5): (A): Shintani [1983], (B): Minami [1970], (C): Akino and Hayami [1973], (D): Yamada and Hayami [1972], (E): Yamaguchi [1987] $\dot{w}_1$ for example, means $\Delta w_1 / w_1$.

decreases when m_1 is negative.

TABLE 1 shows that all periods except the 1890's, 1920's, 1960's correspond with this category. Especially, the surplus labor decreased at a high speed in the 1880's and 1930's. Both the 1890's and 1960's were periods with on enlarging gap between $VMPL_1$ and wage rate in agriculture. However, the difference of the calculated value is clear between the two periods. From the above discussion, we can see that the 1920's is a period which has increased surplus labor in agriculture in both senses (i.e., the period of enlarged wage differentials, and the period of enlarged differences between $VMPL_1$ and w_1). As is well known, the serious Japanese economic depression and the great Kanto earthquake occurred in this period. We can understand that the growth rates of $VMPL_1$ are negative in this period. In addition, the growth rate of the wage rate in agriculture was negative in this period. On the contrary, the periods which decreased both the wage differentials and the gaps between $VMPL_1$ and w_1 are in the 1910's and 1930's.

In short, the agricultural surplus labor increased in the 1920's but decreased in the periods before (i.e.,1910's) and after the 1920's (i.e., 1930's). Also, the gap between $VMPL_1$ and w_1 (or the amount of surplus labor) decreased at a high speed in the 1880's but increased in the 1890's. However, the gap (the surplus labor) decreased again in the 1900's and continued until the 1920's. In the 1920's, the gap (the surplus labor) stayed at almost the same level or increased very slightly, but decreased at a fairly high speed in the 1930's. For the post World War II periods, the gap or surplus labor decreased in the 1950's. In the 1960's, the gap increased at fairly large rates. However, this comes from the fact that the wage rate in agriculture increased more than the growth rate of $VMPL_1$. This means that the Japanese economy passed the turning point and the labor became a scarce factor (therefore, w_1 increased) as Minami (1970) pointed out.

Here, we would switch our topic to the capital market and calculate the gap between the interest rate and the value marginal product of capital $VMPK_1$. Note that m_3 was the gap between the growth rates of $VMPK_1$ and agricultural interest rate r_1, and m_4 was the gap between the growth rates of $VMPK_2$ (suffix 1 means agricultural sector, 2 means non-agricultural sector) and nonagricultural interest rate r_2. Judging from the calculated values of m_3 and m_4 in TABLE 2, m_3 has negative signs in most of the periods except the 1890's, which has a very small positive value (0.1%). m_4 takes negative signs in whole periods (As it is hard to obtain the sectoral interest rates for almost 100 years, we adopt the same interest rates in both sectors. However, it would be possible to assume that the interest rates in both sectors would move in a parallel way because of the difficulties of gathering data for these long periods). m_3 and m_4 are the differences between the growth rates of the interest rate and the value of marginal product of capital. What does "m_3 and m_4 are negative" mean? We can interpret this phenomenon as follows: Interest rates go up only in periods with extremely high growth rates in the value of marginal product of capital. In other words, interest rates usually stay the same or decrease even in periods with a positive growth rate in the value of marginal product.

TABLE 2. Degree of Imperfect Competition of Capital and Nonagricultural Labor Markets

	$(\dot{VMPL}_2)$	$\dot{m}_2$	$\dot{r}$	$(\dot{VMPK}_1)$	$(\dot{VMPK}_2)$	$\dot{m}_3$	$\dot{m}_4$
1880-1890	0.9	-5.3	-1.3	1.2 (2.4)	3.1 (0.1)	-2.5 (-3.7)	-4.4 (-1.4)
1890-1900	8.5	-1.1	3.9	3.8 (5.2)	11.1 (7.6)	0.1 (-1.3)	-7.2 (-3.7)
1900-1910	3.8	1.0	-4.2	1.0 (2.6)	2.0 (1.1)	-5.2 (-6.8)	-6.2 (-5.3)
1910-1920	12.3	1.8	7.8	13.9 (15.2)	8.8 (8.8)	-6.1 (-7.4)	-1.0 (-1.0)
1920-1930	-2.2	2.4	-9.6	-6.7 (-5.3)	-2.3 (-4.2)	-2.9 (-4.3)	-7.3 (-5.4)
1930-1940	6.1	-3.9	-6.9	8.7 (10.2)	6.4 (4.4)	-15.6 (-17.1)	-13.3 (-11.3)
1940-1950	-	-	-	-	-	-	-
1950-1960	12.5	-3.3	-1.0	4.9 (1.9)	2.8 (6.8)	-5.9 (-2.9)	-3.8 (-7.8)
1960-1970	13.8	-2.7	-3.1	5.2 (0.2)	5.2 (5.2)	-8.3 (-3.3)	-8.3 (-8.3)

The figures of parenthesis are the values which assume that production elasticity is constant in each period.

Therefore, in such a period like the 1920's, which had a negative growth rate in the value of marginal product of capital, the growth rate of the interest rate took a negative value. In short, interest rates seem to follow the movements of *VMPK* and drop their level whenever the growth rates of *VMPK* become negative. This is very different from the case of labor. If we rearrange the numerical values of the growth rates of $VMPL_1$ in each period from the largest to the smallest, the result would be as follows; 1910's (18.3%), 1960's (13.8%), 1930's (11.9%), 1950's (8.6%), 1890's (7.0%), 1900's (5.1%), 1880's (4.8%), and 1920's (-2.9%). Subtracting the growth rates of agricultural price (P_1) from these growth rates, we can obtain the growth rates of the marginal product of labor in agriculture (MPL_1). If we also rearrange these values from the largest to the smallest, we can obtain the result as follows (see TABLE 3): 1960's (6.8%), 1950's (5.7%), 1910's (5.4%), 1880's (5.1%), 1900's (3.0%), 1890's (2.5%), 1920's (2.5%), and 1930's (1.4%).

From these results, we can say that the growth rates of the marginal product of labor in agriculture (MPL_1) are large in the postwar periods like the 1950's and the 1960's and small in the depression periods like the 1930's (agricultural depression) and the 1920's (economic depression). Similarly, we can rearrange for the growth rates of the value of marginal product of labor in nonagricultural sector ($VMP\ L_2$) as follows: 1960's (13.8%), 1950's (12.5%), 1910's (12.3%), 1890's (8.5%), 1930's (6.1%), 1900's (3.8%), 1880's (0.9%), and 1920's (-2.2%). Subtracting the growth rates of nonagricultural price (P_2) from these growth rates, we

TABLE 3. Growth Rates of Marginal Product of Labor and Capital

	$(\dot{MPL}_1)$	$\left[\frac{\dot{w}_1}{P_1}\right]$	$(\dot{MPL}_2)$	$\left[\frac{\dot{w}_2}{P_2}\right]$	$(\dot{MPK}_1)$	$\left[\frac{\dot{r}}{P_1}\right]$	$(\dot{MPK}_2)$	$\left[\frac{\dot{r}}{P_2}\right]$	$\dot{P}_1$	$\dot{P}_2$
1880-1890	5.1	-6.1	1.2	-4.7	1.5	-1.0	3.4	-1.0	-0.3	-0.3
1890-1900	2.5	3.8	1.3	0.2	-0.7	-0.6	3.9	-3.3	4.5	7.2
1900-1910	3.0	-0.1	0.8	1.8	-1.1	-6.3	-1.0	-7.2	2.1	3.0
1910-1920	5.4	3.0	0.8	2.6	1.0	-5.1	-2.7	-3.7	12.9	11.5
1920-1930	2.5	2.2	-0.4	2.0	-1.3	-4.2	-0.5	-7.8	-5.4	-1.8
1930-1940	1.4	-3.7	2.7	-1.2	-1.8	-17.4	3.0	-10.3	10.5	3.4
1940-1950	-	-	-	-	-	-	-	-	-	-
1950-1960	5.7	3.2	8.6	5.3	2.0	-3.9	-1.1	-4.9	2.9	3.9
1960-1970	6.8	12.8	9.0	6.3	-1.8	-10.1	0.4	-7.9	7.0	4.8

can obtain the growth rates of the marginal product of labor in non-agriculture (MPL_2). The result is as follows (see TABLE 3); 1960's (9.0%), 1950's (8.6%), 1930's (2.7%), 1890's (1.3%), 1880's (1.2%), 1910's (0.8%), 1900's (0.8%), and 1920's (-0.4%). Therefore, the nonagricultural sector is similar to the agricultural sector in a sense that the growth rates of the marginal product of labor in non-agriculture (MPL_2) are large in postwar periods like the 1950's and the 1960's and small in economic depression periods like the 1920's. The difference is that nonagricultural values in 1930's are rather large and this means that the nonagricultural sector is in rather good condition in this period.

On the other hand, the growth rates of $VMPK_1$ are as follows (see TABLE 2): 1910's (13.9%), 1930's (8.7%), 1960's (5.2%), 1950's (4.9%), 1980th (3.8%), 1880's (1.2%), 1900's (1.0%), and1920's (-6.7%). Subtracting the growth rates of agricultural price (P_1) from these growth rates, we can obtain the growth rates of marginal product of capital in agriculture (MPK_1). The growth rates of marginal product of capital in agriculture is as follows (see TABLE 3); 1950's (2.0%), 1880's (1.5%), 1910's (1.0%), 1890's (-0.7%), 1900's (-1.1%), 1920's (-1.3%), 1930's (-1.8%), and 1960's (-1.8%). We can see how small they are as compared with the result of the case of labor. In other words, they have much smaller positive or in most cases rather negative growth rates. The growth rates of $VMPK_2$ are as follows: 1890's (11.1%), 1910's (8.8%), 1930's (6.4%), 1960's (5.2%), 1880's (3.1%), 1950's (2.8%), 1900's (2.0%), and 1920's (-2.3%).

Subtracting the growth rates of nonagricultural price (P_2) from these growth rates, we can obtain the growth rates of the marginal product of capital in non-agriculture (MPK_2) as follows (see TABLE 3): 1890's (3.9%), 1880's (3.4%), 1930's (3.0%), 1960's (0.4%), 1920's (-0.5%), 1900's (-1.0%), 1950's (-1.1%), and 1910's (-2.7%). This result is similar to the case of agricultural capital and has fairly small positive or negative values. This result shows that there is a clear difference between the labor and capital markets. First, the growth rates of the

marginal product of labor in both sectors have positive values. The only one exception is the 1920's (-0.4%). However, the growth rates of the marginal product of capital in both sectors have smaller positive or mostly negative values. Second, the growth rates of the marginal product of labor in both sectors in the post war periods have large positive values (e.g., 6.85% in the 1960's, 5.7% in the 1950's for the agricultural sector and 9.0% in the 1960's, and 8.6% in the 1950's for nonagricultural sector) but the growth rates of the marginal product of capital in both sectors have negative or near zero values.

From the equation of marginal product of labor = output elasticity of labor multiplied by labor productivity, the marginal product of labor would increase when labor productivity increases. The surplus labor in agriculture decreased with the exception of the 1890's (the 1960's, which experienced the turning point of the Japanese economy, was different from the point of the 1890's although m_1 was positive in the 1960's), therefore this brought an increase in agricultural productivity. Also, the growth rates of agricultural capital were very large in the postwar periods. This also brought an increase in agricultural productivity. In the nonagricultural sector, the growth rates of capital were very large from the beginning and led to productivity increases. These factors increased the marginal productivity of labor in both sectors. On the other hand, capital productivity did not change so much. This comes from the well-known fact that the capital coefficient which is the reciprocal value of capital productivity is usually almost constant over time.

Therefore, the growth rates of the marginal productivity of capital had zero or negative values. The values of m_3 and m_4 (which are defined as the growth rate of interest minus that of *VMPK*) were negative with the exception of the value of m_3 in the 1890's. This was in sharp contrast to the case of labor. This comes from the following two reasons. First, the growth rates of the interest rate were negative except for the 1890's and 1910's as TABLE 2 shows. Second, the growth rates of the value of marginal product of capital were negative but had smaller absolute values than the interest rate in the 1920's. For these two reasons, the values of m_3 and m_4 were negative. In any case, real interest rates were large in the beginning of the Meiji period and the period immediately after World War II and they decreased over time.

4. Agricultural Surplus Labor and Growth Accounting for Japanese Agriculture

TABLE 4 shows the calculated values of the growth accounting for the Japanese economy using our model (see e.g., M. Yamaguchi and H. Binswanger [1975]. Also, see the Appendix TABLE 1 for the model used here). In our calculations, first we calculated the contribution values of total imperfect competition *N*. They show that the contribution values are very large; therefore, we need to analyze the contribution factors in more detail. The result is shown in the lower part of TABLE 4. Total imperfect competition *N* can be divided into six items from our model, i.e., the contribution of wage differentials in both sectors CY_1m_w, the contribution of the difference between the agricultural wage rate and the value of marginal product of labor in

TABLE 4. Growth Accounting for Japanese Agricultural Output

	$\Delta Y_1/Y_1$	CY_1T_1	CY_1T_2	CY_1K	CY_1L	CY_1Q	CY_1B	CY_1a	CY_1N
1880-1890	3.4 (100)	2.9 (85)	-0.1 (-3)	0.5 (15)	0.1 (3)	0.1 (3)	0.1 (3)	1.7 (50)	-1.9 (-56)
1890-1900	1.7 (100)	1.1 (65)	-0.1 (-6)	0.5 (29)	0.2 (12)	0.1 (6)	0.2 (12)	-0.9 (-53)	0.6 (35)
1900-1910	2.2 (100)	1.5 (68)	-0.0 (0)	0.5 (23)	0.1 (5)	0.1 (5)	0.2 (9)	-0.2 (-9)	0 (0)
1910-1920	3.2 (100)	2.9 (91)	0.0 (0)	0.6 (19)	0.2 (6)	0.2 (6)	0.2 (6)	0.3 (9)	-1.2 (-38)
1920-1930	1.1 (100)	0.8 (73)	0.0 (0)	0.4 (36)	0.4 (36)	0.3 (27)	-0.0 (0)	-1.5 (-136)	0.7 (64)
1930-1940	0.4 (100)	0.2 (50)	0.0 (0)	0.4 (100)	0.6 (150)	0.2 (50)	0.1 (25)	0.5 (125)	-1.6 (-400)
1940-1950	-0.5 (100)	-1.0			0.1	0.2	-0.1		
1950-1960	3.6 (100)	3.2 (89)	-0.2 (-6)	0.5 (14)	1.0 (28)	0.3 (8)	0.1 (3)	3.3 (-92)	2.0 (56)
1960-1970	2.1 (100)	2.2 (105)	-0.1 (-5)	1.2 (57)	0.5 (24)	0.3 (14)	-0.1 (-5)	-3.1 (-148)	1.2 (57)

	CY_1N	CY_1m_w	CY_1m_1	CY_1m_2	CY_1m_3	CY_1m_4	CY_1m_r
1880-1890	-1.9 (-56)	0.2 (6)	-1.2 (-35)	0.6 (18)	-0.3 (-9)	0.6 (18)	-1.8 (-53)
1890-1900	0.6 (35)	-0.1 (-6)	0.2 (12)	0.1 (6)	0.0 (0)	0.9 (53)	-0.5 (-29)
1900-1910	0.0 (0)	0.4 (18)	-0.5 (-23)	-0.2 (-9)	-0.6 (-27)	0.7 (32)	0.2 (9)
1910-1920	-1.2 (-38)	-0.3 (-9)	-0.4 (-13)	-0.3 (-9)	-0.6 (-19)	0.1 (3)	0.3 (9)
1920-1930	0.7 (64)	0.7 (64)	-0.1 (-9)	-0.5 (-45)	-0.5 (-45)	1.2 (109)	-0.1 (-9)
1930-1940	-1.6 (-400)	-1.2 (300)	-1.3 (-325)	1.0 (250)	-1.6 (-400)	1.3 (325)	0.2 (50)
1940-1950							
1950-1960	2.0 (56)	1.1 (31)	-0.9 (-25)	1.1 (31)	-0.5 (-14)	0.3 (8)	0.9 (25)
1960-1970	1.2 (57)	-3.0 (-143)	2.0 (95)	0.9 (43)	-0.9 (-43)	0.9 (43)	1.3 (62)

$CY_1\ T_1$, for example, means the contribution of technical change in agriculture T_1 to agricultural output Y_1.

agriculture CY_1m_1, the contribution of the difference between the nonagricultural wage rate and the value of marginal product of labor in non-agriculture CY_1m_2, the contribution of the difference between the agricultural interest rate and the value of marginal product of capital in agriculture CY_1m_3, the contribution of the difference between the nonagricultural interest rate and the value of marginal product of capital in non-agriculture CY_1m_4, and the contribution of the interest rate differentials in both sectors CY_1m_r.

From these calculations, we can see how wage differentials, interest rate differentials, the differences between factor prices and the value of marginal product of factor inputs contribute to the growth rates of agricultural output. From TABLE 4, we can see that the contributions of wage differentials CY_1m_w, the difference between the agricultural wage rate and the value marginal product of labor in agriculture CY_1m_1, the difference between the agricultural interest rate and the value of marginal product of capital in agriculture CY_1m_3 are fairly large contributors to the growth rates of agricultural output. Especially in the 1930's, the contribution of total imperfect competition N had four times the numerical values of the growth rate of agricultural output. Judging from the calculated values, the contributions of the differences between wage rates and the value of marginal product of labor in both sectors CY_1m_1 and CY_2m_2, and the contributions of the differences between the interest rate and the value of marginal product of capital in non-agriculture CY_1m_4, and the contribution of wage differentials CY_1m_w are very large in the 1930's.

TABLE 5 shows the calculated contribution values of the wage differentials m_w and of the differences between agricultural wage rates and the value of marginal products of labor m_1, to the growth rates of eight endogenous variables such as agricultural output Y_1, nonagricultural output Y_2, agricultural capital K_1, nonagricultural capital K_2, agricultural labor L_1, nonagricultural labor L_2, relative price P, and real per capita income E. For example, $CY_1\, m_w$ shows the contribution of wage differentials m_w to the growth rates of agricultural output. TABLE 5 shows that the wage differentials m_w and the difference between the agricultural wage rates and the value of marginal product of labor in agriculture m_1 have a large contribution. In this way, this paper showed the calculated values of imperfect competition, and saw how this imperfect competition affected and contributed to the economic development of Japan.

5. Surplus Labor in the Agricultural Sector in Taiwan, China and Thailand

5.1 Surplus labor in the agricultural sector in Thailand

FIGURE 2 shows the values of change in surplus labor in the agricultural sector calculated by the use of two methods. As shown above, the first method of calculating the increase or decrease in surplus labor calculates the change in the indices of m_1 [which is defined as m_1=$\mathrm{MPL}_1/(W_1/P_1)$]. Here, MPL_1 is the marginal productivity of labor in agriculture, W_1 is the nominal wage rate and P_1 is the price of agricultural goods. If the growth rate of MPL_1 is larger

TABLE 5. Contribution of Imperfect Competition to 8 Endogenous Variables

	CY_1m_w		CY_2m_w		CK_1m_w		CK_2m_w		CL_1m_w		CL_2m_w		CPm_w		CEm_w	
1880-1890	0.2	(6)	-1.2	(-32)	0.1	(14)	-0.0	(0)	-0.6	( )	-1.5	(-88)	-1.3	(-21)	0.7	(-26)
1890-1900	-0.1	(-6)	0.4	(10)	-0.0	(0)	0.0	(0)	0.3	(300)	0.8	(57)	0.5	(-26)	0.2	(9)
1900-1910	0.4	(1.8)	-1.1	(-42)	-0.0	(0)	0.0	(0)	1.0	( )	2.4	(185)	-1.5	(188)	-0.7	(-54)
1910-1920	0.3	(-9)	0.5	(13)	0.1	(11)	-0.0	(0)	-0.7	(58)	1.4	(44)	0.9	(129)	0.3	(12)
1920-1930	0.7	(66)	-0.9	(-38)	-0.2	(-20)	0.0	(0)	1.6	( )	-2.1	(-124)	-1.9	(58)	0.5	(-100)
1930-1940	-1.2	(-300)	0.8	(14)	0.6	(86)	-0.0	(0)	-2.3	(767)	1.7	(61)	2.6	(36)	0.6	(15)
1940-1950																
1950-1960	1.1	(31)	-0.7	(-8)	-0.4	(-9)	0.2	(3)	1.7	(-100)	-1.0	(-21)	-2.2	(147)	-0.4	(-6)
1960-1970	-3.0	(143)	1.0	(8)	1.7	(19)	-0.1	(-1)	-5.4	(150)	1.6	(55)	5.7	(271)	1.0	(10)
	CY_1m_1		CY_2m_1		CK_1m_1		CK_2m_1		CL_1m_1		CL_2m_1		CPm_1		CEm_1	
1880-1890	1.2	(-35)	6.7	(181)	-0.3	(-43)	0.2	(6)	-3.6	( )	8.3	(488)	7.3	(116)	3.9	(144)
1890-1900	0.2	(12)	-0.6	(-15)	0.0	(0)	-0.0	(0)	0.5	(500)	-1.1	(-79)	-0.8	(42)	-0.4	(-18)
1900-1910	0.5	(-23)	1.2	(46)	0.0	(0)	0.0	(0)	-1.1	( )	2.6	(200)	1.7	(-213)	0.8	(62)
1910-1920	0.4	(-13)	0.7	(18)	0.1	(11)	-0.0	(0)	-1.0	(83)	1.9	(59)	1.2	(171)	0.4	(15)
1920-1930	-0.1	(-9)	0.1	(4)	0.0	(0)	0.0	(0)	-0.1	( )	0.2	(12)	0.2	(-6)	0.0	(0)
1930-1940	-1.3	(-325)	0.9	(16)	0.6	(86)	-0.1	(-2)	-2.5	(838)	1.9	(68)	2.9	(40)	0.6	(15)
1940-1950																
1950-1960	0.9	(-25)	0.6	(7)	0.3	(7)	-0.1	(-2)	-1.4	(82)	0.8	(17)	1.8	(-120)	0.4	(6)
1960-1970	2.0	(95)	-0.7	(-6)	-1.1	(-12)	0.1	(1)	3.7	(-103)	-1.1	(-38)	-4.0	(-190)	-0.7	(-7)

Y_1 : Agricultural Output, Y_2 : Nonagricultural Output, K_1 : Agricultural Capital Stock, K_2 : Nonagricultural Capital Stock, L_1 : Agricultural Labor, L_2 : Nonagricultural Labor, P : Relative Price (Ag / Nonag), E : Per Capita Income.

than the growth rate of (W_1/P_1) in a period, then we regard that agricultural surplus labor decreased in this period. [Usually, MPL_1 is smaller than the real wage rate (W_1/P_1) if there is surplus labor in the economy. According to the Fei = Ranis definition, redundant labor is labor whose MPL is zero, and surplus labor is labor whose MPL is less than the real wage rate.]. Indices 1 of the surplus labor in Thailand (i.e., $\Delta m_1/m_1$ in FIGURE 2) have negative values in the period from 1973 to 1977 (the value of 1975 in FIGURE 2 is the value of the 5 year moving average growth rate of 1973, 74, 75, 76 and 77). This means that agricultural surplus labor decreased in this period. However, agricultural surplus labor increased in the next period (from 1978 to 1981). During the following period (from 1982 to 89), agricultural surplus labor decreased again. In particular, the speed of decrease was very large in the years from around 1983 to 88.

The second method of calculating the increase or decrease in surplus labor calculates the change in indices of m_w [which is defined as $m_w=(W_1/W_2)$]. Here, W_1 is the nominal wage rate in agriculture and W_2 is the nominal wage rate in the nonagricultural sector. If the growth rate of W_1 is larger than that of W_2 in a period, then we regard that agricultural surplus labor decreased in that period. Usually, the wage rate in agriculture (W_1) is lower than the wage rate in the nonagricultural sector (W_2) if there is surplus labor in the agricultural sector. Therefore, we interpret this to mean that surplus labor, in terms of the second definition, would decrease if the growth rate of m_w had a positive sign. Indices 2 that measure the surplus labor in Thailand (m_w) have negative values in 1973, in the periods from 1976 to 1980 (except for 1978), from 1982 to 1987, and from 1992 to 1993 respectively. This would be interpreted as indicating that the agricultural surplus labor, according to the second definition, increased in these periods. FIGURE 2 shows these increases in the surplus labor as positive (not negative) for simplicity. Conversely, agricultural surplus labor decreased in the periods from 1974 to 1976, and from 1988 to 1991. In order to see the net increase or decrease in surplus labor, we calculated the net increase or decrease in surplus labor (See total in FIGURE 2). In other words, total in FIGURE 2 is defined as "total= $m_1 + m_w$". This shows that surplus labor decreased in the period from 1973 to 1976, but increased from 1977 to 1983. Surplus labor again decreased in the period from 1984 to 1991. However, this again increased in 1992 and 1993.

5.2 Surplus labor in agricultural sector in Taiwan and China

We measured the increase or decrease in surplus labor in Taiwan and China (See FIGURE 2) and measured how the change in these surpluses contributed to the economic development of these countries. We estimated when the turning point of labor in China and Thailand occurred and obtained the conclusion that they need more time to reach the turning point of labor. From the calculated results of growth accounting in each country, we can summarize as follows: for the agricultural output growth of China, the contribution of agricultural technical change was largest, i.e., 52% (51% in Thailand), the contribution of total labor was second, i.e., 32% (37% in Thailand), the contribution of total capital was 30% (11% in Thailand) and the contribution of population was 4% (4% in Thailand too). In the case of Japan, the contributions

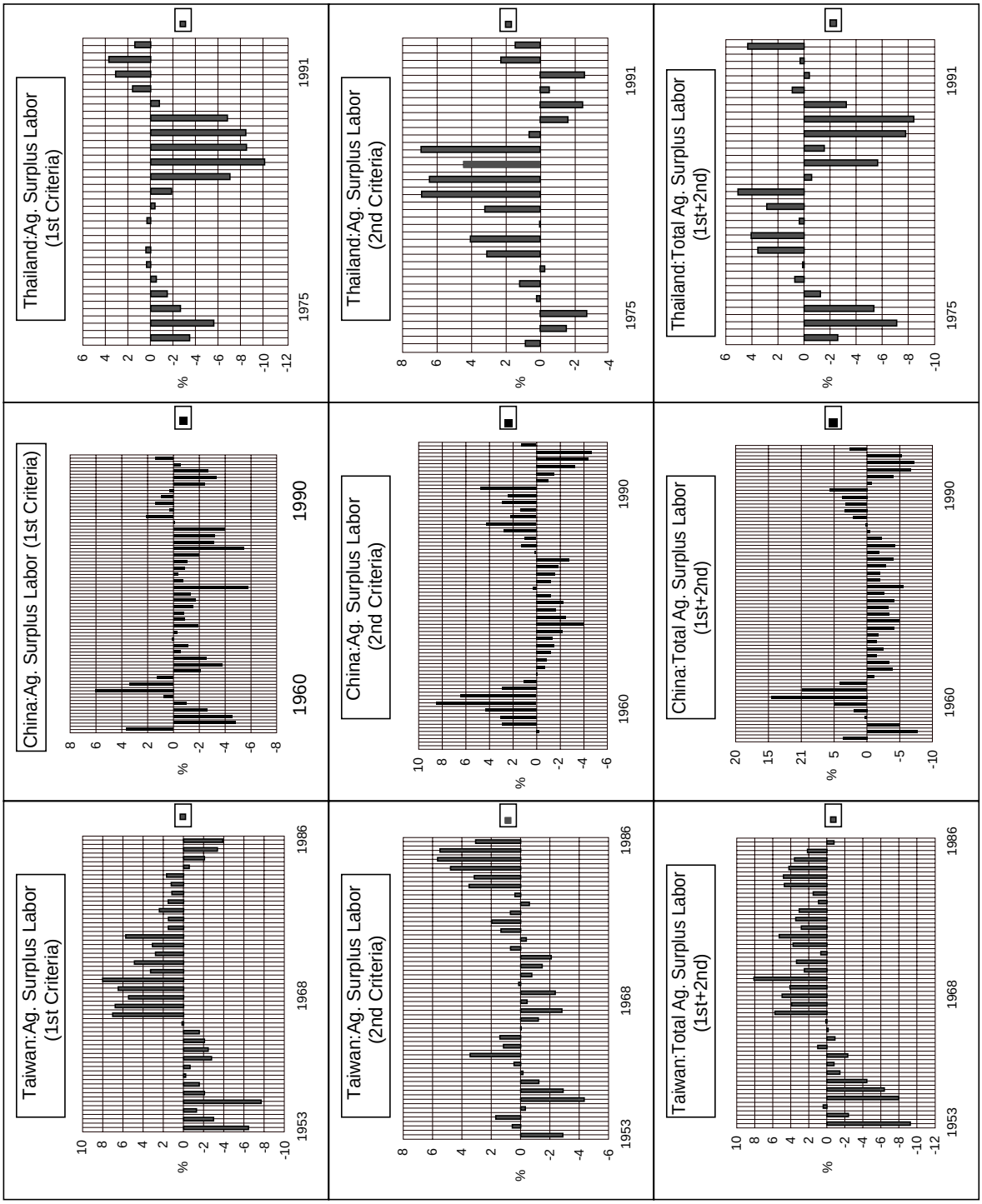


FIGURE 2. Change of Surplus Labor in Taiwan, China and Thailand

of agricultural technical change and population were very large. Second, for nonagricultural output, the contribution of nonagricultural technical change was the largest in China (for Japanese nonagricultural output growth, the contribution of nonagricultural technical change was very small because the contributions in the 1920's and the 1910's were especially small.). Although the contributions of total capital in Japan and total labor in Thailand were very large for nonagricultural output growth, the contribution of total capital was also fairly large (28%) in China.

Third, for per capita income growth, the contribution of nonagricultural technical change was the largest (44%) and that of total capital was also fairly large (35%) in China. However, the contribution of total labor was the largest (63%) and that of nonagricultural technical change was second (52%) in Thailand. The contribution of total capital in Japan was very large (92%) and that of agricultural technical change was also fairly large (37%) for per capita income growth in Japan. But the contribution of nonagricultural technical change was very small. This comes from the reasons stated above, i.e., nonagricultural technical change in the 1920's and the 1910's was almost zero or negative in these periods (the contribution of nonagricultural technical change becomes 39% if we exclude these periods). Also, China spent only 30 years to make the same degree of economic development which Japan took almost 90 years or so (Thailand spent only 40 years to make the same degree of economic development which Japan took almost 70 years or so). Japan used to be regarded as an example of the fastest growth in the world, but China and Thailand exceed the speed of Japan. This is consistent with Gershenkron's conclusion.

6. Regression Analysis of m_1 and m_w

We have already published the push–pull effects of technical change in the agricultural and nonagricultural sector (see M. Yamaguchi and H. Binswanger (1975) and M. Yamaguchi and G. Kennedy (1984a)). In other words, technical change in both sectors has nonsymmetrical effects on labor. Technical change pushes agricultural labor to the nonagricultural sector but nonagricultural technical change does not push nonagricultural labor to the agricultural sector, but pulls agricultural labor to the nonagricultural sector. This comes from the low agricultural income and price elasticity (see Yamaguchi and H. Binswanger (1975)). As a result, technical change in both sectors reduces agricultural labor and increases the value of marginal product of labor in agriculture ($VMPL_1$). Therefore, m_1 ($=w_1/VMPL_1$) decreases. On the other hand, population growth has the opposite effect on agricultural labor. Population growth increases agricultural labor and reduces the value of marginal product of labor in agriculture ($VMPL_1$). Therefore, m_1 ($=w_1/VMPL_1$) increases. TABLE 6 shows the regression analysis for this. The result shows good support to this view.

In the same way, technical change in both sectors reduces agricultural labor and increases nonagricultural labor. Then, the wage rate of nonagricultural labor (w_2) decreases. Therefore,

TABLE 6. Estimated Results of affecting Surplus Labor in Agriculture

Dependent variable	(Agricultural Surplus m_1)		(Agricultural Surplus m_2)
	(1)	(2)	(1)
Ag. Tech. Change (T_1)	-1.023	-1.022	0.002
	(-64.09)	(-58.80)	(0.708)
Nonag. Tec. Change (T_2)	-0.032	-0.024	0.010
	(-2.128)	(-1.480)	(3.082)
Population (ΔQ)	0.804	0.963	-0.095
	(2.784)	(3.113)	(-1.837)
Dummy 1 (Year of 1918)	-1.129		
	(-3.326)		
Dummy 2 (1886-1905)	0.258		
	(3.120)		
Constant	-0.238	-0.146	-0.013
	(-3.847)	(-2.464)	(-1.158)
Adjusted R^2	0.989	0.987	0.191

m_w ($=w_1/w_2$) increases. On the other hand, population growth has the opposite effect on agricultural labor. Population growth increases agricultural labor and reduces the wage rate of agricultural labor (w_1). Therefore, m_w ($=w_1/w_2$) decreases. TABLE 6 shows the regression analysis for these. The result also shows good support to these views.

7. Summary and Conclusion

(1) We calculated the change in the degree of imperfection in each decade from 1880 to 1970. Judging from the sense of the widening of wage differentials, we found that the imperfection increased in the 1880's, 1900's, 1920's and 1950's. For the sense of a widening value between the agricultural wage rate and the value of marginal product in agricultural labor, we found that the imperfection increased in the 1890's, 1920's and 1960's. Therefore, we can understand that the decade of the 1920's is the period which increased the agricultural surplus in both senses. Only in the 1920's, the growth rate of the value of marginal product of labor in agriculture had a minus sign. Also, the growth in the wage rate in agriculture had a minus sign too.

(2) Judging from the ordinary calculation method which is the method to check the gap

between the wage rate and the marginal product of labor, surplus labor in agriculture decreased greatly in the 1880's, but increased in the 1890's. Again, surplus labor in agriculture decreased greatly from the 1900's to the 1920's. However, the degree of decrease became smaller over time. And the 1920's is an almost stagnant period or rather the increase was very small. The 1930's was the period of large decrease of agricultural surplus. We do not have data for the 1940's but we can guess that surplus labor in agriculture increased greatly in the 1940's. However, surplus labor in agriculture again decreased fairly much in the 1950's. In the beginning of the 1960's, the Japanese economy experienced a turning point for labor and both the value of marginal product of labor in agriculture and the agricultural wage rate increased. Therefore, we should interpret the 1960's as it is a decreasing period of agricultural surplus labor although the calculation result shows positive.

(3) The gap between the interest rate and the marginal product of capital decreased over time except for the agricultural sector in the 1890's. The growth rates of the interest rate had minus signs except for the 1890's and the 1910's which showed a large increase in the value of marginal product of capital. The interest rate decreased greatly in the 1920's which had a large decrease in the value of marginal product of capital in both sectors. In other words, the interest rate looks likely to follow the movement of the value marginal product of capital very slowly and decrease immediately when the growth of the value of marginal product of capital decreases. Therefore, the growth rates of the real interest rate (which is the value of the growth rate of the interest rate minus the value of marginal product of capital) always had negative signs. The Japanese interest rate was very large in the beginning of the Meiji period and after World War II and decreased over time. Also, the growth rates of the marginal product of capital were zero or negative, although those of the marginal product of labor had very high positive values.

(4) Growth accounting for agriculture shows that the contribution of imperfect competition is very large. Therefore, it would be necessary to analyze the content of imperfection. This imperfect competition is classified into 6 items: CY_1m_w (contribution of the growth of the wage differential to agricultural output growth), CY_1m_1 (contribution of the difference between the growth rate of the wage rate in agriculture and that of the marginal product of labor to agricultural output growth), CY_1m_2 (contribution of the difference between the growth rate of the wage rate in non-agriculture and that of the marginal product of labor to agricultural output growth), CY_1m_r (contribution of the growth of the interest rate differential to agricultural output growth), CY_1m_3 (contribution of the difference between the growth rate of the wage rate in non-agriculture and that of the marginal product of labor to agricultural output growth), and CY_1m_4 (contribution of the difference between the growth rate of the wage rate in non-agriculture and that of the marginal product of labor to agricultural output growth). For the growth of agricultural output, CY_1m_w, CY_1m_1, CY_1m_2 and CY_1m_3 have large values. Especially, 6 contributions of imperfection in total amounted to about 4 times the growth agricultural output. For the growth of labor in agricultural and nonagricultural sectors, and relative price, the contribution of m_1 and m_w have very large values.

(5) Judging from the regression analysis, $\dot{m}_1$ (=$\Delta m_1/m_1$) (= the difference in growth rates between the value of marginal product of agricultural labor ($VMPL_1$) and the wage rate in agriculture (w_1)) decreases (this means that the surplus labor in agriculture decreases) when technical change in both sectors increases. On the other hand, population growth has an opposite effect to technical change and increases surplus labor in agriculture. Judging from the regression analysis, $\dot{m}_w$ (=$\Delta m_w /m_w$) (=the difference of growth rates between the wage rates in agriculture (w_1) and non-agriculture (w_2)) increases (this means that the surplus labor in agriculture decreases) when technical change in both sectors increases. On the other hand, population growth has an opposite effect to technical change and increases surplus labor in agriculture.

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