No. 235

The Determinants of Labor Migration out of Agriculture in Japan

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September 1983

Revised May 1984

1. Introduction

Migration of labor out of agriculture to the nonagricultural sectors has been of prime importance for the economic development in Japan since the Meiji era up to date.

According to Table 1, the total numbers of employment in the nonagricultural sectors increased by 11 and 21.5 million persons for the periods 1894-1938 and 1958-1980, respectively. On the other hand, the numbers of net migrants out of agriculture to the nonagricultural sectors were 7 and 11 million persons, respectively, for the corresponding periods.

The degree of contribution of the net migration to the increase in the nonagricultural employment was 63.5 percent during the 1894-1938 period. On the other hand, although the nonagricultural sectors increased the share in the total labor force and hence increased the degree of contribution to the increase in employment in their own sectors during the postwar years, the net migration from agriculture still accounted for more than 50 percent of the total increase in the nonagricultural employment during the 1958-1980 period. These figures show that agriculture has contributed to the growth of the nonagricultural sectors and hence to the growth of the economy as a whole by providing these sectors with a large number of workers since the Meiji era up to date.

Next, the annual net migration rate, difined as the ratio of the number of net migrants to that of total agricultural gainful workers, was 1.1 percent on the average for the 1894-1938 period. However, it fluctuated in accordance with the business cycle of the economy. It was

almost 2.0 percent in the 1910's during which the Japanese economy enjoyed the First World War boom. It then declined during the 1920's, more specifically, after the mid-1920's until the early 1930's. During this period the Japanese economy experienced serious depressions. After the economic panic (1929-1931) was over, it again increased to around 1.6 percent per year for the 1930's during which the Japanese economy enjoyed a boom before it broke into the Second World War.

On the other hand, the annual net migration rate for the period 1958-1980 was 5.9 percent on the average which was much higher than that before the pre-World War II period. It also fluctuated in accordance with the bussiness cycle of the portwar Japanese economy. It was almost 7 percent during the 1960's through the early 1970's during which the Japanese economy experienced a drastic growth. However, it declined to around 5 percent during the years after the "Oil Shock" occured in 1973.

What factors have been responsible for the labor transfer from agriculture to the nonagricultural sectors in the process of the economic development in Japan since the Meiji era up to date? More specifically, is it possible to indentify differences in the patterns of the agricultural labor migration between the periods before and after the Second World War?

According to Minami [1973], the Japanese economy passed the "turning point" around the late 1950's through the early 1960's. According to this proposition, the periods 1894-1938 and 1958-1980 in the present study may fall into the stages of development of the Japanese economy before and after the turning point, respectively. In other words, according to the turning point hypotheses proposed by Minami [1973], the

Table 1

Net Migration and the Degree of Contribution to the Increase in Nonagricultural Employment, 1894-1938 and 1958-1980

(unit : 1,000 persons, percent)

		Increase in nonagricultural employment (1)	Number of net migrants (2)	Degree of contribution (3)=(2)/(1)	Net migration rate (4)
Pre-World War II Period	1894 - 1900	715	405.9	56.8	0.37
	1901 - 1905	313	114.9	36.7	0.33
	1906 - 1910	731	528.6	72.3	0.55
	1911 - 1915	1,969	1,588.3	80.7	1.79
	1916 - 1920	1,740	1,310.2	75.3	1.96
	1921 - 1925	1,610	1,055.5	65.5	1.39
	1926 - 1930	932	145.0	15.6	0.33
	1931 - 1935	1,957	1,118.1	57.1	1.52
	1936 - 1938	1,102	763.3	69.3	1.75
	1894 - 1938	11,069	7,029.8	63.5	1.11
Post-World War II Period	1958 - 1960	2,140	1,008.9	47.1	3.61
	1961 - 1965	6,170	3,288.4	53.3	5.75
	1966 - 1970	5,670	2,967.4	52.5	6.65
	1971 - 1975	3,540	2,322.2	65.9	7.18
	1976 - 1980	3,990	1,374.4	34.4	5.11
	1958 - 1980	21,510	10,980.8	51.0	5.88

Notes : 1) The number of net migrants out of agriculture per year (M) for the 1894-1938 period, following Umemura [1961] pp.158-159, was estimated by $M_t = (1+r_t)L_{at} - L_{at+1}$ where L_a and r are respectively the number of agricultural gainful workers and the natural growth rate of total labor force, and t designates time (year). As for the 1958-1980 period, the number of net migrants per year was directly obtained from official data sources. However, that for 1958-1962 includes migrants from households in Forestry and Fisheries. Then, the number of net migrants for a specific period was obtained simply by summing up the number of net migrants of each year in that period.

2) The net migration rate per year was obtained by dividing the number of migrants per year by the number of agricultural gainful workers in the corresponding year. The net migration rate for a specific period is a simple average of the net migration rates of the years in that period.

Sources : The numbers of total and agricultural gainful workers for the 1894-1938 period were obtained from Ohkawa and Shinohara [1979], Table A53, pp.392-393 and Table A18, pp.293-297, respectively. The number of agricultural gainful workers for the 1958-1980 period was obtained from various editions of Rodo Tokei Nempo (Statistical Yearbook of Labor) published by the Statistical Bureau of the Prime Minister's Office. The number of net migrants was taken from various editions of Noringyoka Shugyo

Doko Chosa (Statistical Survey on Changes in Employment of Households in Agriculture, Forestry, and Fisheries) for 1958-1962 and Noka Shugyo Doko Chosa (Statistical Survey on Changes in Employment of Farm Households) for 1963-1980 published by the Ministry of Agriculture, Forestry, and Fisheries.

period 1894-1938 may be characterized by the existence of "unlimited supplies of labor" in Lewis' [1954] term, while the period 1958-1980 may be represented by the economic state of "limited supplies of labor".

The objective of this study may therefore amount to try to identify differences in the migration patterns between the two periods before and after the turning point of the Japanese economy. For this purpose, a migration function is to be specified and estimated for these two periods.

Although quantitative studies of the sectoral labor migration in the Japanese economy have been accumulating,[1)] there have been very few or no study which tried to identify differences in the migration patterns in accordance with the stages of development of the Japanese economy. It is thus expected that the present study will offer a better empirical documentation on the labor migration out of agriculture in the process of the development of the Japanese economy since the Meiji era up to the present.

The hypothesis is formulated and a migration function is specified in section two. Then, section three discusses the definitions of the variables used for the estimation of the migration function and the sources of the data. In section four, the estimates of the migration function are evaluated and analyzed. Finally, section five concludes the present study by summarizing the empirical findings.

2. The Hypothesis and the Statistical Model

2.1 The hypothisis

Traditionally, wage differentials hypothesis and job opportunities

hypothesis have been proposed for explaining the sectoral labor migration between agriculture and nonagriculture. The former is often regarded as "push" hypothesis, implying that if there exist gaps in returns to labor between agriculture and the nonagricultural sectors, potential migrants in agriculture will tend to move to the nonagricultural sectors. In this sence, it may be understood that wage differentials hypothesis emphasizes the supply side of sectoral labor migration.

On the other hand, job opportunities hypothesis is regarded as "pull" hypothesis. This hypothesis proposes that even if wage differntials are perceived by potential migrants in agriculture, they could not transfer to the nonagricultural sectors if job opportunities in the nonagricultural sectors are limited. In other words, it emphasizes that job opportunities are a dominant determinant of the sectoral labor migration. In this sense, it may be understood that this hypothesis stresses the demand side of the sectoral labor migration.

However, these two hypotheses may not be considered mutually exclusive. Instead, it may be more realistic to propose that actual labor migration between the two sectors is explained complementarily by the wage differential in the two sectors and job opportunities. However, the relative importance of these two factors as the determinants of sectoral labor migration may depend on the economic conditions, especially on the labor market conditions, in the process of the development of an economy.

If the economy has not yet passed the "turning point" and thus there exists "unlimited supplies of labor" in the subsistence sector, the supply price of agricultural labor to the modern sector is determined

at the subsistence level (Lewis, 1954). Here, it may be assumed that the subsistence sector and the modern sector are represented respectively by the agricultural and nonagricultural sectors.

Under such an economic situation, if there exist wage differentials between agriculture and the nonagricultural sectors, there would be many agricultural workers who are willing to move to the nonagricultural sectors at the prevailing levels of wage differentials. It may therefore be possible for firms in the nonagricultural sectors to pull as much labor from agriculture as they need at the prevailling wage rate which is equal to the subsistence level. This implies that the transfer of labor from agriculture to the nonagricultural sectors is limited by the size of the demand for labor in the nonagricultural sectors. In this case, therefore, it would be expected that the migration of labor from agriculture to the nonagricultural sectors is largely explained by job opportunities in the nonagricultural sectors.

On the other hand, as capital accumulation proceeds in the nonagricultural sectors and technological progress proceeds in both argiculture and the nonagricultural sectors, unlimited supplies of labor will become exhausted and the economy will pass the "turning point". That is, the supply of labor to the nonagricultural sectors will be limited and the labor market will then be at full employment or near full employment. Thus, the economy will now be in the neoclassical world.

Under such an economic situation, firms in the nonagricultural sectors will have to raise the wage rate if they want to employ additional labor. On the other hand, potential migrants from agriculture to the nonagricultural sectors will now be more sensitive to changes in the

wage rates and hence the wage differential in the two sectors, since it may be considered that they behave as to maximize their incomes by choosing jobs suitable for their skill levels. In this case, it would be expected that the migration of labor out of agriculture is largely explained by the wage differential between agriculture and the nonagricultural sectors.

In his elaborated work, Minami [1973] proposed that the Japanese economy passed the turning point around the late 1950's through the early 1960's. According to this proposition, unlimited supplies of labor existed in the agricultural sector until around the late 1950's through the early 1960's, while the supply of labor has been limited during the period after the late 1950's up to date.

It would therefore be expected that job opportunities were a dominant determinant of the sectoral labor migation before the Second World War, while the wage differential have largely explained the migration of labor from agriculture to the nonagricultural sectors for the period after the late 1950's. This hypotheses will be empirically tested in the present study by estimating a migration function which will be specified below.

2.2 The Statistical Model

A simple econometric migration function may be written as,

(1) $m = f(Y, Z, e)$,

where m is the net migration rate defined as the ratio of the number of net migrants to that of agricultural gainful workers, Y and Z represent the wage differential in the two sectors and job opportunities, respectively, and e is an error term which is expected to capture the effects

of the other factors affecting the migration.

There are two questions as to the introduction of Y. One is the question whether the wage differential should be measured as the relative ratio or the absolute differences between the agricultural wage rate and the nonagricultural wage rate. There is no a priori unambiguous theoretical ground thus far for which alternative should be chosen. It is entirely a matter of empirical experiments. Thus, these two alternatives will be tried in the statistical estimation in section four.

The other question is as to what should be the correct measure of the wage differential in the two sectors, either relative or absolute. This question is closely related not only to who the migrants were but also to the time span of estimating the wage differential -- daily, weekly, monthly, or yearly.

First, since migration may be considered to be practiced on a long run prospect, it is assumed that it is most relevant to measure the wage differential on a yearly base. Thus, the concept "wage differntial" may become more like "income differential" per year. In the following, therefore, the terminology "income differential" will be used instead of "wage differential".

Next, according to Minami [1973], the migrants were largely family laborers during the pre-World War II period. Since these family laborers are in general not paid any wages, it is necessary to impute some wage rate to them. For this purpose, two kinds of agricultural wage rates are available. One is the wage rate for temporarily-hired labor which is in general employed at peak seasons. The other is the wage rate for

annual-contract hired labor.

Following Minami [1973], it is assumed that the annual-contract wage earnings per year are the expected income for family laborers if they remain engaged in farmings. The reason for this choice is that the wage earnings of annual-contract labor may be considered very close to the shadow price of the family labor, since annual-contract laborers usually live together with the family members in the same houses or on the same lots and work on the farms with the family laborers.

What should then be the correct measure of the expected income in the nonagricultural sectors which may be compared with the wage earnings of annual-contract hired labor? Since potential migrants from agriculture are in general unskilled laborers, the wage earnings which they expect to receive after the transfer would be the ones for unskilled laborers in the nonagricultural sectors. Thus, the annual wage earnings per average production worker in the manufacturing sector are considered to be a best proxy among the available series of wage data.

Next, during the period after the late 1950's, not only family laborers but also even a large number of heads and first sons who were expected to inherit farmings transfered to the nonagricultural sectors. In such a case, annual-contract wage earnings may not be relevant as a proxy variable for the expected income in the agricultural sector. It is then assumed that annual farm income per agricultural gainful worker in an average farm household is a most relevant proxy in this case.

As for the wage earnings for potential migrants to expect to receive in the nonagricultural sectors, the annual wage earnings per worker of firms with five or more employees are introduced. They may be regarded

as an weighted average wage earnings of unskilled and skilled workers. The main reason for this choice is that the migrants during this period obtained jobs which require not only low levels of skills but also higher levels of skills.[2)]

Next, what should be the correct variable which represent job opportunities? Since this study tries to analyze the movement of labor from agriculture to the nonagricultural sectors, it should measure the degree of easiness of obtaining jobs in the nonagricultural sectors. It is then assumed that the annual growth rate of the nonagricultural gross domestic product designated as g, is a most relevant proxy for job opportunities for the pre-World War II period.

However, this may not be relevant for the period after the late 1950's since the technological progress has been dominated by labor-saving types and therefore changes in g may not directly reflect the size of the demand for labor in the nonagricultural sectors. Instead, unemployment rate would be expected to measure more directly the size of job opportunities. Therefore, unemployment rate is introduced as a best proxy variable for job opportunities for the period after the late 1950's.[3)]

The migration function (1) is now specified for statistical estimation. Both linear and loglinear forms are assumed in the present study. They are written as

$$(2) \qquad m = a_0 + a_1 Y + a_2 Z + e,$$

$$(3) \qquad \ln m = b_0 + b_1 \ln Y + b_2 \ln Z + v,$$

where Z is the annual growth rate of nonagricultural gross domestic

product for the pre-World War II period (g) and the unemployment rate (U) for the period after the late 1950's, a_0, a_1, and a_2 and b_0, b_1, and b_2, are the parameters to be estimated, and e and v are the disturbance terms which are assumed to possess the standard properties. The expected signs for the estimated parameters are positive for a_1 and b_1 and positive for a_2 and b_2 for the pre-World War II period but negative for the period after the late 1950's.

The periods for the empirical estimation are 1894-1937 for the pre-World War II period which is considered to be featured by "unlimited supplies of labor" and 1958-1980 during which the supply of labor is considered to be limited.

3. The Definitions of the Variables and the Sources of the Data

The net migration rate

In order to estimate the net migration rate, it is necessary to obtain the number of net migrants. Fortunately, this can easily be done for the period after 1958 from an officially published yearbook, i.e., Noka Shugyo Doko Chosa Hokoku (Statistical Survey on Changes in Employment of Farm Households) published annually by Norin Suisan Sho (the Ministry of Agriculture, Forestry, and Fisheries). The total number of net migrants was taken from this source for each year of the 1958-1980 period.[4)]

It was then divided by the number of total agricultural gainful workers of the corresponding year which was taken from Rodo Tokei Nempo (Statistical Yearbook of Labor) published annually by Sorifu Tokei Kyoku (the Statistical Bureau, the Prime Minister's Office). This yielded the

net migration rate, m, for each year of the 1958-1980 period.

On the other hand, there is no officially published data of the number of net migrants for the pre-World War II period. Thus, it has to be estimated by making use of estimates of the total number of agricultural gainful workers. Several series of estimates of the total number of agricultural gainful workers are available for this purpose.[5] The series in Ohkawa and Shinohara [1979] were chosen in this study for the following reason. They estimated the number of agricultural gainful workers by multiplying Umemura's [1969,1973] estimates of the number of gainful workers in agriculture and forestry by the ratio of the number of workers in agriculture to the number in agriculture and forestry. This ratio was obtained from the 1920 and 1930 Population Censuses. Since the Umemura's estimates are so far considered to be the most reliable estimates among all the estimates of the number of workers in agriculture and forestry, it may be assumed that the Ohkawa and Shinohara [1979] estimates are the most reliable estimates of the number of agricultural gainful workers.

The number of net migrants were estimated by $M_t = (1+r_t)L_{at}-L_{at+1}$ where M is the number of net migrants, L_a is the number of agricultural gainful workers, r is the annual natural growth rate of total labor force, and subscript t denotes time.[6] Note here that it was assumed because of the lack of data that the natural growth rate of the number of agricultural gainful workers is equal to that of total labor force. As mentioned above, the numbers of agricultural and total gainful workers were obtained from Ohkawa and Shinohara [1979], tables A18 (pp.293-297) and A53 (pp.392-393).

The estimated number of the net migrants in each year was then divided by the number of agricultural gainful workers of the corresponding year, yielding the net migration rate, m.

However, the estimates of agricultural gainful workers are given for the center of each year for the 1894-1919 period and for October of each year for the 1920-1937 period. Thus, the net migration rate estimated for each year may not give the complete picture of the actual migration during that particular year. It is then assumed that the net migration rate of each year is given by $(m_{t-1}+m_t)/2$ which is expressed in percent.

The Income Differential

The wage earnings per annual-contract hired labor per year for the 1894-1937 period were obtained from Umemura and others, eds. [1966], Estimates of Long-Term Economic Statistics (ELTES), Vol.9, Noringyo (Agriculture and Forestry), pp.220-221. These estimates are weighted average of male and female wage earnings with the weights being the numbers of male and female agricultural gainful workers, respectively. These are expressed in yen.

On the other hand, the annual wage earnings per average production worker in the manufacturing sector were taken from Ohkawa and Shinohara [1979], pp.390-391. These are an average of the annual wage earnings of male and female workers which are expressed in yen.

In order to obtain the real annual wage earnings, these two series of estimates of the annual wage earnings were deflated by the consumer price index (CPI) with 1934-1936 prices being unity. The CPI was taken

from Ohkawa and others, eds. [1967], ELTES, Vol.8, Bukka (Prices), p. 134. The relative and absolute income differentials were obtained by taking the ratio and the difference between the agricultural and non-agricultural wage earnings. They are denoted as YR_1 and YD_1, respectively.

For the 1958-1980 period, farm income per agricultural gainful worker in an average farm household was obtained from Noka Keizai Chosa Hokoku (Survey Report on Farm Household Economy) published annually by Norin Suisan Sho (the Ministry of Agriculture, Forestry, and Fisheries). On the other hand, wage earnings per year per worker of firms with five or more employees were obtained from Rodo Tokei Nempo (Statistical Yearbook of Labor) published annually by Sorifu Tokei Kyoku (the Statistical Bureau, the Prime Minister's Office).

These estimates of incomes in the two sectors were deflated by the CPI with 1975 prices being unity which was obtained from Nihon Tokei Nenkan (Statistical Yearbook of Japan) published annually by Sorifu Tokei Kyoku (the Statistical Bureau, the Prime Minister's Office). These are expressed in 1,000 yen per year. Then, the relative and absolute differentials between the real wage earnings per worker in the nonagricultural sectors and the real farm income per agricultural gainful worker were estimated. These are designated as YR_2 and YD_2, respectively.

Job opportunities

As mentioned in the previous section, the annual growth rate of real nonagricultural gross domestic product (g) and unemployment rate (U) are employed as the proxies for job opportunities for the 1894-1937 and

1958-1980 periods, respectively.

The annual growth rate of real nonagricultural gross domestic product is defined as the ratio of the real nonagricultural gross domestic product in the previous year to that in the present year and is expressed in terms of percent. The data for real nonagricultural gross domestic product was obtained from Ohkawa and others, eds. [1974], ELTES, Vol.1, Kokumin Shotoku (National Income), Table 37, p.234.

The unemployment rate for the 1958-1980 period was obtained from Rodo Tokei Nempo (Statistical Yearbook of Labor) published annually by Sorifu Tokei Kyoku (the Statistical Bureau, the Prime Minister's Office). This is an average of male and female unemployment rate and is expressed in terms of percent.

4. Empirical Results

4.1 Results for 1958-1980

The linear equation (2) and the loglinear equation (3) were estimated for the 1958-1980 period, trying both the relative and absolute income differencials, YR_2 and YD_2, respectively, together with unemployment rate, U, as the explanatory variables. However, the results where the combination of YR_2 and U was employed were worse than those where the combination of YD_2 and U was used, in terms of R^2 and the computed t-statistics of the coefficients, especially of that of the relative income ratio, YR_2. This held true for both the linear and loglinear specifications. Thus, reported in Table 2 are the estimated results of both the linear and loglinear specifications for which the latter combination of the explanatory variables was employed.

The fit of the linear and loglinear equations are fairly good -- the R^2's are 0.82 and 0.83, respectively. Moreover, the estimated coefficients are all statistically significant at either the five or the one percent level. This implies that 82 to 83 percent of the variations in the net migration rate during the 1958-1980 period is explained by the variations in the absolute income differencial between agriculture (YD_2) and the nonagricultural sectors and unemployment rate (U).

Next, the hypothesis of zero autocorrelation is tested against the alternative hypothesis of positive first-order autocorrelation. For 23 observations and 3 explanatory variables including the constant term, the Durbin-Watson (D.W.) statistics at the one percent significance level are $d_L = 0.86$ and $d_U = 1.40$ and at the five percent level $d_L = 1.08$ and $d_U = 1.66$. The computed D.W. statistics for the linear equation are 1.55 which is greater than d_U at the one percent significance level but is less than d_U at the five percent significance level. This indicates that there is no postive first-order autocorrelation at the one percent significance level but the test is inconclusive at the five percent level. In the case of the loglinear equation, the test is inconclusive either at the one or five percent level, since the computed D.W. statistics 1.31 is in the range of either 0.86-1.40 of the one percent level or 1.08-1.66 of the five percent level. As above, although the test of the hypothesis of zero autocorrelation against the alternative hypothesis of positive first-order autocorrelation is on the whole inconclucive for the results of both the linear and loglinear specifications of the net migration function, it is assumed that the

Table 2

Estimates of the Migration Function, 1958-1980

	Linear specification	Loglinear specification
Constant	7.181 * (17.55)	-1.272 * (-3.736)
Absolute income differential (YD_2)	0.0096* (8.480)	
Unemployment rate (U)	-3.644 * (-8.913)	
Log of absolute income differential (ln YD_2)		0.550 * (9.105)
Log of Unemployment rate (ln U)		-0.758 * (-8.469)
R^2	0.815	0.829
D.W.	1.55	1.31

Notes: 1) For the definitions of the variables, refer to text.

2) The sample size is 23 for each case.

3) Figures in parentheses are computed t-statistics.

4) * and ** indicate the statistical significance at the 5 and 10 percent levels, respectively. A one-tail test was applied except for the coefficient of the constant term.

estimates in Table 2 are the final specifications for the 1958-1980 period. And they will be used for further analysis.

First, by making use of the estimates of the linear equation, the elasticities of the net migration rate with respect to the absolute income differential and unemployment rate were computed at the means of the variables. They are 0.63 and -0.85, respectively, which are fairly comparable with the corresponding elasticities, 0.55 and -0.76, respectively, which are directly given by the estimates of the loglinear equation. Moreover, the elasticity of the net migration rate with respect to the absolute income differential, 0.55-0.63, is fairly close to 0.59-0.84 which was obtained by Mundlak and Strauss [1978] for the 1951-1972 period.

In addition, the absolute value of the elasticity with respect to unemployment rate, 0.76-0.85, is greater than that with respect to the absolute income differential, 0.55-0.63. This may indicate that although both the income differential in the two sectors and unemployment rate played an important role in explaining the sizable transfer of labor from agriculture to the nonagricultural sectors during the 1958-1980 period, the migrants were more responsive to the variations in job oppotunities than to the variations in the income differential.

However, one could not judge from the relative magnitudes of the absolute values of the elasticities which explanatory variable was a more dominant factor in determining the actual net labor migration from agriculture. For this purpose, one has to compute the degree of the relative contribution of each explanatory variable to the actual variations of the dependent variable.

Table 3

Relative Contributions of the Explanatory Variables to the Variations of the Net Migration Rate, 1958-1980

	Absolute income differential (YD_2)	Unemployment rate (U)	Total
Linear specification	33.5	48.0	81.5
Loglinear specification	48.9	34.1	83.0

Note: 1) For the procedure of the computation, see text.

2) Figures are expressed in terms of percent.

The procedure of the computation is as follows. In general, the estimated variance of the dependent variable is given by,

$$\hat{y}'\hat{y} = \hat{b}_2 \sum_{i=1}^{n} x_{2i}y_i + \cdots + \hat{b}_k \sum_{i=1}^{n} x_{ki}y_i$$

where $y_i (i = 1, \cdots, n)$ and $x_{ji} (j = 2, \cdots, k)$ are the deviations from the arithmetic means of the dependent and the explanatory variables, respectively. b_j's $(j = 2, \cdots, k)$ are the estimated coefficients and $\hat{y}$ is the vector of the estimated values of y, i.e., the vector of the deviations from the arithmetic mean of the dependent variable. The degree of the relative contribution of each explanatory variable may be computed by dividing each term in the above equation by y'y and expressed in terms of percent. Thus, the sum of the degrees of the relative contributions, i.e., $\hat{y}'\hat{y}/y'y$, gives the R^2.[7]

By making use of this method, the degrees of the relative contributions of the income differential and unemployment rate to the variations of the net migration rate were computed for the results of both the linear and loglinear equations. These are reported in Table 3. It is shown in this table that in the case of the linear specification of the migration function, the absolute income differential explains 33.5 percent, while unemployment rate explains 48 percent of the actual variations of the net migration rate. As a result, unemployment rate seems to have been a more dominant determinant of the net migration during the 1958-1980 period than the income differential.

On the other hand, in the case of the loglinear specification, the degrees of the relative contributions of these explanatory variables were 48.9 and 34.1 percent, respectively. This implies that the income

differential was a more dominant factor than unemployment rate in determining the net migration out of agriculture to the nonagricultural sectors.

Because of these contradictory results, one could not judge which variable was a more dominant factor for explaining the variations in the net migration rate during the 1858-1980 period. However, one may at least state that both the income differential and unemployment rate were on the whole equally important factors of explaining the sectoral labor migration during the period 1958-1980.

It was expected in the beginning that the income differential was a more dominant determinant of the net migration for this period, since this period is considered to be characterized by "limited supplies of labor" and to be at full employment or near full employment. The results that job opportunities represented by unemployment rate were equally important as the income differential in determining the net migration during the 1958-1980 period may have been caused by the inclusion of the years after the "Oil Shock" in 1973 during which unemployment rate became relatively higher and therefore potential migrants may have found it more difficult to obtain suitable jobs.

However, this would not spoil the validity of the hypothesis that the income differential is a dominant determinant of the net migration during the period after the turning point of the Japanese economy.

4.2 Results for 1894-1937

Next, the estimated results for the 1894-1937 period are evaluated and analyzed.

Since negative net migration rates were observed for several years

during this period, some divice was necessary for estimating the log-linear migration equation given in (3). Thus, the dependent variable, ln m, was modified as ln (100 + m) for the estimation. However, the results were much worse in terms of R^2, t-statistics, and D.W. statistics than those obtained by estimating the linear equation (2), although the signs of the estimated coefficients of the former were the same as those of the latter. Consequently, only the results for the linear specification will be evaluated and analyzed for the 1894-1937 period.

The R^2, t-statistics, and D.W. statistics where the combination of the relative income ratio (YR_2) and the growth rate of nonagricultural gross domestic product (g) was employed as the explanatory variables were very similar with those where the combination of the absolute income differential (YD_2) and g was used. These results are reported in Table 4. Although the results of the test of the null hypothesis of no autocorrelation against the alternative hypothesis of positive first-order autocorrelation are inconclusive for both cases, these results are regarded to be the final specifications and will be used for further analysis.

According to Table 4, the estimated coefficients of g in both cases are statistically significant at either the one or five percent level, while the coefficients of both YR_1 and YD_1 are not. This implies that the income differential was not a determinant of the net migration for the 1894-1937 period. Instead, job opportunities as represented by the growth rate of nonagricultural gross domestic product (g) were a dominant determinant of the net migration during this period.

Next, the elasticities with respect only to g were computed, since

Table 4

Estimates of the Migration Function, 1894-1937

	(1)	(2)
Constant	-0.840** (-1.838)	-0.613** (-1.866)
Relative income differential (YR_1)	0.203 (0.998)	
Absolute income differential (YD_1)		0.00121 (0.896)
Growth rate of nonagricultural GDP (g)	0.353* (4.912)	0.361* (5.157)
R^2	0.436	0.434
D.W.	1.24	1.25
Sample	44	44

Notes: 1) Figures in parentheses are computed t-statistics.

2) * and ** indicate that the coefficients are statistically significant at the 5 and 10 percent levels, respectively. A one-tail test was applied except for the coefficient of the constant term.

3) (1) and (2) indicate the combinations of YR_1 and g and YD_1 and g, respectively, in the estimation of the migration function.

Table 5

Elasticities of the Net Migration Rate, 1894-1937

	(1)	(2)
Relative income differential (YR_1)	NA	
Absolute income differential (YD_1)		NA
Growth rate of nonagricultural GDP (g)	1.39	1.42

Notes: 1) The elasticities were computed at the means of the variables by making use of the estimates given in Table 4.

2) (1) and (2) correspond to those in Table 4.

3) NA indicates inapplicability because the corresponding coefficient is not statistically significant.

the coefficients of YR_1 and YD_1 are not significantly different from zero. The results are given in Table 5. The elasticities were around 1.4, indicating that the migrants responded fairly sensitively to job opportunities during the 1894-1937 period.

Incidentally, this elasticity 1.4 for this period is greater than that for the 1958-1980, 0.76-0.85, in the absolute term, although a direct comparison like this may have some problems because the proxy variables used for job opportunities are different between the two periods. This may imply that the migrants were more responsive to job opportunities in the 1894-1937 period than in the 1958-1980 period.

Finally, the relative contributions of the explanatory variables to the actual variations of the net migration rate were computed by applying the same procedure which was used for the 1958-1980 period. The results are given in Table 6. According to this table, arround 40 percent of the actual variations of the net migration rate or around 91 to 94 percent of the R^2's is explained by the growth rate of nonagricultual gross domestic product, a proxy for job opportunities. As was already expected from the results in Tables 4 and 5, it may be said that job opportunities were a dominant determinant of the net migration out of agriculture to the nonagricultural sectors during the 1894-1937 period.

This result is consistent with the result obtained by Minami [1964] who found that, by estimating a migration function, the income differential did not explain the migration out of agriculture during the 1921-1961 excluding the years from 1940 through 1950. He showed in his study that the most important factor of explaining the labor migration out of

Table 6

Relative Contributions of the Explanatory Variables to the Variations of the Dependent Variable, 1894-1937

	(1)	(2)
Relative income differential (YR_1)	(4.0)	
Absolute income differenctial (YD_1)		(2.8)
Growth rate of Nonagricultural GDP (g)	39.7	40.6
Total	43.7	43.4

Notes: 1) For the procedure of the computation, refer to text.

2) (1) and (2) correspond to those in Table 4.

3) Numbers in parentheses are based on statistically insignificant coefficients.

4) Figures are expressed in terms of percent.

agriculture was job opportunities during this period. Note that this period 1921-1961 may be characterized as one before the turning point of the Japanese economy.

Furthermore, in spite of their strong expectation, Mundlak and Strauss [1978] failed to show that the income differential explains the labor migration out of agriculture during the 1911-1940 period. Although they obtained a statistically significant coefficient on the variable which is a product of the income differential and job opportunities, one could not claim from this result that the income differential was an important determinant of the net migration for this period because of the nature of that variable.

Thus, one may say that a dominant determinant of the labor migration from agriculture to the nonagricultural sectors during the pre-World War II period was job opportunities in the nonagricultural sectors, and that the income differential did not work as a determinant of the labor migration during this period. From this, one may conclude that the hypothesis formulated in section two is valid, since job opportunities were a dominant determinant of the labor migration out of agriculture during the period before the Second World War which is considered to be characterized by the existence of "unlimited supplies of labor" in the agricultural sector.

By the way, the period 1894-1937 may be divided into two subperiods, 1894-1919 and 1920-1937, which have different economic features. The period 1894-1919 is characterized by the "concurrent" or "balanced" growth of agriculture and the nonagricultural sectors in the sense that the terms of trade of the two sectors were kept fairly constant [Ohkawa,

1969]. In other words, agriculture during this period grew steadily due to improvements in agricultural lands and biochemical technological progress and attained a fairly fast growth in the productivity which was balanced with the growth in the nonagricultural sectors. As a result, the relative differential of the daily wage rates in the two sectors grew very little during the 1894-1919 period.

However, agriculture became stagnant during the 1920-1937 period partly because the agricultural technological progress characterized by improvements in biochemical technologies and lands entered in the stage of diminishing returns and partly because the increased import of rice from Korea and Taiwan decreased the price levels of agricultural output. On the other hand, the rate of increase in employment in the industrial sector from 1920 to the early 1930's was very low because of the economic depressions and the labor-saving type technological progress associated with the heavy industrialization. However, this heavy industrialization sustained strong demand for skilled labor and hence increased the wage rates for skilled labor to much higher levels than the wage rates for unskilled labor. This resulted in the so-called "dual structure" in the labor market. In other words, the labor market was broken down into two distinct labor markets during this period, i.e., one for unskilled labor with low wage rates and the other for skilled labor with high wage rates.

One may then ask if the hypothesis that the labor migration from agriculture during the pre-World War II period was dominantly determined by job opportunities is valid equally for these two apparantly distinct periods. In order to answer this question, the linear migration equation

(2) was again estimated for these two periods separately in the same way as done for the whole period 1894-1937.

The estimates of the net migration function for these two periods are shown in Table 7 together with the estimates for the whole period 1894-1937. Again, although the results of the test of the null hypothesis of no auto-correlation against the alternative hypothesis of positive first-order auto-correlation are inconclusive for all the cases, these estimates are assumed to be the final specifications and used for further analysis. Based on these estimates, the elasticities of the net migration rate with respect to the income differentials (YR_1 and YD_1) and the growth rate of nonagricultural gross domestic product (g) were computed for both subperiods. They are reported in Table 8 together with the elasticities for the whole period 1894-1937.

One may observe from these estimates in Tables 7 and 8 two distinct features between the two subperiods. First, the estimated coefficients of g are statistically significant and the magnitudes of them (0.32 to 0.37) and the computed elasticities with respect to g (1.24 to 1.39) are almost equal between these two subperiods. This may imply that job opportunities were equally an important factor in explaining the labor migration out of agriculture to the nonagricultural sectors during these two subperiods.

Second, the coefficients of the income differentials are, however, statistically significant for the 1894-1919 period, while they are not for the 1920-1937 period. Moreover, the elasticities of the net migration rate with respect to the income differentials are rather high for the 1894-1919 period. They are almost equal to or higher than that with

Table 7

Estimates of the Migration Function, 1894-1919 and 1920-1937

	1894 - 1919		1920 - 1937		1894 - 1937	
	(1)	(2)	(1)	(2)	(1)	(2)
Constant	-4.610* (-4.647)	-1.623* (-3.770)	0.430 (0.367)	0.712 (0.664)	-0.840** (1.838)	-0.613** (-1.866)
Relative income differential (YR_1)	2.480* (4.067)		-0.251 (-0.475)		0.203 (0.998)	
Absolute income differential (YD_1)		0.0168* (3.273)		-0.0044 (-0.817)		0.00121 (0.896)
Growth rate of nonagricultural GDP (g)	0.324* (4.132)	0.330* (3.851)	0.342* (2.450)	0.367* (2.778)	0.353* (4.912)	0.361* (5.157)
R^2	0.692	0.639	0.371	0.389	0.436	0.434
D.W.	1.55	1.56	1.60	1.66	1.24	1.25
Samples	26	26	18	18	44	44

Notes: 1) Figures in parentheses are computed t-statistics.

2) * and ** indicate that the coefficients are statistically significant at the 5 and 10 percent levels, respectively. A one-tail test was applied except for the coefficient of the constant term.

3) (1) and (2) indicate the combinations of YR_1 and g and YD_1 and g, respectively, in the estimation of the migration function.

respect to g (they are also higher than those obtained for the 1958-1980 period). This indicates that the migrants responded sensitively to both the income differential in the two sectors and job opportunities during the 1894-1919 periods, whereas they responded only to job opportunities during the 1920-1937 period.

Examinations of the relative contributions of the explanatory variables to the actual variations of the net migration rate, which are reported in Table 9, confirm this finding. Table 9 shows that during the 1920-1937 period, job opportunities represented by g was a dominant determinant of the labor migration from agriculture, while both the income differential and job opportunities were equally important determinants of the transfer of agricultural labor to the nonagricultural sectors during the 1894-1919 period. This finding for the 1894-1919 period is very similar to that for the 1958-1980 period.

These results suggest that structural changes may have occurred in the labor market in the Japanese economy from the 1894-1919 period to the 1920-1937 period.

The results for the 1894-1919 period may suggest that there were equilibrating forces in the labor market, and "unlimited supplies of labor" may not have existed during this period. This may be interpreted as follows.

As mentioned earlier, agriculture during this period attained a steady growth in parallel with the growth of the nonagricultural sectors. In addition, the growth of the nonagricultural sectors was attained by in general relatively labor-using technological progress during this period. Under these conditions, potential migrants from agriculture may

Table 8

Elasticities of the Net Migration Rate, 1894-1919 and 1920-1937

	1894 - 1919		1920 - 1937		1894 - 1937	
	(1)	(2)	(1)	(2)	(1)	(2)
Relative income differential (YR_1)	4.49		NA		NA	
Absolute income differential (YD_1)		1.32		NA		NA
Growth rate of nonagricultural GDP (g)	1.36	1.39	1.24	1.33	1.39	1.42

Notes: 1) The elasticities were computed at the means of the variables by making use of the estimates given in Table 7.

2) (1) and (2) correspond to those in Table 7.

3) NA indicates inapplicability because the corresponding coefficient is not statistically significant.

Table 9

Relative Contributions of the Explanatory Variables to the Variations of the Dependent Variable, 1894-1919 and 1920-1937

	1894 - 1919		1920 - 1937		1894 - 1937	
	(1)	(2)	(1)	(2)	(1)	(2)
Relative income differential (YR_1)	34.2		(-4.7)		(4.0)	
Absolute income differential (YD_1)		28.2		(-6.0)		(2.8)
Growth rate of nonagricultural GDP (g)	35.1	35.7	41.9	44.9	39.7	40.6
Total	69.3	63.9	37.2	38.9	43.7	43.4

Notes: 1) For the procedure of the computation, refer to text.

2) (1) and (2) correspond to those in Table 7.

3) Numbers in parentheses are based on statistically insignificant coefficients.

4) Figures are expressed in terms of percent.

have been sensitive to the wage differential in the two sectors as well as to job opportunities in order to increase or at least maintain their relative incomes when it comes to moving to the nonagricultural sectors.

On the other hand, the results for the period 1920-1937 may suggest that the wage rates in the two sectors did not work as an equilibrating force in the labor market, and that the Japanese economy was in a situation with "unlimited supplies of labor" during this period. In other words, the estimated results for this period validate the hypothesis that a dominant determinant of labor migration out of agriculture is job opportunities if there exist "unlimited supplies of labor".

This may reflect very well the actual economic situation during this period which was mentioned earlier. Stagnation of agriculture and the introduction of relatively labor-saving technologies in the industrial sector may have suspended improvements in land/labor ratio and therefore resulted in low marginal productivity of labor in agriculture during this period, especially during the 1920's. This in turn may have resulted in "unlimited supplies of labor" in the agricultural sector [Teranishi, 1972].

What are then the implications of this empirical finding? At least, it suggests that as far as the estimates of the net migration function are concerned, it may not be justifiable to assume that "unlimited supplies of labor" existed in the Japanese economy during the whole period before the Second World War, or more specifically, during the period 1894-1937 analyzed in the present study. This argument may be supported by Umemura [1956] and Yasuba [1980] among others.

Umemura [1956] argues that the labor market was near at equilibrium

during the 1880's through the early 1920's in the neoclassical sense by pointing out the fact that agricultural wage rates per day were on the whole equal to nonagricultural wage rates per day during this period. On the other hand, the net migration rate of labor from agriculture to the nonagricultural sectors was around unity on the average during this period, which was almost equal to the natural growth rate of labor force in agriculture. According to Umemura, this may have prevented the labor market from forming "disguised unemployment" or "unlimited supplies of labor" during this period.

However, a decrease in the net migration rate from around 1925 to the early 1930's created surplus labor in agriculture and hence wage differentials between agriculture and the nonagricultural sectors. This surplus labor was, what Umemura called, "disguised unemployment". Once the net migration rate declines, surplus labor is accumulated, and thus disguised unemployment may not be exhausted unless a high migration rate continues. In this way, "unlimited supplies of labor" may have been formed during the interwar period.[8)]

Yasuba [1979], admitting the existence of the turning point of the Japanese economy around 1960, asserts that the Japanese economy already passed another turning point around the late 1890's through the early 1900's, and entered again the economic state of unlimited supplies of labor after the Second World War through the late 1950's. This proposition supports our results of the estimation of the migration function for the 1894-1919 period, although it does not for the estimates for the 1920-1937 period.

5. Summary

This study has investigated what factors were dominant determinants of the migration of labor out of agriculture to the nonagricultural sectors before and after the Second World War. The hypothesis proposed is that job opportunities are a dominant determinant of migration when "unlimited supplies of labor" exists in the economy, while the income differential in the two sectors becomes an important factor of explaining the sectoral labor migration when the economy is in the stage of "limited supplies of labor."

In order to test this hypothesis, a migration function was estimated for the 1894-1937 and 1958-1980 periods. Since the Japanese economy is said to have passed the turning point around the late 1950's through the early 1960's [Minami, 1973], the former period may be regarded as one before the turning point and the latter as one after the turning point.

The empirical results of the migration function for the 1958-1980 showed that the income differential in the two sectors was as equally important as job opportunities in determing the migration of labor out of agriculture. This may indicate that the latter half of the hypothesis is valid.

On the other hand, the estimates of the migration function for the 1894-1937 period showed that only job opportunities were a dominant determinant of the labor migration out of agriculture. As such, this may indicate that the first half of the hypothesis is valid. However, a different picture was obtained when the period 1894-1937 was divided into two subperiods, 1894-1919 and 1920-1937, and the same migration function was estimated for each period. The former period is

characterized by the "concurrent" growth between agriculture and the nonagricultural sectors, while the latter period is characterized by the "dual structure" [Ohkawa, 1969].

The estimated results for the 1894-1919 period showed that both the income differential and job opportunities were equally significant factors in explaining the sectoral labor migration, suggesting that the labor market may have been in equilibrium and "unlimited supplies of labor" may not have existed during this period. On the other hand, the estimates for the 1920-1937 period showed that only job opportunities were a dominant determinant of migration, indicating that "unlimited supplies of labor" may have existed during this period, and thus the hypothesis in this study is valid.

These results suggest that it is dubious to assume that unlimited supplies of labor existed during the whole period before the Second World War, as far as the estimation of a migration function is concerned. This finding may be supported by Umemura [1956], among others, who asserts that the labor market was in equilibrium during the period before the interwar period.

Footnote

1) See, for example, Minami [1964, 1967], Kodama [1970], and Mundlak and Strauss [1978] among others.

2) Many migrants have been engaged in clerical work in offices of regional governments and agricultural cooperatives as well as private firms in urban areas. These work may require fairly high levels of skills.

3) The annual growth rate of the nonagricultural gross domestic product (g) and vacancy rate were also tried in the estimation for the period after the late 1950's. However, the estimated results were poor for both cases compared to those where unemployment rate was used.

As for the case for pre-World War II period, neither unemployment rate nor vacancy rate was available. Thus, only g was tried for this period.

4) For 1958-1962, however, the number of net migrants includes migrants from households in Forestry and Fisheries. The source of data for this period is Noringyoka Shugyo Doko Chosa Hokoku (Statistical Survey on Changes in Employment of Households in Agriculture, Forestry, and Fisheries) published by the Ministry of Agriculture, Forestry, and Fisheries.

5) For example, see Minami [1973], Table A-11, pp.312-313, Ohkawa and Rosovsky [1973], Basic Statistical Table 15, pp.310-311, Umemura and Others [1966], pp.218-219, and Ohkawa and Shinohara [1979], Table A18, pp.293-297, among others.

6) For the dirivation of this formula, see Umemura [1961], pp.158-159.

7) Refer to J. Johnston [1972], pp.130-132.

8) A very similar view is also presented by Teranishi [1972] who argues that "unlimited supplies of labor" may have been formed during the 1920's and 1930's.

References

Johnston, J., Econometric Methods, 2nd edition (New York: McGraw-Hill Book Company, 1972).

Kodama, M., "Noka Rodoryoku no Ido Yoin to Keizai Hendo (Determinants of Outmigration of Labor of Farm Households and Economic Fluctuations)," Nogyo Keizai Kenkyu (Journal of Rural Economics) 41 (March 1970): 156-165.

Lewis, A., "Economic Development with Unlimited Supplies of Labour," The Manchester School of Economic and Social Studies 22 (May 1954): 139-191.

Minami, R., "Noka Jinko Ido no Suikei to Bunseki (Estimation and Analysis of Outmigration of Farm Population)," Hitotsubashi Ronso (Hitotsubashi Review) 52 (November 1964): 523-552.

Minami, R., "Population Migration away from Agriculture in Japan," Economic Development and Cultural Change 15 (January 1967): 183-201.

Minami, R., The Turning Point in Economic Development: Japan's Experience (Tokyo: Kinokuniya, 1973).

Mundlak, Y. and J. Strauss, "Occupational Migration out of Agriculture in Japan," Journal of Development Economics 5 (March 1978): 55-71

Norin Suisan Sho (Ministry of Agriculture, Forestry, and Fisheries), Noringyoka Shugyo Doko Chosa Hokoku (Statistical Survey on Changes in Employment of Households in Agriculture, Forestry, and Fisheries) (Tokyo, various editions for 1958-1962).

Norin Suisan Sho (Ministry of Agriculture, Forestry, and Fisheries), Noka Shugyo Doko Chosa Hokoku (Statisfical Survey on Changes in Employemnt of Farm Households) (Tokyo, various editions for 1963-1980).

Norin Suisan Sho (Ministry of Agriculture, Forestry, and Fisheries), Noka Keizai Chosa Hokoku (Statistical Survey on Farm Household Economy) (Tokyo, various editions).

Ohkawa, K., "Phases of Agricultural Development and Economic Growth," in K. Ohkawa, B. F. Johnston, and H. Kaneda, eds., Agriculture and Economic Growth: Japan's Experience (Tokyo: University of Tokyo Press, 1969): 3-36.

Ohkawa, K. and H. Rosovsky, Japanese Economic Growth (Stanford: Stanford University Press. 1973).

Ohkawa, K. and M. Shinohara, eds., Patterns of Japanese Economic Development (New Haven and London: Yale University Press, 1979).

Ohkawa, K. and Others, Kokumin Shotoku (National Income), K. Ohkawa, M. Shinohara, and M. Umemura, eds., Choki Keizai Tokei (Estimates of Long-Term Economic Statistics of Japan since 1868), Vol. 1 (Tokyo: Toyo Keizai Shimpo Sha, 1974).

Ohkawa, K. and Others, Bukka (Prices), K. Ohkawa, M. Shinohara, and M. Umemura, eds., Choki Keizai Tokei (Estimates of Long-Term Economic Statistics of Japan since 1868), Vol. 8 (Tokyo: Toyo Keizai Shimpo Sha, 1967).

Sorifu Tokei Kyoku (Statistical Bureau of Prime Minister's Office), Rodo Tokei Nempo (Statistical Yearbook of Labor) (Tokyo, various editions).

Sorifu Tokei Kyoku (Statistical Bureau of Prime Minister's Office), Nihon Tokei Nenkan (Statistical Yearbook of Japan) (Tokyo, various editions).

Teranishi, S., "Nihon Keizai-Ron no Tembo: Senzen no Bu, Sono 1 (A Survey on Studies on the Japanese Economy: Pre-World War II, Part 1)," Keizai Kenkyu (Economic Review) 23 (April 1972): 134-158.

Umemura, M., "Sangyokan Rodo Ido to sono Koka (Intersectoral Labor Migration and Its Effects)," in S. Tohata and K. Ohkawa, eds., Nihon no Keizai to Nogyo (Japanese Economy and Agriculture), Vol. 1 (Tokyo: Iwanami Shoten, 1956): 141-158.

Umemura, M., Chingin, Koyo, Nogyo (Wages, Employment, and Agriculture) (Tokyo: Taimeido, 1961).

Umemura, M., "Yugyoshasu no Shin Suikei (A New Estimation of the Numbers of Gainful Workers)," Keizai Kenkyu (Economic Review) 19 (October 1969): 322-329.

Umemura, M., "Sangyobetsu Koyo no Hendo: 1880-1940 Nen (Changes in the Employment among Industries: 1880-1940)," Keizai Kenkyu (Economic Review) 24 (April 1973): 107-116.

Umemura, M. and Others, Noringyo (Agriculture and Forestry), K. Ohkawa, M. Shinohara, and M. Umemura, eds., Choki Keizai Tokei (Estimates of Long-Term Economic Statistics of Japan since 1868), Vol. 9 (Tokyo: Toyo Keizai Shimpo Sha, 1966).

Yasuba, Y., Keizai Seicho Ron (The Theory of Economic Growth) (Tokyo: Chikuma Shobo, 1980).