DEVELOPMENT WITH SURPLUS POPULATION—THE CASE OF TAIWAN: A CRITIQUE OF THE CLASSICAL TWO-SECTOR MODEL, À LA LEWIS

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Development with Surplus Population—the Case of Taiwan: A Critique of the Classical Two-Sector Model, à la Lewis*

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In theories of development, assumptions made regarding the condition of labor supply distinguish the classical from the neoclassical approach to the transformation of a dual economy. In Lewis's well-known classical two-sector model[1] and Ranis-Fei's refined version,[2] labor supply is assumed to be infinitely elastic at the initial phase of development, whereas in Jorgenson's neoclassical model real wages may vary and earnings in the traditional sector are assumed to be proportional to those in the advanced sector.[3] The distinction maintained on the conditions of the labor supply function carries with it important implications relating to the process of labor transfer, movements of terms of trade, and conditions of economic viability of industrialization in the development of a dual economy. In this paper, I attempt to assess empirically in a two-sector framework the growth experience of Taiwan during the 1951–65 period and, it is hoped, to shed some light on the empirical relevance of the classical and neoclassical models. Attention is focused on the place of labor transfer and the role of technical change in agriculture in the development of a labor surplus economy. The experience of Taiwan during this crucial period when growth became self-sustaining may be interesting with respect to other contemporary developing nations facing largely similar conditions of high labor/land ratio and rapidly growing population. The paper is divided into four sections: (1) an examination of the rate and sources of output growth, (2) a discussion of labor absorption and its place in Taiwan's economic

* The author is indebted to William Cook, Seymour S. Goodman, Donald L. Huddle, and Jacques Mehtz, and William Y. Mo for comments and suggestions.

[1] W. Arthur Lewis, "Economic Development with Unlimited Supplies of Labor," *Manchester School* 22, no. 2 (May 1954): 139–91; reprinted in A. N. Agarwala and S. P. Singh, eds., *The Economics of Underdevelopment* (New York: Oxford University Press, 1958), pp. 400–449.

[2] John C. H. Fei and Gustav Ranis, *Development of the Labor Surplus Economy* (Homewood, Ill.: Richard D. Irwin, Inc., 1964); Ranis and Fei, "A Theory of Economic Development," *American Economic Review* 51, no. 4 (September 1961): 533–65.

[3] Dale W. Jorgenson, "Surplus Agricultural Labour and the Development of a Dual Economy," *Oxford Economic Papers* 19, no. 3 (November 1967): 288–312.

transformation, (3) a consideration of changes in real wages and in terms of trade and their growth implications, and (4) a summary and concluding remarks.

The Rate and Sources of Output Growth

As a point of departure, I follow the assumption by Lewis, Ranis-Fei, and Jorgenson that a dual economy consists of a traditional and a capitalist sector. Theoretically, the role of reproducible capital in the production function should serve as the basis for dividing the economy. But since this criterion is difficult to apply empirically, I shall identify the agricultural sector of the Taiwanese economy with the traditional sector, and the nonagricultural sector with the capitalist sector. It should be noted at the outset that despite the acknowledged importance of foreign trade and external aid to Taiwan's postwar economic development, their explicit role in and contributions to the growth of the economy are not the immediate concern of this study.[4] Therefore they are simply combined with the nonagricultural sector.

The growth of the agricultural sector is measured by changes in gross farm output, which is defined here as gross farm production net of farm output retained on farms as intermediate products. To facilitate analysis, farm inputs are classified in the four conventional categories: land, labor, working capital, and fixed capital. With the exception of working capital, represented by the quantities of commercial fertilizers consumed on farms, changes in input flows are assumed to be proportional to changes in the stock of cultivated land, farm employment, and fixed capital in agriculture. The expansion of the nonagricultural sector is estimated by changes in gross domestic product originating outside agriculture. Nonagricultural inputs are categorized as labor and capital. Table 1 presents the output and input series for both sectors.

If we assume that production in agriculture is characterized by constant return to scale, variable factor proportions, and neutral technical change, we can postulate an aggregate production of the Cobb-Douglas type for the sector as follows:[5]

$$y = A(t)x_1^a x_2^b x_3^c x_4^d \qquad (a + b + c + d = 1) \tag{1}$$

where y stands for gross farm output, x_1, x_2, x_3, and x_4 for land, labor, working capital, and fixed capital, respectively (the exponents are the relative shares of factor income of land, labor, working capital, and fixed capital), and $A(t)$ represents technical change, broadly defined, assumed

[4] For a discussion of the role of U.S. aid in Taiwan's postwar economic development, see Neil H. Jocoby, *U.S. Aid to Taiwan: A Study of Foreign Aid, Self-Help, and Development* (New York: Frederick A. Praeger, Inc., 1966).

[5] We note that the same type of agricultural production function is assumed by Ranis-Fei and by Jorgenson.

TABLE 1

OUTPUT AND INPUT INDEXES OF THE TAIWANESE ECONOMY

	AGRICULTURE						NONAGRICULTURE*			
		Input Indexes						Input Indexes		
YEAR	Output Index (NT$6,086 Million = 100)†	Land (874,000 Hectares = 100)‡	Labor (1,514,000 Man Equiv. = 100)§	Working Capital (345,000 M/T = 100)‖	Fixed Capital (NT$18,956 Million = 100)#	Aggregate**	Output Index (NT$23,621 Million = 100)††	Labor (1,153,000 Workers = 100)§	Capital (NT$92,557 Million = 100)‡‡	Aggregate§§
1951...	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1952...	109.3	100.2	100.7	132.7	105.0	106.5	107.0	104.2	103.5	103.9
1953...	122.9	99.9	101.8	145.5	110.0	109.5	113.4	104.1	107.6	105.5
1954...	123.4	100.0	102.1	164.6	115.0	112.8	132.0	108.0	111.4	109.3
1955...	122.9	99.9	101.1	162.9	119.0	112.5	134.0	111.5	114.3	112.6
1956...	133.8	100.2	99.9	183.5	123.5	115.0	144.1	112.4	117.8	114.5
1957...	145.7	99.9	99.7	192.2	128.6	116.4	151.6	121.4	121.4	121.4
1958...	154.5	101.1	99.7	194.8	134.1	117.6	162.6	127.8	126.2	127.2
1959...	153.3	100.4	101.8	196.8	141.6	119.4	182.6	133.0	130.7	132.1
1960...	153.4	99.5	102.8	192.8	147.8	119.7	190.4	137.5	137.2	137.4
1961...	169.0	99.8	104.4	184.3	155.4	120.3	208.4	142.9	146.4	144.3
1962...	171.8	99.8	105.7	201.2	162.2	123.6	224.5	147.6	155.3	150.5
1963...	169.6	99.8	107.6	215.6	169.3	127.0	258.4	154.7	163.2	158.0
1964...	185.7	101.0	109.4	254.2	178.5	132.1	294.3	160.4	174.2	165.6
1965...	198.0	101.0	109.7	230.4	191.7	131.8	328.0	163.7	189.6	173.3

* The sector is inclusive of manufacturing, mining, construction, utilities, transportation, trade, banking and insurance, government, other services, and fishery.

† The series from 1951 to 1960 is from Yhi-Min Ho, pp. 23–24 (see n. 7). The series covers a total of seventy-four major farm products, which are aggregated by using the 1952–56 average farm prices as weights. This series is here extended, by the same method of aggregation, to 1965.

‡ From Taiwan, Department of Agriculture and Forestry, *Taiwan Agricultural Yearbook*, various issues.

§ Compiled from data taken from Taiwan, Department of Civil Affairs, *Taiwan Household Registration Record* and *Taiwan Demographic Fact Book*, various issues; Taiwan, Council for International Economic Cooperation and Development, *Taiwan Statistical Data Book*, various issues. Female employment is converted into male equivalent by the ratio of one female worker equal to 0.6 male workers.

‖ The series is represented by the quantity of commercial fertilizers consumed on farms. Data on the consumption of commercial fertilizers are from *Taiwan Statistical Data Book*, various issues.

The series here consists of farm buildings, farm tools and equipment, farm animals, plants and trees, irrigation works, and country roads. Estimates on farm buildings, tools and equipment, animals, and plants and trees are based on Taiwan, Committee of Sample Census of Agriculture, *Report on the 1956 Sample Census of Agriculture*. Capital input in physical units is aggregated by the cost of replacement in the census year. The capital stock in 1956 prices is then converted into 1964 prices by a price index of agricultural products. The conversion is made to facilitate the use of other official data on the net investment recorded in constant 1964 prices. The total value of irrigation works in agriculture is taken to be the accumulated sum of irrigation investment in the 1901–56 period. Data on irrigation investment are from E. L. Rada and T. H. Lee, *Irrigation Investment in Taiwan* (Taipei: Chinese-American Joint Commission on Rural Reconstruction, 1963). Total value of country roads is estimated to be NT$3,192 million at the end of 1963 by the Council for International Economic Cooperation and Development. The estimate is adopted here. Data on the net investment in constant 1964 prices are from Taiwan, Directorate General of Budgets, Accounts, and Statistics, Executive Yuan, Republic of China, *National Income of the Republic of China*, various issues.

** The index is derived from equation (2).

†† From National Income of the Republic of China, various issues. Output is valued at the constant 1964 prices.

‡‡ Fixed capital in manufacturing, mining, and the utilities industries at the end of 1965 is estimated and compiled from Taiwan, Council for International Economic Cooperation and Development, *Report on Industrial Surveys in Taiwan, 1965*. Data on inventory and net investment are from *National Income of the Republic of China*. The estimates of the capital stock in trade, transportation, banking, public administration, public utilities, and construction made by the Council for International Economic Cooperation and Development are adopted here.

§§ Derived from equation (5).

to be a function of time. If $A(t)$ is approximated by discrete year-to-year change, equation (1) can be rewritten as $y_t = A_0(1 + r)^t x_{1t}^a x_{2t}^b x_{3t}^c x_{4t}^d$. Let $Y_t = y_t/y_0$ and $X_{it} = x_{it}/x_{i0}$ $(i = 1, 2, 3, 4)$. Then the index of farm output of year t with respect to year 0 can be stated as:

$$Y_t = (1 + r)^t X_{1t}^a X_{2t}^b X_{3t}^c X_{4t}^d;$$

or $Y_t = (1 + r)^t I^t$, where I_t is the aggregate input index of year t with respect to the base year 0—namely,

$$I_t = X_{1t}^a X_{2t}^b X_{3t}^c X_{4t}^d. \tag{2}$$

The rate of technical change for the agricultural sector can be estimated from the equation:

$$R_{Tt} = R_{Qt} - R_{Nt}, \tag{3}$$

where R_{Tt} = growth rate of technical change, R_{Qt} = growth rate of output index, and R_{Nt} = growth rate of aggregate input index. The above growth rate of output and aggregate input indices are approximated from the following: $R_{Qt} = [(Y_t - Y_{t-1})/Y_{t-1}]100$, and $R_{Nt} = [(I_t - I_{t-1})/I_{t-1}]100$. Similarly, in nonagriculture we say:[6]

$$q = A(t)k^\alpha l^\beta \qquad (\alpha + \beta = 1), \tag{4}$$

where gross domestic product originating from nonagriculture is q, capital and labor are k and l; and α and β are the relative shares of capital and labor in total factor income. As before, if a discrete year-to-year approximation of $A(t)$ is used, and we let $Q_t = q_t/q_0$, $K_t = k_t/k_0$, and $L_t = l_t/l_0$, it follows that $Q_t = (1 + r)^t K_t^\alpha L_t^\beta$, or

$$Q_t = (1 + r)^t N_t, \qquad \text{where } N_t = K_t^\alpha L_t^\beta. \tag{5}$$

The rate of technical change for nonagriculture can be defined similarly.

The relative shares of factor costs in agriculture are estimated as: land, 0.2462; labor, 0.4524; working capital, 0.1929; and fixed capital, 0.1085.[7] Shares of capital and labor in total factor income originating from nonagriculture, estimated from official income data, are 0.6107 for labor and 0.3893 for capital. These estimated relative factor shares are used to derive the aggregate input index and the rate of technical changes in agriculture and in nonagriculture.

[6] The same assumption is made by Jorgenson.

[7] The relative shares of factor income in agriculture are taken from Yhi-Min Ho, *Agricultural Development of Taiwan, 1903–1960* (Nashville, Tenn.: Vanderbilt University Press, 1966), p. 63.

By differentiating equation (1), for agriculture, totally with respect to time and dividing through by y, we derive:[8]

$$\frac{(dY/dt)}{Y} = \frac{(dA/dt)}{A} + \frac{a(dX_1/dt)}{X_1} + \frac{b(dX_2/dt)}{X_2} + \frac{c(dX_3/dt)}{X_3} + \frac{d(dX_4/dt)}{X_4}.$$

Given discrete year-to-year approximation, we would state this fundamental growth equation as:

$$\bar{Y} = \bar{A} + a\bar{X}_1 + b\bar{X}_2 + c\bar{X}_3 + d\bar{X}_4. \tag{6}$$

According to this equation, the rate of growth of the observed output of agriculture is the sum of the rate of technical change in agriculture and rates of growth in the conventional inputs, each weighted by its cost share. Similarly, the growth equation for nonagriculture can be written as:

$$\bar{Q} = \bar{A} + \alpha\bar{K} + \beta\bar{L}. \tag{7}$$

The estimated rate of technical change for each sector and sources of output growth in terms of growth components are summarized in table 2.

The overall development record of Taiwan during the 1951–65 period, as presented in table 2, is quite impressive. Both the agricultural and the nonagricultural sectors registered an enormously high growth rate —8.8 percent per year for nonagriculture and 5.0 percent per year for agriculture. Evidence indicates that Taiwan's nonagriculture first began to experience rapid growth about 1950.[9] Moreover, the rate of expansion in this sector has tended to accelerate. As a result, a notably divergent trend in the relative growth strength of the two sectors started to develop in 1958. Thus in the early 1951–58 period, nonagriculture and agriculture grew at an annual rate of 7.2 percent and 6.4 percent, respectively; but for the late 1958–65 period, the two respective rates were 10.1 and 3.6 percent. Significantly enough, the development of this imbalance in the relative growth of the two sectors took place in the face of a shift in the terms of trade against nonagriculture.

As indicated in table 2, 62 percent of the increment in farm output and 55 percent of the increment in nonagricultural output in 1951–65 are attributable to technical change, thus technical change has played an

[8] See Robert M. Solow, "Technical Change and the Aggregate Production Function," *Review of Economics and Statistics* 39, no. 3 (August 1957): 312–20.

[9] According to one estimate, made by the Sino-American Joint Commission on Rural Reconstruction (JCRR), Taiwan's nonagricultural sector grew at an annual rate of 4.4 percent between 1911 and 1940. Although the estimate is made on a basis not quite comparable to our two-sector classification, it is nevertheless reassuring that the rapid growth of nonagriculture is confined to the period 1951–65. The estimate made by JCRR appeared in S. C. Hsieh and T. H. Lee, *Agricultural Development and Its Contributions to Economic Growth in Taiwan* (Taiwan: JCRR, 1966), p. 107.

TABLE 2

GROWTH COMPONENTS OF OUTPUT, AGRICULTURE AND NONAGRICULTURE*

	AGRICULTURE						NONAGRICULTURE			
PERIOD	Output	Land	Labor	Working Capital	Fixed Capital	Technical Change†	Output	Labor	Fixed Capital	Technical Change†
1951–55....	5.3	0.0 (0.0)	0.1 (0.3)	2.5 (13.0)	0.5 (4.4)	2.2	7.6	1.7 (2.8)	1.3 (3.4)	4.6
1956–60....	3.5	0.0 (−0.2)	0.3 (0.7)	0.2 (1.3)	0.5 (4.6)	2.5	7.2	3.1 (5.1)	1.5 (3.9)	2.6
1961–65....	4.0	0.1 (0.3)	0.6 (1.3)	1.1 (5.7)	0.5 (4.8)	1.7	12.0	2.1 (3.5)	2.6 (6.7)	7.3
1951–65....	5.0	0.0 (0.1)	0.2 (0.5)	1.2 (6.1)	0.5 (4.8)	3.1	8.8	2.2 (3.6)	1.8 (4.7)	4.8

SOURCE.—From table 1.

* Figures in parentheses are growth rates of inputs.

† Derived from equation (3).

important role. Output changes due to increases in productive factors are as follows: *in agriculture*—working capital, 24 percent; labor, 4 percent, fixed capital, 10 percent; *in nonagriculture*—labor, 25 percent; capital 21 percent.

The evidence from Taiwan also cast some possible light on the relationship between the rate of capital formation and that of technical change.[10] Note from table 2 that the rate of capital formation in nonagriculture in the 1956–60 period is higher than in the preceding 1951–55 period, but the rate of technical change sharply declined from 4.6 percent in 1951–55 to 2.6 percent in 1956–60. Because of a high rate of growth in employment relative to capital formation, the capital/labor ratio also declined from the 1951–55 level in nonagriculture in 1956–60. This might suggest that what is important for the rate of technical change in nonagriculture is not so much the rate of capital formation as the capital/labor ratio. In agriculture, on the other hand, despite a consistent rise in the capital/labor ratio, the rate of technical change declined, and did so when the nature of innovational activities in the sector changed notably. As is known, for a long time, the two major sources of output expansion in Taiwan's agriculture had been higher intensity of land use and improved yields of land based on continuing innovations together with increased use of commercial fertilizers and irrigation.[11] These two major sources of agricultural growth had alternated in importance over time—yield improvement prevailing in the prewar years, and rises in land intensity in the early postwar period.[12] But quite surprisingly, innovations associated with improvement in land intensity ceased to be an important source of farm output growth in 1961–65. Rather, acreage expansion through land reclamation again emerged as primary. The evidence seems to suggest that the rapidity with which technical change takes place may depend very much on the stage of growth. Perhaps, in the initial phase of development, innovations accompanied by the extensive application of modern commercial fertilizers and the provision of irrigation facilities may lead to dramatic increase in land yields and, hence, capital formation and technical change will be closely related. However, at later stages of development, intensity

[10] See, e.g., Robert M. Solow, "Investment and Technical Progress," in *Mathematical Methods in the Social Sciences*, ed. K. S. Arrow, S. Karlin, and P. Suppes (Stanford, Calif.: Stanford University Press, 1959); E. S. Phelps, "The New View of Investment: A Neoclassical Analysis," *Quarterly Journal of Economics* 76, no. 4 (November 1962): 548–67; R. C. O. Mathews, "The New View of Investment: Comment," *Quarterly Journal of Economics* 78, no. 1 (February 1964): 164–71; Edward Dennison, *The Sources of Economic Growth in the United States* (New York: Committee for Economic Development, 1962); and B. Massell, "Capital Formation and Technical Change in U.S. Manufacturing," *Review of Economics and Statistics* 42, no. 2 (May 1960): 182–88.

[11] See Hsieh and Lee; Samuel Pao-San Ho, "Agricultural Transformation under Colonialism: The Case of Taiwan," *Journal of Economic History* 28, no. 3 (September 1968): 313–40; and Yhi-Min Ho, chap. 8.

[12] Y.-M. Ho, pp. 87–90.

replaces land-yielding improvement as the primary source of growth, and the relationship between capital formation and technical change may be altered. Continued efforts to raise the intensity of land utilization further may prove costly, thus ceasing to be an attractive growth alternative. My findings also suggest, in line with T. W. Schultz, that a sustained high rate of technical change in agriculture may require continuous infusion of new input.[13]

Industrial Growth and Labor Absorption

Between 1951 and 1965 population in Taiwan increased at an annual rate of 3.4 percent—one of the fastest growing populations of the world. Rapid growth in population inevitably brings with it an ever-expanding labor force. Here we meet head on the central issue in the classical model: the absorption of surplus labor through industrial expansion. On this issue, Jorgenson also asserts that "the role of the industrial sector in economic development is critical for the elimination of disguised unemployment."[14] However, we can state at the outset that the extent of the enormous success of the development efforts in Taiwan cannot be measured in terms of labor absorption. The growth rate of nonfarm employment is relatively unimpressive; the rate for males is 3.6 percent per year, barely enough to cope with the growth in the nonagricultural labor force, net of migration. The situation is similar for females: 3.5 percent annual growth in the nonfarm employment compared with 3.3 percent annual growth in the nonfarm labor force. We shall, however, analyze this important question of labor transfer and absorption in detail.

In terms of our statistical framework, of course, the term "labor transfer" refers to internal migration of labor from the agricultural to the nonagricultural sector. The magnitude of this internal migration and the age and sex characteristics of the migration may be estimated as the difference between the expected and the observed population of each sector. In our calculation, the agricultural population and its age and sex composition at the end of 1950 is taken as the base. The expected agricultural population each year is then projected on the basis of prevailing birth and mortality rates (age-specified) in the rural sector of Taiwan. Thus, the estimate rests on the following two assumptions: (1) the age and sex composition of agricultural population in the initial year of 1950 is the same as that of the rural population; and (2) the fertility and mortality rates of the rural population of Taiwan are identical to those in agriculture. The expected population in nonagriculture by definition then is the difference between the observed total population and the expected agricultural population. Our estimates of the internal migration are presented in table 3.

[13] Theodore W. Schulz, *Transforming Traditional Agriculture* (New Haven, Conn.: Yale University Press, 1964).

[14] D. W. Jorgenson, p. 300.

TABLE 3

MIGRATION, 1951–65 (UNIT = 1,000 PERSONS)*

YEAR	TOTAL MIGRATION		MIGRATION OF LABOR FORCE									
			12–19		20–29		30–39		40 and Over		Total	
	MALE	FEMALE	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1951	−5	−1	−2	−1	0	1	4	1	−1	−1	1	0
1952	24	33	8	5	4	12	−1	2	0	3	11	22
1953	20	10	−2	2	3	−4	−1	1	9	6	9	5
1954	17	42	11	11	12	9	0	4	−10	3	13	27
1955	36	18	2	0	22	6	−4	−1	−1	5	19	10
1956	41	43	5	5	33	6	−6	2	−6	15	26	28
1957	52	24	5	5	26	6	8	11	6	−10	45	12
1958	30	48	6	11	2	12	−8	1	1	11	1	35
1959	36	56	5	3	9	9	0	9	−2	4	12	25
1960	−113	−101	−21	−2	−3	−18	−22	−12	−28	−25	−74	−57
1961	55	34	7	−12	12	9	8	8	3	3	30	8
1962	31	70	5	3	3	12	7	7	−1	16	14	38
1963	−3	106	32	14	−84	13	8	15	11	20	−33	62
1964	65	75	16	16	14	14	11	9	4	11	45	50
1965	63	48	34	22	1	1	9	9	−2	13	42	45
Total net migration	349	505	111	82	54	88	13	66	−17	74	161	310

SOURCE.—Data on the geographical distribution, age and sex composition, and mortality and fertility rates of the population are computed from *Taiwan Household Registration Record* and *Taiwan Demographic Fact Book*, various issues. Information on agricultural population is drawn from *Taiwan Agricultural Yearbook*, various issues.

* Positive figures are out-migration from agriculture; negative ones indicate in-migration to agriculture.

According to our estimates, approximately 8 percent of the agricultural male labor force and 15 percent of the farm female labor force migrated from agriculture.[15] What was the major cause of emigration from agriculture? And to what extent had the emigrated farm labor force been absorbed by industrial employment? The answers to the two questions may be found in the light of (1) the time pattern of the internal migration, (2) the growth in industrial employment, (3) the growth of the expected labor force in nonagriculture, and (4) unemployment. As data problems do not permit the study of female unemployment as meaningfully defined, I shall confine the discussion of unemployment to males. Suppose we regard those gainfully occupied and those currently attending schools in the labor force as active labor force. Unemployment then can be approximated as the difference between the inactive labor force and those over age 64 (see table 4). According to this definition, unemployment of nonfarm male labor is 9 percent or more over the relevant fifteen-year period, with the exception of 1958–62. Apart from possible disguised unemployment, the estimate of unemployment is lower in agriculture. In this last sector, periods of active outmigration were generally related to either a rising unemployment rate in the sector, as in 1952–57; or to a high and rising unemployment rate, as in 1961–65 (see table 3, col. 12; table 4, col. 8). The outmigration of labor from agriculture fell sharply in 1958 and 1959 when the unemployment rate in agriculture was relatively low and declining. This would indicate that outmigration from agriculture is associated with low, or lack of employment opportunities inside this sector, and not so much with inducements from the outside sector. In line with this argument, it may be noted that the outmigration of the farm labor force proceeded under the peculiar condition that real wages for the unskilled in nonagriculture were less than real farm earnings per worker in agriculture. We further note that the 1958–60 decline in outmigration from agriculture significantly coincides with a noticeable improvement in the unemployment situation in nonagriculture. Thus, it may indicate that the process of labor reallocation could well have been one of relocating surplus labor from agriculture to nonagriculture.

To a large extent, the growth in industrial employment relative to the growth of the labor force within the industrial sector determines the ability of this sector to absorb emigrated farm labor. Suppose we assume that the following relation holds: $\Delta A = \Delta E - (\Delta L_n - \Delta S_n)$, where ΔA is the net absorption of the emigrated farm workers, ΔE the increment in nonfarm employment, ΔL_n the increment in the expected labor force in nonfarm sector,[16] and ΔS_n the increment in the number of students in nonagriculture. Thus, $(\Delta L_n - \Delta S_n)$ represents the net addition to the labor force

[15] Labor force is defined here as the portion of the population over 11 years of age.

[16] Note that the net addition to the nonagricultural labor force represents the growth in the labor force in nonagriculture without migration.

TABLE 4

ECONOMIC STATUS OF LABOR FORCE (%)

	AGRICULTURE								NONAGRICULTURE							
	Active Labor Force				Inactive Labor Force				Active Labor Force				Inactive Labor Force			
	Employed		Schooling*		Over 64		Unemployed		Employed		Schooling*		Over 64		Unemployed	
YEAR	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1951...	88.4	39.9	6.4	3.4	2.1	3.1	3.1	53.6	78.0	14.7	8.6	6.3	1.4	2.5	12.0	76.5
1952...	87.5	39.9	7.3	3.6	2.0	3.2	3.2	54.2	79.1	13.8	9.4	6.2	1.6	2.4	9.9	77.6
1953...	86.4	38.3	8.1	4.0	2.0	3.2	3.5	54.5	76.6	12.4	9.8	7.1	1.3	2.3	12.3	78.2
1954...	85.9	36.9	8.3	4.4	2.1	3.1	3.7	55.6	77.0	11.8	10.1	7.2	1.3	2.5	11.6	78.5
1955...	83.8	35.7	9.7	5.0	2.1	3.1	4.4	56.0	76.6	11.9	10.8	8.1	1.1	2.4	11.5	77.6
1956...	81.8	35.7	10.6	5.7	2.1	3.1	4.5	55.5	74.8	10.0	12.0	8.4	1.2	2.5	12.0	79.1
1957...	82.8	34.3	11.9	6.7	2.1	3.1	3.2	55.9	77.4	13.1	12.0	8.9	1.3	2.4	9.3	75.6
1958...	81.8	33.3	13.2	6.6	2.1	3.1	2.9	57.0	78.6	13.2	13.4	9.2	1.4	2.3	5.7	75.3
1959...	81.9	33.4	14.6	7.7	2.1	3.1	1.4	55.8	77.3	13.2	14.0	9.8	1.3	2.4	7.4	74.6
1960...	76.7	31.3	14.8	8.6	2.2	3.2	6.3	56.9	80.4	13.8	15.0	10.1	1.4	1.9	3.2	74.2
1961...	76.7	30.6	15.6	9.0	2.2	3.2	5.3	57.2	78.4	14.0	15.1	11.9	1.5	2.2	5.0	71.9
1962...	76.4	30.2	16.8	9.6	2.2	3.2	4.6	57.0	76.7	13.7	15.6	11.7	1.5	2.3	6.2	72.3
1963...	73.1	30.4	17.0	10.7	2.2	3.1	7.7	55.8	71.6	14.0	14.9	11.7	1.5	2.4	12.0	71.9
1964...	73.5	30.1	17.9	11.7	2.2	3.2	6.4	55.0	71.1	14.7	15.6	12.3	1.5	2.4	11.8	70.6
1965...	71.9	29.6	18.8	13.0	2.3	3.2	7.0	54.2	72.1	13.1	16.5	12.8	1.5	2.4	9.9	71.7

SOURCE.—See table 3.

* The total number of students of age twelve and over are official statistics published by the Ministry of Education, Republic of China. The number of students in each sector is estimated through the following procedure: We first assume that the portion of the labor force attending schools in agriculture and in nonagriculture is proportional to the number of graduates of the primary schools and the junior high schools to the labor force in each sector. If, for example, 15 percent of the labor force in nonagriculture and 10 percent of the agricultural labor force, completed either primary or junior high school education, we obtained a ratio of 60 to 40 percent. If in any given year 12 percent of the total labor force attended schools, we derive a 7.2 percent (12 percent multiplied by 0.6), which is taken to be the proportion of nonagricultural labor force currently attending schools. The division is in fact based on the rural-urban division of the population, instead of the division of agriculture versus non-agriculture.

available for employment. To compare it with the increment in nonfarm employment, the net absorption of the emigrated farm labor can be estimated. My estimates, along with the magnitude of net migration, are shown in table 5. Given the relation assumed, it would appear that the

TABLE 5
LABOR ABSORPTION OF NONAGRICULTURE
(UNIT = 1,000 PERSONS)

	ΔL_n*	ΔS_n†	$\Delta L_n - \Delta S_n$	ΔE‡	ΔA§	Migration‖
Male:						
1951–57.....	180	80	100	228	128	124
1958–60.....	198	66	132	157	25	−61
1961–65.....	424	110	314	242	−72	98
Female:						
1951–57.....	185	66	119	19	−100	104
1958–60.....	134	21	113	28	−85	3
1961–65.....	344	114	230	61	−169	203

* Nonagricultural labor force net of migration for any given year is the difference between the total labor force and the expected labor force in agriculture.
† See the note in table 4.
‡ See table 1, §.
§ See the text.
‖ From table 3.

emigrated farm male labor in 1951–57 had been fully brought into gainful employment in nonagriculture, for ΔA is approximately equal to the number of immigrants the industrial sector gained. However, 12 percent of the nonfarm labor force were unemployed in 1951. Unless we assume that these jobless nonfarm laborers remained unemployed, we can reasonably infer that the expansion of nonfarm employment probably relied more upon previously unemployed workers within the sector than upon the newly emigrated farm workers as the major source of labor supply. This argument is in line with the event that subsequently took place in 1958–60, when agriculture gained in net migration, despite the measured ability of the industrial sector to absorb emigrated farm labor, as indicated by a positive ΔA. This would certainly suggest that the growth of industrial employment failed to reach the emigrated farm workers and those that had previously emigrated from agriculture chose to return. Although the rate of capital formation and technical change had accelerated in 1961–65, the increase in nonagriculture employment is disappointing compared with the size of migration. The sharp rise in the unemployment rate in nonagriculture in 1961–65 thus reflects the low rate of labor absorption of the industrial sector in the face of a revival of outmigration of farm workers.

The outmigration of the agricultural female workers proceeded throughout the period despite total lack of absorption, as indicated by the negative magnitude of ΔA. Since expansion in employment for females in nonagriculture cannot explain the outmigration of females from agriculture,

it is reasonable to argue that population pressure is the cause. We also note that the rate of participation of the female labor force in nonagriculture remained being stable throughout the period. Thus, a high rate of absorption is unlikely unless the attitude of the female labor in nonagriculture toward income and leisure had undergone some rather unprecedented and drastic change.

Another interesting aspect of the Taiwanese growth scene is that despite a low labor absorption rate outside of agriculture, the congested condition within agriculture, and a rapidly growing population, the level of unemployment is surprisingly stable; in fact, if anything, it was lower at the end than at the beginning of the period. The expansion of education is the only possible explanation. The portion of the male labor force in agriculture attending schools increased from 6.4 percent in 1951 to 18.8 percent in 1965. For the female labor force, the increase was from 3.4 percent to 13.0 percent in the same time span. Much the same happened in nonagriculture, the rate rising from 8.6 percent to 16.5 percent for males, from 6.3 percent to 12.8 percent for females. That a growing portion of the labor force enrolled in various schools certainly provided an outlet for the pressures on employment, at least in the short run, without which the unemployment rate unquestionably would have been much higher. The role of education in Taiwan opens up a major horizon relating to development strategy. For if real income rises steadily, particularly in agriculture, it may give rise to an intermediate stage in the labor transfer process, in which training and education are provided to the unskilled. This intermediate stage presumably can serve the useful function of providing a cushion in the short run to divert the pressures on employment and a reservoir in the long run to supply the skilled labor for industrial expansion. This particular growth path appears to be a feasible developmental policy relating to the choices between direct productive investment versus social overhead investment in education, and between development through capital-intensive techniques and/or industries versus development through labor-intensive techniques and industries. The experience serves as an indication if development in the industrial sector is capital-biased; perhaps a concurrent expansion of education is desirable, from both short-run and long-run points of view. As a growth strategy, however, expansion in education side by side with capital-deepening in industry is probably feasible only under some rather unusual social and economic conditions. For one thing, considerable investment in education and a strong family tie along the traditional line are required to accommodate the unemployed without causing social unrest. Apparently, the conditions were appropriate in Taiwan. Also, the growth in real income realized through the rapid rate of technical change throughout the Taiwanese economy over the relevant period may have made this growth alternative feasible.

Changes in Real Earnings and in Terms of Trade

Earnings in Agriculture and in Nonagriculture

Although not implying that Taiwan's agriculture remains traditional, earnings per worker in agriculture are calculated here without any reference to the marginal product of labor in the sector. Despite the revolutionary change in agricultural productivity, the deep-rooted centuries-old traditions, institutional arrangements, and social mores in Taiwan's agriculture are left very much untouched. Hence, we assume that the marginal productivity theory cannot be applied to explain farm earnings within such a social framework. Following Lewis, earnings per worker in agriculture are assumed to be set by average productivity under the given conditions of land taxation, land tenure system, and the family sharing arrangement. In table 6 the information on changes in the average productivity of farm workers, earnings per employed, and real earnings per worker in agriculture is presented. Real earnings shown in the table are obtained from annual money earnings deflated by an index of prices farmers paid. For the period 1951–65 as a whole, real earnings per worker in agriculture increased almost as much as average labor productivity, while the rate of increase in farm earnings was below that of labor productivity in 1953–63. The rise in prices farmers paid relative to those farmers received may have caused the gap between farm productivity and farm earnings in that period.

Money wages in nonagriculture are obtained as a weighted average of daily earnings in manufacturing, mining, and utilities. These figures are then converted into annual money earnings in order to achieve comparability with the earnings per farm worker, which are stated on an annual basis. With respect to real earnings per worker in nonagriculture, two measures are computed, based on two separate price indexes—a cost-of-living index for consumers in major cities and an index of agricultural products. The former can be taken as measure of the changes in living standards of workers in nonagriculture, the latter as an indicator of real wages in terms of agricultural goods. Both measures are shown in table 6.

Contrary to the case in agriculture, increases in the real earnings per worker (money earnings adjusted by cost of living) in nonagriculture exceeded rises in labor productivity up until 1964, when a reversal took place. The result, although similar, is much less accentuated, if the real earnings in nonagriculture are measured in terms of agricultural products. In that case, the rise in real earnings per worker above that in labor productivity was true only up until 1958, when the reversal happened. Thus, in terms of agricultural goods, real earnings lagged behind productivity increases for the balance of the period.

Although Lewis emphasizes the importance of agricultural improvement, he is explicitly more concerned with the possible adverse effect of rising prices of food on industrial expansion, should agriculture fail to grow, than with increases in farmers' real income. This is understandable:

TABLE 6

LABOR PRODUCTIVITY AND REAL EARNINGS PER WORKER

	AGRICULTURE				NONAGRICULTURE					
									Index of Real Wages (NT$2,691 = 100)	
PERIOD	Labor Productivity*	Index of Earnings per Worker (NT$1,724 = 100)†	Index of Prices Farmers Paid‡	Index of Real Earnings per Worker (NT$1,724 = 100)§	Labor Productivity	Index of Earnings per Worker (NT$2,691 = 100)	Cost-of-Living Index#	Price Index of Agricultural Products**	Measure A††	Measure B‡‡
1951...	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1952...	108.5	140.7	129.0	109.1	102.7	146.2	129.5	141.6	112.9	103.2
1953...	120.7	201.6	176.6	114.2	108.9	176.4	149.9	188.1	117.7	93.8
1954...	120.0	171.0	163.6	104.5	122.2	194.1	148.0	159.5	131.2	121.7
1955...	121.6	212.9	179.2	118.8	120.2	222.4	163.0	205.1	136.4	108.4
1956...	133.9	235.0	195.5	120.2	128.2	258.9	181.6	209.9	142.5	123.3
1957...	146.1	269.0	208.8	129.3	124.9	295.5	200.4	227.1	147.4	130.1
1958...	155.0	292.0	211.1	138.3	127.2	317.9	206.9	237.0	151.8	132.6
1959...	150.6	323.0	232.5	138.9	137.3	332.4	228.9	271.7	145.2	122.4
1960...	149.2	428.6	314.6	136.2	138.5	384.3	271.0	352.6	141.8	109.0
1961...	161.9	457.9	328.8	139.3	145.8	456.7	292.2	406.4	156.3	112.4
1962...	162.5	454.8	323.9	140.4	152.2	483.9	299.1	405.3	161.8	119.4
1963...	156.8	464.8	330.8	140.5	167.0	502.6	305.7	420.1	164.4	119.6
1964...	169.7	578.2	339.4	170.4	183.5	518.8	305.2	463.6	170.0	111.9
1965...	180.5	602.3	338.3	178.0	200.4	566.6	304.9	443.2	185.8	127.8

* Computed from data shown in table 1.

† Computed from farm income data in *National Income of the Republic of China.*

‡ The index is taken from K. W. Chang, p. 535 (see n. 19). The index covers the period from 1952 to 1965; the 1951 figure is approximated by the price index of consumers.

§ Earnings per worker deflated by the index of prices farmers paid.

Annual earnings per worker in nonagriculture are derived from the weighted average daily wages in manufacturing, mining, and the utilities industries. Data on daily earnings are from *Taiwan Reconstruction Statistics*, no. 3, table 28, and from *Taiwan Statistical Data Book*, 1967, p. 117.

The index for the 1951–55 period is the average of indices of cost-of-living for urban workers and for civil servants; figures for year between 1956 and 1965 are taken from K. W. Chang, p. 533.

** The index from the period from 1951 to 1960 is taken from Y. M. Ho, pp. 110–11. The index is extended here, by the same method, to 1965. The original index takes the 1952–56 period as the base.

†† Earnings deflated by the cost-of-living index.

‡‡ Earnings deflated by the price index of agricultural products.

in Lewis's two-sector scheme improvement in peasants' real income may cause an upward movement of real wages in nonagriculture, and anything that reduces capitalists' surplus represses the rate of industrial growth. Nevertheless, even in Lewis's scheme, rises in agricultural productivity will generate a real-income effect, which may enlarge domestic markets for industrial goods, and thus promote industrial growth. Lewis assumes, a priori, that the real-wage effect on costs outweighs the real-income effect on demand. It is well known that agricultural improvement played a vital role in Japan's economic development, where increases in agricultural productivity largely were siphoned off through high rent and rural taxes to finance industrialization.[17] Hence, these transfer devices presumably had nullified the real-income effect of agricultural improvement in Japan. Although comparable to the Japanese experience in many respects, Taiwan's agricultural development involved no large scheme to siphon off the growing agricultural surplus.[18] Quite possibly the change in real income of farmers played a greater part in Taiwan's industrial growth than in Japan. For one thing, the intermediate stage in the labor transfer process, as noted before, might have failed to emerge in Taiwan without a substantial and steady rise in farmers' real income.

Our empirical findings do not conform to the classical assumption that real wages in terms of agricultural goods in nonagriculture remained constant in the initial phase of development. Evidence indicates that real wages in nonagriculture rose steadily in the presence of surplus labor, as indicated by the high unemployment rate in both sectors. The contradiction between our empirical findings and the assumption of the classical school is readily explainable. To begin with, the components of the real wages indexes compiled here are earnings of labor with various degrees of skills. Constant real wages apply only to the unskilled, as is well recognized by Lewis. The steady upward movement of the real wage over the period 1951–65 perhaps reflects the development of the so-called quasi bottleneck in industrial expansion. There is an indication that the computed schedule of average annual earnings for workers in manufacturing, mining, and utilities industries has overstated the earnings for the unskilled in non-

[17] See, e.g., Bruce F. Johnston, "Agricultural Productivity and Economic Development in Japan," *Journal of Political Economy* 59, no. 6 (December 1951): 498–513; K. Ohkawa and Henry Rosovsky, "The Role of Agriculture in Modern Japanese Economic Development," *Economic Development and Cultural Change* 9, no. 1 (October 1960): 43–67; Toshio Shishido, "Japanese Agriculture: Productivity Trend and Development of Techniques," *Journal of Farm Economics* 43, no. 2 (May 1961): 748–62.

[18] Initiated in 1949 and completed in 1952, the land reform program in Taiwan may have played a part to channel a portion of the surplus in agriculture to nonagriculture for industrial expansion. The land-to-the-tiller program required the payment of the land prices in kind, and landlords received government bonds and shares in government enterprises. Nevertheless, they must be considered as once-for-all schemes. Farmers are obviously allowed to retain their extra output resulting from rises in productivity.

TABLE 7

REAL EARNINGS PER WORKER IN AGRICULTURE AND NONAGRICULTURE (NT$)*

Period	Farm Earnings	Nonfarm Earnings	Farm Earnings as Percentage of Nonfarm Earnings
Earnings deflated by agricultural prices:			
1951–55	1,884	2,837	66.4
1956–60	2,286	3,323	68.8
1961–65	2,650	3,182	83.3
Earnings deflated by cost of living:			
1951–55	1,884	3,219	58.5
1956–60	2,286	3,923	58.3
1961–65	2,650	4,512	58.7

* Computed from table 6.

agriculture. In 1956 a minimum annual wage of NT$3,600 was introduced and imposed in Taiwan.[19] This amount was 52 percent of the present computed annual wage per worker. Also, earnings per employed in agriculture that year were higher than the minimum earnings imposed in nonagriculture. The minimum annual earnings in nonagriculture was adjusted upward by 50 percent in 1963. But prices, measured by the cost-of-living index, increased by about 68 percent between 1956 and 1963. The adjustment is therefore exceeded by price changes.

As shown in table 7, our evidence is consistent with the assumption of the classical and the neoclassical models that a wage differential exists between agriculture and nonagriculture. Most interesting, and surprising too, is the virtually constant ratio of real earnings per worker between the two sectors, when real earnings of nonagriculture are measured by the cost of living. Since earnings for the unskilled in the nonfarm sector are less than those of the employed in the farm sector, it is implausible to regard this last result as evidence supporting Lewis's view that farm earnings set the floor to earnings in nonagriculture. The excess of real farm earnings above real wages of the unskilled in nonagriculture also suggests that the transfer of labor from agriculture to nonagriculture can proceed without the inducement of a wage differential. Apparently, in economies with population pressure labor is likely to be pushed out rather than pulled away from agriculture.

Changes in Terms of Trade

From the viewpoint of farmers' real income, the movement of terms of trade can be measured by changes in the ratio of prices farmers received to prices they paid. A broader measure of changes can be obtained by taking the ratio of prices of agricultural goods to that of nonfarm products.

[19] K. W. Chang, ed., *Economic Development in Taiwan* (Taiwan: Cheng-Chueng Book Co., 1967), p. 645.

For comparative purposes, both measures of changes in the intersectoral terms of trade are computed and shown in table 8.

TABLE 8

CHANGES IN INTERNAL TERMS OF TRADE
(1952–56 = 100)

Year	Price Index of Agricultural Products*	Price Index of Nonagricultural Products†	Terms-of-Trade Measure A‡	Index of Prices Farmers Received§	Index of Prices Farmers Paid§	Terms-of-Trade Measure B‖
1951.....	56.00	79.62	70	...	...	...
1952.....	79.28	82.23	96	77.62	76.45	101.5
1953.....	105.35	89.77	117	104.59	104.65	99.9
1954.....	89.33	93.09	96	96.30	96.90	99.4
1955.....	114.84	107.09	107	106.49	106.19	100.3
1956.....	117.54	127.65	92	114.99	115.80	99.3
1957.....	127.19	144.97	88	127.40	123.70	102.9
1958.....	132.73	142.64	93	127.99	125.07	102.3
1959.....	152.15	151.44	100	142.01	137.78	103.1
1960.....	197.45	162.93	121	197.86	186.35	106.2
1961.....	227.61	159.78	142	204.00	194.79	104.7
1962.....	226.99	171.54	132	193.56	191.90	100.9
1963.....	235.26	188.15	125	210.97	196.04	107.6
1964.....	259.61	203.86	127	219.07	201.06	109.0
1965.....	248.18	202.06	123	217.82	200.44	108.7

* See table 6, col. 8.

† Price index of industrial products for the period 1952–60 is taken from *Taiwan Reconstruction Statistics*, p. 138; for 1961–65 from K. W. Chang, p. 536. The 1951 figure is imputed from index of industrial production and total value of industrial production at current prices.

‡ Price index of agricultural products divided by price index of industrial products.

§ From K. W. Chang, p. 535.

‖ The index of prices farmer received divided by the index of prices farmers paid.

The table indicates that 1958 was an important turning point regarding the movement of the terms of trade between the two sectors. The terms of trade, measured by the ratio of the price index of farm products to that of nonfarm products, were largely unfavorable to agriculture in the 1951–58 period, but steadily became unfavorable to nonagriculture thereafter. It has been noted before that the reversal in the terms of trade came when the relative growth rates of the two sectors began to diverge, with nonagriculture's growth rate pulling ahead. This would seem to undermine Lewis's position that the deterioration of terms of trade against nonagriculture reduces capitalists' surplus, thus tending to slow down the growth of the industrial sector. For the worsening in the terms of trade did not prevent the nonagricultural sector from further growth. In this case, Lewis is again overconcerned with the possibility that worsening in the terms of trade against nonagriculture will raise real wages of nonfarm workers in terms of industrial goods, thus cutting into capitalists' profits, and neglecting the concomitant favorable real-income effect of steady improvement in farmers' income.

In Lewis's two-sector model, a balanced path of growth, implying fixed terms of trade, can be achieved if the ratio of growth of agriculture to nonagriculture is consistent with the income elasticities of demand for farm products relative to that for nonfarm products. Suppose we follow Lewis and assume that in order to maintain a stable terms of trade between the two sectors an appropriate rate of growth of each sector is required. The required rate of the two sectors is assumed to be determined by the two equations: (1) $G_R = r_p + \phi r_m$; and (2) $Q_R = r_K + \psi r_m$; where G_R = required rate of growth of agriculture, Q_R = required rate of growth of nonagriculture, r_p = growth rate of population, r_m = growth rate of real income per capita, r_K = rate of capital formation, ϕ = income elasticity of demand for food products, and ψ = income elasticity of demand for nonfarm products. Whereas the required rate of agriculture takes into account the increase in demand for agricultural products through changes in real income and in population, the required rate of growth of nonagriculture measures the expansion in demand for consumer goods through real income changes and for capital goods due to capital formation.[20] Let G be the observed rate of growth of agriculture and Q the observed rate of growth of nonagriculture. Since it is rare that the actual growth of each sector follows exactly the razor's edge defined by the required growth path, we propose the following: (1) terms of trade would turn against agriculture if

$$\frac{G}{G_R} > \frac{Q}{Q_R};$$

and (2) terms of trade would turn against nonagriculture if

$$\frac{G}{G_R} < \frac{Q}{G_R}.$$

[20] From income statistics published in National Income of the Republic of China, we derived our estimates of income elasticity of demand for food as follows:

Period	Food Consumption per Capita (% Change)	Real Income per Capita (% Change)	Income Elasticity of Demand for Food Products
1951–58	15.4	19.4	0.79
1959–65	19.8	42.8	0.46
1951–65	45.8	82.5	0.56

Food consumption per capita is measured in terms of food expenditures in constant 1964 New Taiwan dollars.

Income elasticity of demand for nonfarm products is assumed to be equal to 1.1. Our result holds as long as income elasticity for nonfarm products is less than 1.3. For nonfarm goods as a group, it is very unlikely that income elasticity can be greater than 1.3. This assertion is based on the examination of the estimates of income elasticities for different manufactured goods made by the United Nations and cited in D. S. Swamy, "A Statistical Evidence of Balanced and Unbalanced Growth," *Review of Economics and Statistics* 49, no. 3 (August 1967): 288–303.

The observed behavior of the internal terms of trade over the period conforms to this formulation. In fact, the hypothesis explains the exact timing of the reversal of the terms of trade in 1958 when they moved against nonagriculture.

Summary and Concluding Remarks

Our analysis of Taiwan's development experience during the 1951–65 period in a two-sector scheme has aimed to shed some light not only on the Taiwanese experience, but also the applicability of the classical and neoclassical models. There can be little question that Taiwan stands as an outstanding example of successful development under the severe pressure of population. Hence, Taiwan can be regarded as an important test case of the relevance of the theoretical propositions in the classical model respecting economies with surplus population. Although principally concerned with industrial growth as such, in essence, the classical model prescribes a balanced growth path. Expansion of the industrial sector requires concurrent development of agriculture at an appropriate rate, maintaining a stable terms of trade between the two sectors. A balanced growth is also essential to keep real wages in terms of industrial products at a constant level. Too rapid an improvement in agricultural productivity may repress industrial growth. In fact, any change that cuts into industrialists' profits will adversely affect the rate of capital formation and, thus, the over-all rate of growth. The central feature of economic transformation in the classical two-sector scheme is the reallocation of surplus labor from agriculture to nonagriculture under a fixed real wage level. Once the growth process is started, while balance is maintained, the industrial sector is assumed to move forward smoothly as labor is continuously pulled away from agriculture. Upon completion of the phase of development with surplus labor in agriculture, growth enters the neoclassical stage in which labor no longer is available to the industrial sector at a constant real wage. Once this important transition takes place, representing the so-called turning-point in the Ranis-Fei refined version of the model, growth is assumed to take on different characteristics.[21] Specifically, real wages in nonagriculture begin to rise and capital-shallowing gives way to capital-deepening in the nonfarm sector.

Taiwan's experience evidently contradicts the growth profile in the classical model on several counts, involving the labor transfer process, the movement of real wages, and changes in the terms of trade. We have found that the enormous growth of nonagriculture in Taiwan had failed to generate sufficient employment to accommodate the transfer of surplus labor from agriculture, and the labor transfer process does not seem to be an important dimension of growth. The movement of labor appeared to be largely a process of relocating the surplus labor from one sector to another.

[21] Fei and Ranis, *Development of the Labor Surplus Economy*, p. 205.

Thus, Taiwan's growth experience with respect to labor reallocation in the relevant period indicates that the role of labor transfer in the development of an economy with surplus population may have been overstressed. The experience is simply further evidence confirming Kuznets's results that increases in per capita income have been primarily due to rising productivity within sectors rather than to shifts in the relative shares of the labor force between sectors.[22] To emphasize the transfer of the labor force in agriculture as an indispensable dimension of economic transformation is to identify economic development with industrialization. This viewpoint is conducive to overestimating the capability of nonagriculture to absorb surplus labor in the initial phase of development and to accommodate growth in labor force. It virtually overlooks agriculture's potential in eliminating surplus labor through labor-intensive innovations within the sector. The difficulty with the classical proposition is that the concept of surplus labor is defined statically with reference only to the existing techniques in agriculture, and that technological change in the traditional sector is assumed to be necessarily labor saving, thus releasing labor. The question whether technical change in agriculture must be labor saving is empirical as much as a matter of developmental policy. Thus, the issue cannot be answered on a priori grounds. Moreover, through intentional choice or by necessity, modern industrial growth has favored capital-intensive techniques and/or industries.[23] This has been true also in Taiwan. The classical emphasis on technical changes in agriculture to release labor therefore may be misleading. Perhaps developing nations with population pressure will be better off to think in terms of reabsorbing surplus labor in agriculture by introducing labor-intensive devices into agriculture. In Taiwan, in spite of the extremely crowded condition in agriculture, farm employment increased annually at a rate of 0.6 percent. Consequently, the possibility of activating surplus labor within the agricultural sector through technical change should not be too readily dismissed in other areas, especially if they are less congested. Under rapid population growth, the pressure for employment is likely to be present in every segment of the economy, not agriculture alone. Thus, the core of the growth problem in economies with surplus population should be the creation of productive employment for the unemployed, be it in agriculture or in nonagriculture.

Our empirical evidence in terms of growth of farm labor force relative to farm employment, a persisting high rate of unemployment in both sectors, and the aforementioned character of the labor transfer process, indicates that Taiwan so far clearly has failed to reach the important landmark of the "turning-point." On the other hand, Taiwan's experience

[22] See Simon Kuznets, "Quantitative Aspects of the Economic Growth of Nations. II. Industrial Distribution of National Product and Labor Force," *Economic Development and Cultural Change* 5, no. 4, suppl. (July 1957): 52–54.

[23] Capital-biased growth is found to be true in most Latin American countries; see Werner Baer and M. E. A. Herve, "Employment and Industrialization in Developing Countries," *Quarterly Journal of Economics* 80, no. 1 (February 1966): 88–107.

during the period of development with surplus labor displayed major characteristics assumed to emerge only after the "turning-point." As noted before, real wages, as measured by money earnings deflated by the cost-of-living index, shifted consistently upward over the relevant period. And the process of capital-deepening in nonagriculture became quite notable beginning in 1958. The bias of the growth pattern in favor of capital-intensive industries and techniques, possibly inconsistent with the resource endowment of Taiwan, might have been encouraged by the steady rise in real wages relative to labor productivity. More important, growth in Taiwan evidently has become a self-sustaining process prior to the attainment of such a turning-point, contrary to theoretical beliefs. This raises a fundamental question concerning the importance and relevance of such a turning-point in development of an economy with surplus labor.

In a recent and highly interesting attempt to identify the turning-point in the Japanese developmental process, Minami concluded: "The turning-point was passed sometime during the postwar years. We cannot offer, however, a definite date for the turning-point. One may observe that it occurred around 1953, because real wage rate and the marginal productivity of labor in the subsistence sector are thought to have begun to rise steadily in that year. Another may insist that it is 1960, because the elasticity of labor supply kinks in 1960."[24] If this turning-point, viewed as the time of cessation of surplus labor in agriculture, was reached in Japan only as recently as 1953–60, long after the Japanese takeoff, Minami's findings constitute further evidence that the turning-point, an elegant concept in pure theory, has been greatly overemphasized; at best it has a remote applicability to contemporarily developing nations with surplus population.

The experience of Taiwan also casts doubt concerning the relevance of the classical assumption of a constant real wage in nonagriculture. Industrial expansion will undoubtedly give rise to demand for labor of all degrees of skills. What appeared to be more relevant is the change in the real wage package for the skilled and the unskilled. The question whether the real wage for the unskilled is indeed constant is only of secondary importance. Industrialists' profits and the relative share of profits in national income aggregate will be duly affected so long as industrial growth entails an upward movement of real wages. In the same vein, the classical assumption that a wage differential exists between sectors as a

[24] Ryoshin Minami, "The Turning Point in the Japanese Economy," *Quarterly Journal of Economics* 82, no. 3 (August 1968): 380–402. Although the exact date at which Japan had passed the turning-point is still in dispute, all participating in the dispute except Ranis and Fei seem to take the view that the turning point had occurred in the 1950s; see, e.g., W. Arthur Lewis, "Unlimited Labour: Further Notes," *Manchester School of Economics and Social Studies* 26, no. 1 (January 1958): 1–32; K. Ohkawa, "Agriculture and Turning-Points in Economic Growth," *Developing Economies* 3 (December 1965): 471–86. Ranis-Fei's view is in *Development of the Labor Surplus Economy*, pp. 260–66.

mechanism of the labor transfer process may be criticized as redundant. Under a severe pressure of population, it appeared in Taiwan that labor responded more readily to employment opportunities than to remunerations of employment.

Our findings further suggest that the real-income effect of increases in farmers' real income, brought about by changes in technology in agriculture and in terms of trade in favor of agriculture is unduly understated in the classical model. However, our empirical two-sector model is an open one. Consequently, the gains of farmers in real income through favorable changes in terms of trade could have been realized without any compensating loss in real income on the part of the domestic nonagricultural sector.

Interesting enough, our results give more evidence to the neoclassical rather than the classical model. The increase in agricultural employment in Taiwan under surplus population is in line with Jorgenson's assertion that "the agricultural labor force may rise, fall, or remain constant."[25] Moreover, in the neoclassical model, real wages in nonagriculture are assumed to be variable rather than fixed, and those in agriculture to be proportional to those in nonagriculture. For whatever reason, such a proportional relation exists in Taiwan. Also, Jorgenson seems to anticipate the foreseen possibility that the strength of growth in the nonagricultural sector may greatly exceed its capacity to absorb agricultural labor, in saying: "The criterion for a critical minimum effort proposed by Ranis and Fei that the rate of growth of population must be less than the rate of growth of the industrial labor force, provided no indication whatever concerning the economic viability of the advanced sector."[26]

Our findings, however, contradict the neoclassical formulation on one account. In the neoclassical model, the terms of trade are assumed to be determined by the growth rate of population, the output elasticity of labor in agriculture, and the rate of change in wages in manufacturing. According to Jorgenson's formulation, a special test has found, the terms of trade between the two sectors should have turned against agriculture in 1958–65.

Some of our differences from the classical and the neoclassical models may stem from deviations in content. Specifically, our two-sector scheme differs from the theoretical two-sector models in four important aspects: (1) our division of the Taiwanese economy, based on empirical expediency, does not exactly correspond to the theoretical division based on the inclusiveness of the production function; (2) population growth is treated as common to both sectors rather than confined to the traditional sector;[27]

[25] Jorgenson, p. 309.

[26] Ibid., p. 308.

[27] Ranis and Fei assume that growth in population is a phenomenon of the traditional sector and that the increment in population is then being allocated to the advanced sector. To analyze the extent to which agricultural surplus labor is absorbed by industrial expansion, the assumption is obviously unsatisfactory.

(3) while, in theories of development of a dual economy, agriculture is invariably assumed to be a traditional sector of low productivity, Taiwan's agriculture is efficient and productive; and (4) ours is two-sector model for an open economy, wherein the foreign trade sector is implicitly found in nonagriculture. However, it would seem that the uncovered deviations from the classical model ought to be viewed as major limitations on its value. In general, our results signify that the condition governing labor supply may be less important as a factor in development than the state of technology and the rate of change in technology in agriculture. In overpopulated, underdeveloped countries, the ultimate outcome of development efforts may depend not so much on the race between growth in industrial employment and growth in population, as suggested by Ranis and Fei, as on the race between the rate of technical change in agriculture and the rate of population growth.