

WHAT ACCOUNTS FOR JAPAN'S HIGH RATE OF GROWTH?*

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The purpose of this paper is to investigate the sources of economic growth in Japan and to compare the results with those in the U.S. and Europe as studied by E. F. Denison. The method used by Denison is followed as far as possible. The character of this paper is of fact finding, and the interpretation of results or the originality of methodology is not dealt with here. The results may be summarized as follows.

(1) Japan's growth rate is two times that of Europe and three times that of the United States.

(2) The contributions of labor, capital, and the residual to economic growth are all higher for Japan than for the U.S. or Europe.

(3) Factors which account for the higher contribution of labor to economic growth are (a) the higher rate of increase in employment, (b) less shortening of working hours, and (c) improved age and sex composition.

(4) Factors which account for the higher contribution of capital to economic growth are a higher rate of increase in capital input and the high elasticity of production with respect to capital.

(5) Other notable points include: (a) the contribution of education is lower for Japan; (b) the capital-labor ratio in Japan increased remarkably; (c) capital's share of national income is higher; and (d) 60% of Japan's economic growth is accounted for by the residual.

1. COMPARISON OF JAPAN'S GROWTH RATE WITH THAT OF OTHER COUNTRIES

Japan's economic growth rate, markedly higher than the growth rates of western nations, was 10.1 per cent (annual average increase in real GNP) during the period 1955-1968. By comparison, Denison's study—though covering a slightly different time period—shows less than 5 per cent annual increase in GNP for Northwest Europe and a little over 3 per cent for the U.S. (see Table 1). Japan's growth rate, in other words, is twice that of Northwest Europe and three times the U.S. rate.¹ The present article seeks to account for these differences using statistical analysis.

2. METHODOLOGY

While there are several ways to analyze differences in economic growth rates, we have used here the method used by Denison both in his investigation of the reasons for U.S. economic growth and in his comparative study of European and U.S. growth rates [2]². Denison's methodology can be summarized as

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¹Even if the periods are aligned, Japan's economic growth rate is about 2 to 3 times that of Europe and the U.S.

²Ohkawa [4], Watanabe-Ekaizu [8] and Watanabe [9] have applied a similar methodology in their studies of Japan.

follows:

- (1) Measure labor, land and capital's relative share of national income.
- (2) Measure the rate of increase in labor, land and capital inputs respectively.
- (3) In regard to labor, account is taken of work hours, age, sex and education in addition to the size of the labor force.
- (4) The contribution of labor, land and capital to economic growth is determined by multiplying the factor's relative share of national income by the rate of increase of factor input.³
- (5) The contribution of advances of knowledge, etc., to the economic growth rate is the residual after subtracting the contributions made by labor, land and capital from the growth rate.⁴

TABLE 1
ECONOMIC GROWTH RATES OF SELECTED COUNTRIES^a

	Period	Growth Rate (%)
Japan	1955-68	10.1
North-West Europe	1950-62	4.8
U.S.A.	1950-62	3.3

Source: Japan: National Income Statistics (FY1970 issue) of the Economic Planning Agency; North-West Europe and the U.S.: E.F. Denison [2], p. 17.

^aJapanese statistics are real GNP; other countries are real national income. North-West Europe includes Belgium, Denmark, France, Germany, the Netherlands, Norway and U.K.

There are problems with Denison's methodology, however, the most important of which are as follows.

Firstly, he uses standard labor equivalents (male, 20-64 years in age, 8 years education) rather than the actual labor force. In converting labor into standard labor units he used wages as the weight; for instance, if wages for women equalled 60 per cent of the male wages, a female worker was treated as 0.6

³If we assume neutral technological progress and perfect competition with returns to factors equal to their marginal product, then the relative share of national income accruing to each factor of production equals the percentage increase in real output when the input of that factor is increased by 1 per cent (=elasticity of production with respect to that factor input).

⁴Denison had in mind the following production function:

$$G(Y) = \alpha G(L) + \beta G(K) + \gamma G(A) + G(R)$$

Provided $\alpha + \beta + \gamma = 1$

Y = Real national income

L = Labor input adjusted for its quality

K = Capital

A = Land

R = Residual

G = Rate of increase, α, β, γ , (= respective shares, L, K and A). In actual calculations, the rate of increase in land, A , = 0.

standard labor equivalent. However, since wage rates are greatly influenced by social factors, it is questionable whether wage rates are proportional to the quality of labor. This may be particularly true in the case of Japan.⁵

Second, Denison ignores the quality of capital. Consequently, a large portion of the actual growth rate is not accounted for by the contributions of labor and capital. The residual, after accounting for the contributions of labor and capital, would probably decrease if the quality of capital were taken into consideration. However, measuring the quality of capital is more difficult than measuring the quality of labor.⁶

Third, he does not consider factors of production other than labor and capital. For instance, public capital is not included.

Fourth, the relative share of each factor of production in national income indicates elasticity of output with respect to that factor. There are two general ways used to estimate the elasticity of output with respect to a factor input. One is to estimate statistically by regression analysis the regression coefficient between the factor input and production. The other is to use relative shares, which Denison has done. This latter method has the advantage of avoiding estimation errors arising from multicollinearity among the factors of production. However, for the relative shares method to be valid, the return to a factor (wages) must equal its marginal product. It is questionable whether this condition is fulfilled in actuality.

Fifth, Denison's analysis cannot answer such questions as why the rate of increase in labor and capital inputs in Japan is larger than elsewhere or why capital's share of Japan's national income is higher or why the rate of increase in factor productivities is greater. His is thus an "anatomic" analysis not a "physiological" analysis.⁷

In this paper, however, I will focus on why, when using Denison's methodology, Japan's rate of economic growth is considerably higher than that of other countries.

3. SUMMARY OF RESULTS

Tables 2 and 3 show the results for Japan, Northwest Europe and the U.S. In the case of Japan, the calculation covers the period 1955–1968; for Northwest Europe and the U.S. figures for the years 1950–1962 are used. This difference in the period covered reflects the use of the latest available data for Japan and the results of Denison's analysis for other countries. From the comparative figures on rates of increase offered in Table 2, it can be seen that Japan's rate of increase is higher in terms of both labor and capital input and, further, that the rate of increase in productivity per unit of input is greater in the case of Japan than for other nations.⁸

⁵On the problem of measuring labor's quality, see Watanabe-Ekaizu [8] and Watanabe [9].

⁶For examples of studies where adjustments are made for the quality of capital, see Solow [5] and Ohkawa [4]. Ohkawa adjusts capital input for utilization rate, type and average age.

⁷Problems in addition to those mentioned above are: 1) Can factors of production be separated into labor, capital and technology and 2) Does Hicks neutrality exist (technological progress that does not change relative shares)?

⁸However, there are various statistical and theoretical problems in calculating factor inputs. These will be described later.

TABLE 2
RATE OF INCREASE OF FACTOR INPUTS (%)
(1955-1968 FOR JAPAN, 1950-1962 FOR OTHERS)

	Japan	U.S.A.	North- West Europe	Belgium	Denmark	France	Germany	Nether- lands	Norway	U.K.	Italy
Total factor input ^a	4.2	1.71	1.67	1.28	1.45	1.20	2.71	1.79	1.07	1.16	1.65
Labor	1.9	1.42	1.08	1.03	0.78	0.58	1.84	1.17	0.21	0.77	1.32
Employment	1.5	1.14	0.93	0.55	0.93	0.11	2.00	1.05	0.18	0.65	0.56
Hours of work	-0.1	-0.21	-0.18	-0.20	-0.24	-0.03	-0.36	-0.21	-0.20	-0.19	0.07
Age, sex composition	0.3	-0.13	0.04	0.11	-0.9	0.13	0.05	0.01	-0.09	-0.05	0.13
Education	0.2	0.62	0.30	0.58	0.18	0.37	0.15	0.32	0.33	0.37	0.55
Capital ^a	10.5	3.58	4.53	2.61	5.06	4.17	6.37	4.72	4.23	3.35	3.50
Nonresidential struc- tures and equipment	9.6	3.74	4.55	2.92	5.38	3.99	6.17	4.60	4.65	3.58	3.78
Inventories	12.4	3.00	4.47	1.56	4.05	4.77	7.05	5.10	2.75	2.56	2.66
Land	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Output per unit of input	5.5	1.36	3.04	2.011	1.94	3.65	4.43	2.79	2.39	1.18	4.25

^aNo dwellings are included in gross input and in capital. Figures for Western countries are derived from Denison [2], p. 190.

TABLE 3
CONTRIBUTION OF FACTOR INPUTS AND OUTPUT PER UNIT OF INPUT TO ECONOMIC GROWTH
(1955-1968 FOR JAPAN, 1950-1962 FOR OTHERS)

	Japan	U.S.A.	North- West Europe	Belgium	Denmark	France	Germany	Nether- lands	Norway	U.K.	Italy
Increase rate of real national income	10.1 ^a	3.32	4.76	3.20	3.51	4.92	7.26	4.73	3.45	2.29	5.96
Total factor input	4.03	1.95	1.69	1.17	1.55	1.24	2.78	1.91	1.04	1.11	1.66
Labor	1.31	1.12	0.83	0.76	0.59	0.45	1.37	0.87	0.15	0.60	0.96
Employment	1.03	0.90	0.71	0.40	0.70	0.08	1.49	0.78	0.13	0.50	0.42
Hours of work	-0.07	-0.17	-0.14	-0.15	-0.18	-0.02	-0.27	-0.16	-0.15	-0.15	0.05
Age, sex composition	0.21	-0.10	0.03	0.08	-0.07	0.10	0.04	0.01	-0.07	-0.04	0.09
Education	0.14	0.49	0.23	0.43	0.14	0.29	0.11	0.24	0.24	0.29	0.40
Capital	2.72	0.83	0.86	0.41	0.96	0.79	1.41	1.04	0.89	0.51	0.70
Dwellings	0.14	0.25	0.07	0.20	0.13	0.02	0.14	0.06	0.04	0.04	0.07
International assets	— ^b	0.05	-0.03	0.60	0.02	0.02	-0.08	0.10	-0.07	-0.05	-0.03
Nonresidential structures and equipment	1.62	0.43	0.64	0.39	0.66	0.56	1.02	0.66	0.79	0.43	0.54
Inventories	0.96	0.10	0.18	-0.60	0.15	0.19	0.33	0.22	0.13	0.09	0.12
Land	—	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Output per unit of input	6.1	1.37	3.07	2.03	1.96	3.68	4.48	2.82	2.41	1.18	4.30

^aReal GNP.

^bFor Japan, the effect of international assets is assumed to be zero. Denison [2], p. 192, for other countries.

Table 3 compares Japan with other nations in terms of each factor's contribution to economic growth. "Factor's contribution" refers here to the figure obtained by multiplying the rate of increase of factor input by the elasticity of output with respect to that factor (= factor's relative share in national income). Japan shows a higher contribution for both labor and capital. Moreover, the contribution of output per unit of input to economic growth is also higher for Japan than for other countries.⁹

Table 4 offers a breakdown of the reasons for these growth rate differentials. From it we see that Japan's growth rate (10.1 per cent) is 5.3 per cent higher than that of Northwest Europe; that about one half (3 per cent) of this is due to a higher rate of increase in productivity; that another 1.9 per cent reflects a greater rate of capital input; and that 0.5 per cent is accounted for by a higher rate of increase (both qualitatively and quantitatively) of labor. A comparison with the U.S. shows similar results. While it is clear that under existing conditions Japan might have a higher growth rate than the U.S. or European nations, what was slightly unexpected was that the rate of contribution of education was lower for Japan than for three other nations. This aspect is in need of re-examination to determine if it represents actual fact or simply reflects an inadequacy in the method of measurement.

A somewhat more detailed explanation of the results of the measurement is attempted below.

TABLE 4
FACTORS ACCOUNTING FOR DIFFERENTIALS IN GROWTH RATES

	Japan—North-West Europe	Japan—U.S.A.
National Income	5.3	6.8
Gross input	2.3	2.1
Labor	0.5	0.2
Employment	0.3	0.1
Work hours	0.1	0.1
Age, sex composition	0.2	0.3
Education	-0.1	-0.4
Capital	1.9	1.9
Dwelling	0.1	-0.1
International assets	—	-0.1
Nonresidential structures and equipment	1.0	1.2
Inventories	0.8	0.9
Productivity	3.0	4.7

Source: Derived from Table 3.

⁹Denison gives following reasons for the increase in the output per unit of input: (1) advance of knowledge, (2) improved allocation of resources, and (3) economies of scale, etc. A breakdown of the reasons accounting for the increase in the output per unit of input will be treated in another paper, but all of these three reasons are considered to be applicable also for Japan in view of the fact that Japan introduced foreign technique positively, that the shift of labor from agriculture to manufacturing industry was swift, and that her economic scale expanded with great speed.

4. SOME COMMENTS ON THE ABOVE RESULTS

1. *Factors of Production*

Japan has a higher rate of increase in both productivity and factor inputs than the other countries (Table 5). In the case of factor inputs, this higher rate of increase is true for both capital and labor, especially for capital (Table 6).

TABLE 5
RATE OF INCREASE OF FACTOR INPUT AND OF PRODUCTIVITY

	Rate of increase of factor input %	Rate of increase of productivity %	Growth rate %
	(a)	(b)	$(1+a) \times (1+b)$
Japan	4.2	5.5	10.1
Northwest Europe	1.7	3.0	4.8
U.S.A.	1.7	1.4	3.3

TABLE 6
RATE OF INCREASE OF LABOR INPUT VOLUME AND OF
CAPITAL INPUT VOLUME

	Labor input %	Capital input %
Japan	1.9	10.5
Northwest Europe	1.1	4.5
U.S.A.	1.4	3.6

TABLE 7
BREAKDOWN OF THE INCREASE IN LABOR INPUT VOLUME

	Total	Employment	Work hours	Age, Sex	Education
Japan	1.9	1.5	-0.1	0.3	0.2
Northwest Europe	1.1	0.9	-0.2	—	0.3
U.S.A.	1.4	1.1	-0.2	-0.1	0.6

2. *Labor Input*

Three factors may account for the higher rate of increase of labor input for Japan: (1) the higher rate of increase in employment, (2) longer working hours and (3) improved age and sex composition. However, as explained above the

contribution of education to labor input was lower in the case of Japan¹⁰ (Table 7).

3. Labor's Contribution to Economic Growth

Labor's contribution to economic growth, computed by multiplying the rate of increase in labor input by the elasticity of production with respect to labor (= relative share of national income accruing to labor), is shown in Table 8.

Increased employment in Japan and the favorable age-sex composition of Japanese workers largely account for the difference between Japan and other countries in labor's contribution to growth rates.¹¹

4. CAPITAL INPUT

The rate of increase of capital input for both equipment and inventory is higher for Japan. In the case of Western countries, there is no difference in the rate of increase in capital input into inventory and equipment, and these are practically the same as the economic growth rate. As a consequence, there is practically no change in the marginal capital coefficient for these countries. However, since what characterizes capital input in Japan is the higher rate of increase in inventory, we must examine the reasons for this (Table 9).

5. CAPITAL'S CONTRIBUTION TO ECONOMIC GROWTH

Capital's contribution to economic growth is 2.7 per cent for Japan and 0.9 per cent for Northwest Europe. The higher contribution of capital in the case of Japan resulted in that nation having a 2 per cent higher economic growth rate

¹⁰Shorter work hours do not necessarily lower labor input because a reduction in time at work improves labor efficiency. Denison's study takes this into consideration by multiplying the reduced work hours by the following weights, to measure the real decrease in labor input: 0.4 for the U.S., 0.3 for France, 0.15 for Germany and 0.25 for the Netherlands, with no weights given to other countries (see Denison [2], p. 60, 61). Confirmation of the observation that the effect of education is small in Japan can be seen in Watanabe-Ekaizu [8]. Denison does not take the wage differential for different educational backgrounds as the qualitative difference in labor due to education. He multiplies the wage differential by 3/5 on the assumption that wage differentials according to educational background include a differential as well for innate ability (see Denison [2], p. 83). No such adjustment is made in our study for Japan. If such an adjustment is applied the effect of education on labor input will be made lower. The low effect of education in the case of Japan may be due to a reduction in the quality of education and to less than ideal employment because university graduates are not given employment equivalent to their abilities. However, it is probably incorrect to accept the low effect of education in Japan per se. Watanabe-Ekaizu state that education affects production in ways not indicated in their calculations: (1) even when the rate of increase in education is small, the high educational base in Japan (stock) facilitates the introduction of new technology; (2) people with high educational levels are employed at low wages; and (3) non-academic education including on-the-job training is carried out extensively.

¹¹Hours worked is based on the weekly work-hours as stated in the *Labor Force Summary*. However, the basis of this survey underwent a significant revision in 1967 which raises the question whether in fact the labor force increased or not. *Monthly Labor Statistics* also includes data on hours worked, but its coverage only includes employment in mining, manufacturing and construction (it excludes agriculture and service employment). A comparison of statistics from these two sources will be made later.

TABLE 8
LABOR'S CONTRIBUTION TO ECONOMIC GROWTH

	Japan	Northwest Europe	U.S.A.
Growth rate	10.1	4.8	3.3
Labor (Total)	1.3	0.8	1.1
Employment	1.0	0.7	0.9
Hours of work	-0.1	-0.1	-0.2
Age, sex composition	0.2	—	-0.1
Education	0.1	0.2	0.5

TABLE 9
INTERNATIONAL COMPARISON OF RATE OF INCREASE IN CAPITAL INPUT (%)

	Total	Equipment	Inventory
Japan	10.5	9.6	12.4
Northwest Europe	4.5	4.6	4.5
U.S.A.	3.6	3.7	3.0

TABLE 10
INTERNATIONAL COMPARISON OF CONTRIBUTION RATE OF CAPITAL TO GROWTH (%)

	Japan	Northwest Europe	U.S.A.
Growth rate	10.1	4.8	3.3
Capital (Total)	2.7	0.9	0.8
Dwellings	0.1	0.1	0.3
International assets	—	—	0.1
Nonresidential structures and equipment	1.6	0.6	0.4
Inventories	1.0	0.2	0.1

than Western countries. Equipment accounts for more than 1 per cent of this difference and inventory a little less than 1 per cent (Table 10).

6. THE RELATIVE ROLES OF CAPITAL AND LABOR

What distinguishes Japan's economic growth pattern from that of Western Europe and the U.S. is the higher contribution rate of capital as compared to labor. In Western Europe both factors contribute equally while in the U.S. labor's contribution is higher than that of capital. The different pattern displayed by Japan reflects a higher rate of increase in capital input and, as will be examined below, is due to a high elasticity of production with respect to capital. In short,

a high rate of increase in capital input and high elasticity of production with respect to capital accounts for Japan's extremely high rate of growth (Table 11).

7. PRODUCTIVITY PER UNIT OF FACTOR INPUT

The rate of increase in productivity per unit of factor input is remarkably high in Japan. Table 12 shows the relative share of each factor's contribution to economic growth, computed by referring to Table 11 and taking total economic growth as 100. Table 12 shows that 60 per cent of Japan's economic growth is accounted for by increased productivity. We will investigate the reasons for this below.¹²

Productivity is defined here as total productivity of factor inputs, labor and capital combined. This definition is to be distinguished from partial productivity of labor (gross output/labor input) and of capital (gross output/capital input). A comparison of these three concepts of productivity reveals that the productivity of capital in Japan is decreasing and is lower than in the Western countries.

TABLE 11
INTERNATIONAL COMPARISON OF CONTRIBUTION TO GROWTH BY CAPITAL,
LABOR, AND RESIDUAL

	Japan	Northwest Europe	U.S.A.
Growth rate	10.1	4.8	3.3
Labor's contribution	1.3	0.8	1.1
Capital's contribution	2.7	0.9	0.8
Residual	6.1	3.1	1.4

TABLE 12
INTERNATIONAL COMPARISON OF RATE OF CONTRIBUTION TO GROWTH BY
CAPITAL, LABOR AND RESIDUAL

	Japan	Northwest Europe	U.S.A.
Growth rate	100.0	100.0	100.0
Labor	12.9	16.7	33.3
Capital	26.7	18.8	24.2
Residual	60.4	64.6	42.4

¹²According to Watanabe-Ekaizu [7] the major reason for Japan's large increase in productivity is that Japan has followed the growth pattern of other advanced countries by importing their technologies. Ohkawa's study [4] which takes the quality of capital into consideration reduces the residual to 0.12 per cent for 1955-1961 (see Table 19). According to Mr. Terui's tentative computation, the average age of capital for all private enterprises has precipitously decreased from 11.24 in 1955 to 6.40 in 1968. If we consider this phenomenon to represent an improvement in the quality of capital and incorporate it as a contribution due to the growth of capital, it lowers the rate of contribution of the residual equivalently.

TABLE 13
RATE OF INCREASE IN PRODUCTIVITY OF LABOR AND CAPITAL AND IN THE
CAPITAL-LABOR RATIO

	Labor Productivity	Capital Productivity	Total Productivity	Capital- Labor Ratio
Japan	8.0	-0.4	5.5	8.4
U.S.A.	1.9	-0.3	1.4	2.1
Northwest Europe	3.7	0.3	3.0	3.4
Belgium	2.1	0.6	2.0	1.6
Denmark	2.7	-1.5	1.9	4.2
France	4.3	0.7	3.7	3.6
Germany	5.4	0.9	4.4	4.4
Netherlands	3.5	0.0	2.8	3.5
Norway	3.3	-0.7	2.4	4.0
U.K.	1.5	-1.0	1.2	2.6
Italy	4.6	2.4	4.3	2.2

Note: Prepared from Table 2.

Labor productivity = increased rate of production ÷ increased rate of labor input.

Capital productivity = increased rate of production ÷ increased rate of capital input.

Capital includes both equipment and inventory.

The period covered is 1955-1968 for Japan, and 1950-1962 for others.

However, the remarkably high increase of the capital-labor ratio in Japan is raising labor productivity and thereby raising total productivity (Table 13).

8. INCOME SHARES

In this calculation the concept of income shares is important since it indicates the elasticity of production with respect to factor input. As will be explained below, labor's share includes not only wages and salaries but also a part of proprietors' income. What distinguishes Japan from other countries is that labor's share is low and capital's share of national income is high (Table 14). For this reason capital's contribution to Japan's economic growth is high. Table 15 shows income shares of national income accruing to labor, land and capital (excluding dwellings).

TABLE 14
INTERNATIONAL COMPARISON OF RELATIVE FACTOR SHARES OF NATIONAL
INCOME

	Japan	West Europe	U.S.A.
Total	100	100	100
Labor	69	76	79
Dwellings	4	2	4
Other assets	28	22	17

TABLE 15
INTERNATIONAL COMPARISON OF RELATIVE SHARES IN NATIONAL INCOME OF
LABOR, LAND AND CAPITAL

	Japan	West Europe	U.S.A.
Labor	71.3	77.6	82.0
Land	3.1	4.0	3.0
Capital ^a	25.5	18.4	15.0
Total	100.0	100.0	100.0

^aExcludes income from dwellings.

Table 16 shows the change in relative shares over time. Although labor's share decreased slightly during 1960–1964, no significant change is evident in relative shares since 1955.

TABLE 16
RELATIVE SHARES OF NATIONAL INCOME, JAPAN

	1955–1959	1960–1964	1965–1968	1955–1968
Labor	72	70	73	71
Land	3	3	4	3
Capital	25	28	24	26
Total	100	100	100	100

5. SHIFTS IN THE ECONOMIC GROWTH RATE OF JAPAN AND OTHER COUNTRIES—TIME SERIES ANALYSIS

Japan's economic growth rate has accelerated over time, though the exact rate of increase depends on how the period is divided (Table 17). This acceleration in the growth rate is due more to the increase in productivity than to the increase in factor inputs. If we identify the basic reasons for this accelerating growth rate, the contribution of the age–sex composition of the labor force decreased while that of education increased. The contributions made by increases in capital and in productivity increased gradually. When compared with other countries the rate of growth decreased in the latter periods for Northwest Europe and the United States (Table 18). This is due—the only exception being capital for Northwest Europe—to a decrease in the contribution of all items, labor input, capital input and productivity per unit of input.

6. COMPARISON WITH OTHER ESTIMATES

Watanabe-Ekaizu [8] and Ohkawa [4] have made estimates similar to ours. Although the calculations differ slightly both in the period covered and in the methodology employed, Table 19 sets out in tabular form these three estimates after aligning the time periods.

TABLE 17

RATE OF INCREASE IN FACTOR INPUT AND ITS CONTRIBUTION TO ECONOMIC GROWTH, JAPAN

	Factor Input				Contribution Rate			
	1955-1960	1960-1965	1965-1968	1955-1968	1955-1960	1960-1965	1965-1968	1955-1968
Real GNP	—	—	—	—	8.9	10.0	12.3	10.1
Total input ^a	4.3	4.2	4.0	4.2	4.23	4.13	3.89	4.03
Labor	2.9	1.2	1.4	1.9	2.10	0.87	0.97	1.31
Employment	1.6	1.3	1.7	1.5	1.12	0.87	1.18	1.03
Work hours	0.8	-0.6	-0.7	-0.1	0.56	-0.40	-0.49	-0.07
Age, sex	0.5	0.3	0.1	0.3	0.35	0.20	0.07	0.21
Education	0.1	0.3	0.3	0.2	0.07	0.20	0.21	0.14
Capital ^a	8.4	11.7	12.0	10.5	2.13	3.26	2.92	2.72
Dwellings	3.5	4.1	4.1	3.9	0.11	0.16	0.16	0.14
International assets	—	—	—	—	—	—	—	—
Equipment	7.0	11.4	11.1	9.6	1.16	2.09	1.73	1.62
Inventory	11.3	12.5	13.9	12.4	0.86	1.01	1.03	0.96
Land	—	—	—	—	—	—	—	—
Production per input volume ^b	4.3	5.4	7.8	5.5	4.7	5.9	8.4	6.1

^aExcludes dwellings from factor input.

^bFactor input is estimated thus:

$(100 + \text{national income increase rate} - \text{contribution rate of dwelling growth}) \div (100 + \text{total input excluding dwelling}) - 100$.

Contribution rate is estimated in this way:

$\text{Increase rate of national income} - \text{contribution rate for total input}$.

TABLE 18
COMPARATIVE ECONOMIC GROWTH BY PERIODS

	Factor input			Contribution rate		
	1955-1960	1960-1965	1965-1968	1955-1960	1960-1965	1965-1968
<i>Japan</i>						
Economic growth rate	—	—	—	8.9	10.0	12.3
Total input	4.3	4.2	4.0	4.2	4.1	3.9
Labor	2.9	1.2	1.4	2.1	0.9	1.0
Capital	8.4	11.7	12.0	2.1	3.3	2.9
Output per unit input	4.3	5.4	7.8	4.7	5.9	8.4
	1950-1955	1955-1962	—	1950-1955	1955-1962	
<i>Northwest Europe</i>						
Economic growth rate	—	—	—	4.5	3.3	
Total input	1.9	1.5	—	0.6	0.9	—
Labor	1.5	0.8	—	0.2	0.1	
Capital	3.9	5.0	—	0.4	0.8	—
Output per input	3.9	2.5	—	3.9	2.5	—
<i>U.S.A.</i>						
Economic growth rate	—	—	—	4.2	2.7	—
Total input	2.1	1.5	—	2.3	1.7	—
Labor	1.7	1.2	—	1.3	1.0	
Capital	4.2	3.1	—	1.0	0.7	—
Output per unit input	1.9	1.0	—	1.9	1.0	

The principal methodological differences are these: Watanabe-Ekaizu [8] assume labor's share of national income to be 0.4 and 0.6; they do not make a separate calculation of labor's share (we estimated it as 0.71); and Ohkawa [4], since the focus of his calculations was on the private and non-agricultural sectors, considers qualitative changes in capital in terms of rate of utilization, and in terms of composition by type and duration of service. (Consequently the residual is reduced and labor's share of national income becomes exceedingly high in Ohkawa's study—77.5 per cent.)

Leaving aside Ohkawa's estimate in this comparison because his calculations have a different orientation, we note the Watanabe-Ekaizu estimation of labor's contribution to Japan's economic growth is lower than ours. One reason for this is that they assumed labor's share of national income to be lower than our actual estimation.

TABLE 19
COMPARISON BETWEEN VARIOUS ESTIMATES OF CONTRIBUTION RATE TO JAPAN'S ECONOMIC GROWTH

	Kanamori	Watanabe-Ekaizu		Ohkawa	
	1955-1968	1955-1964		1955-1961	
		(1)	(2)	(1)	(2)
National income	10.1	10.40	10.40	13.58	13.58
Total input	4.03	6.56	4.89	8.13	6.05
Labor	1.31	0.68	0.97	4.53	2.33
Employment	1.03	0.56	0.80	—	—
Work hours	-0.07	0.04	0.06	—	—
Age, sex	0.21	—	—	—	—
Education	0.14	0.08	0.11	—	—
Capital	2.72	5.88	3.92	3.60	3.72
Dwelling	0.14	—	—	—	—
Overseas assets	—	—	—	—	—
Equipment	1.62	—	—	—	—
Inventory	0.96	—	—	—	—
Land	—	—	—	—	—
Output per unit input	6.1	3.84	5.51	5.45	7.53

Remarks:

- (1) of Watanabe-Ekaizu supposes capital share to be 0.6 while (2) supposes it to be 0.4; and
(1) of Ohkawa takes into consideration the quality of labor and capital, while (2) does not.

Editor's Note: Because of space limitation, it is not possible to publish the Appendix to Mr. Kanamori's article, but it may be requested from the author. The Appendix contains an explanation of the methods of estimation under the following headings:

- (1) Factor shares of national income.
- (2) Composition of labor force and rates of increase.
- (3) Work hours.
- (4) Contribution of education to the economic growth rate.

- (5) Sex-age composition of the labor force.
- (6) Labor input and its contribution to economic growth.
- (7) Increase in private enterprise equipment and its contribution to economic growth.
- (8) Increase in private enterprise inventory and its contribution.
- (9) Increase in dwelling assets and its contribution.

The following supplementary statistical tables are also included in the Appendix:

List of Supplementary Statistical Tables

- 1-1 Distribution of national income to labor income, dwelling income, and property income.
- 1-2 Distribution of income to labor, land and capital.
- 1-3 International comparison of distribution of national income.
- 1-4 International comparison of income distribution to labor, land and capital.
- 1-5 International comparison of income distribution.
- 1-6 International comparison of changes in distribution for employees.
- 2-1 Composition of Japan's labor forces.
- 2-2 International comparison of labor force composition.
- 2-3 International comparison of population, labor forces, and ratio of labor forces among population.
- 2-4 Index, rate of increase and contribution to growth rate of employment, persons.
- 3-1 Weekly work hours.
- 3-2 International comparison of weekly work hours.
- 4-1 Education-career-wise number of employees (all industries).
- 4-2 International comparison of education-career-wise, employees (male).
- 4-3 Education-career-wise wage differential.
- 4-4 International comparison of education-career-wise wage differential.
- 4-5 Labor quality improvement due to education.
- 4-6 Education-career-wise wage differential.
- 4-7 Comparison of effect of education on labor quality improvement between 1958 weight and 1968 weight.
- 5-1 Percentage distribution of employment by age-sex groups.
- 5-2 Age-sex group wages (monthly average in 1968).
- 5-3 Comparison between U.S.A. and Japan of age-sex group wage differential.
- 6-1 Labor input index.
- 6-2 Annual average increase of labor input and its contribution rate to economic growth.
- 7-1 Gross stock of private enterprise equipment (all industries).
- 7-2 International comparison of the rate of increase in gross stock, its contribution to growth rate and rate of increase in the capital-labor ratio.
- 8-1 Rate of increase of real private inventory and its contribution to growth rate.
- 8-2 Rate of increase in enterprise inventory and its contribution to growth rate.
- 9-1 Rate of increase in dwelling assets and its contribution to growth rate.

BIBLIOGRAPHY

- [1] E. F. Denison, *The Sources of Economic Growth in the United States and the Alternatives Before Us*. Committee for Economic Development, Supplementary Paper No. 13, 1962.
- [2] ———, *Why Growth Rates Differ*. The Brookings Institution, 1967.
- [3] R. Magota, H. Kawano, N. Fukita and K. Sato, "Why is Japan's Income Share for Labor Lower?", in *Wage Manual for 1969*. Toyo-Keizai Shinposha (in Japanese).
- [4] K. Ohkawa, "Production and Distribution of Japanese Economy for 1905-1963", *Keizai Kenkyu*, April 1968 (in Japanese).
- [5] R. M. Solow, "The Production Function and the Theory of Capital", *Review of Economic Studies*, 1955-56.
- [6] K. Tsujimura, "Employment Structure and Income Share for Labor", in "Post-war Japan's Economic Growth" (edited by Komiya), *Iwanamishoten*, 1963 (in Japanese).
- [7] Watanabe, T. and S. Ekaizu, "Technical Progress and Economic Growth", in "Economic Growth and Resources Allocation" (edited by Kaji), *Iwanamishoten*, 1967 (in Japanese).
- [8] ———, "Labor Quality and Economic Growth", in *Riron Keizaigaku*, March 1968 (in Japanese).
- [9] T. Watanabe, "Labor Quality and Economic Growth", in "Quantitative Economic Analysis", *Sobunsha*, 1970 (in Japanese).