The Relationship between Population Growth and Economic Development

A Comparison between 18 th and 19 th Century Europe and Developing Countries Today

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Introduction

The purpose of any comparison between the economic development of 18 th and 19 th century Europe and Less Developed Countries (LDCs) today is a dual one: It shall give some insights in the general structure of the economic development process, and, in pursuing this, provide some feasible blueprints for the economic development policy of the LDCs today. The relevance of the comparative study depends on the relevance of the explaining variables and relationships chosen for the comparison. In this study the relationship between the population variable and various economic key variables is dealt with. Surprising enough, little research has been done on this subject. There is a substantial body of literature on population, less on population and economic development, considerably less on comparative studies of early European economic development and LDCs, and virtually a *quantité négligeable* on comparative studies of this kind which put the relationship between population growth and economic development

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I wish to thank Professors Masao Hisatake, Sidney Sherrod Mitchell, and Tsuneo Nakauchi for their valuable comments. This research was conducted under a grant from Asia Foundation(Multinational Comparative Study on Urban Population Growth and Government Policy in Asian Countries)

in the center of their inquiry.

The empirical data in this study refer mostly to Europe, including, however, some references to the USA, Australasia, and Japan, whenever it adds to the empirical clarification or vividness. Similarly, all LDCs are usually included, but particular attention is given to the Asian Developing Countries when the empirical data suggest a specified treatment.

I. Different levels of per capita product

Before analysing the relationship between economic development and population growth in a dynamic context, attention shall be given to the difference in the initial absolute value of this key variable. The levels of per capita income in the industrialized countries at the time before their take-off (1500–1750) were considerably higher than the corresponding levels of per capita income in the Less Developed Countries today. Estimates on the basis of backward projections of national income data reveal that the per capita income of presently Developed Countries — Western and Central Europe, North America and Oceania — ranged well above $200 (in 1952–54 prices). Even in Russia, the late comer in developing, the per capita income around 1885 was probably more than $150 (in 1952–54 prices) (1). PHYLLIS DEANE estimates that incomes in England in the 18th century were closer to those of Argentina or Chile today than to those of India or Burma today. (See Table 1)

The per capita incomes of a large part of LDCs are below the $200 range (See Table 2). The absolute level of per capita incomes determines the level of other economic variables, like the investment rate and the savings rate which determine, in turn, the growth rate of the per capita incomes.

II. Patterns of population growth

1. Let us first make a short exposition of the definitions and theoretical relationships on which our empirical analysis is based. Any

Table 1 : Contemporary Estimates of the National Income the United Kingdom in the Nineteenth Century

Year and derivation of national income estimates	Population, in millions	Average money national income, £	Domestic exports as percentage national income	Estimate of trend in average real incomes 1800=100
1800 (Pitt, Beeke, Bell)	15.7	19	13	100
1812 (Colquhoun)	18.4	22	10	94
1822 (Lowe)	21.3	17	10	114
1831 (Pebrer)	24.1	23	7	174
1836 (Mulhall)	25.4	24	8	168
1841 (Spackman)	26.8	21	11	145
1846 (Smee)	28.0	21	10	160
1851 (Levi)	27.4	23	13	193
1860 (Mulhall)	28.8	33	14	234
1867 (Levi, Baxter)	30.4	28	21	205
1870 (Mulhall)	31.3	31	22	222
1879—80 (Levi)	34.3	35	18	274
1880 (Mulhall)	34.6	33	19	278
1882—83 (Levi)	35.2	36	21	296
1883 (Giffen)	35.5	36	18	307
1886 (Mulhall)	36.3	34	18	326
1889 (Mulhall)	37.2	35	19	342
1895 (Mulhall)	39.2	36	16	402
1902 (Giffen)	41.9	42	16	405

Source : Phyllis Deane, "The Industrial Revolution and Economic Growth: The Evidence of Early British National Income Estimates," Economic Development and Cultural Change, Vol. V, No. 2, January, 1957, quoted in: Higgins, Benjamin, Economic Development, New York 1968, p. 191. (Allowance to be made for changes in price level: index 100=US$300)

change in population, $\triangle P$, over a period of time is determined by the births, B, deaths, D, and migration during that period of time. Excluding migration we get

$$\triangle P = B - D.$$

Relating the absolute change of population to the total population we get the relative change, and multiplying by 100 the percentage change

Table 2 : Selected Less-developed Countries by Growth in Gross National Product and Level of Per Capita Income

	GNP Per Capita (1967)					
GNP Crowth Rate, Annual Average (1960–67)	Under $100	$100 to under $200	$200 to under $300	$300 to under $500	$500 and more	No. of Countries
Above 6%		South Korea Mauritania Thailand	El Salvador Iran Ivory Coast Jordan China(Taiwan)	Nicaragua Peru	Cyprus Greece Israel Libya Mexico Panama Spain Trinidad & Tobago Yugoslavia	19
5–6%	Guinea Malawi Pakistan	Bolivia Syria U.A.R.	Honduras Iraq Malaysia Papua & New Guinea Turkey	Costa Rica Guatemala		13
4–5%	Ethiopia Tanzania	Ecuador Kenya Philippines Zambia	Brazil Colombia Paraguay	Gabon	Chile Lebanon Venezuela	13
3–4%	India Nigeria	Ceylon Congo(B) Morocco Sudan Uganda	Dominican Republic Ghana Liberia Tunisia	Guyana Jamaica		13
Below 3%	Burma Congo(K) Haiti Mali Somalia	Cameroon Indonesia	Algeria Senegal		Argentina Uruguay	11

Source: World Bank, quoted in Pearson(ed) Partners in Development, New York, Washington, London, 1969, p. 360/361.

$$r_p = \frac{100.\,B}{P} - \frac{100.\,D}{P}$$

$\frac{B}{P}$ is called the crude birth rate (CBR), $\frac{D}{P}$ the crude death rate (CDR).

In the following empirical analysis, the main trends in r_p of the

Table 3 : Equivalent Average Annual Rates of Growth Expressed in Per Cent Per Annum, Selected European Countries, 1815–1925

Country[a]	Period 1815–1870	1870–1925
Germany	1.01[b]	0.98[b]
Austria	0.72	0.60
Hungary	0.58	0.67
Switzerland	0.84	0.76
France	0.41	0.14
Belgium	0.85	0.68
Netherlands	0.95	1.37
Great Britain and Ireland	1.11	0.77
Scandinavia	1.09	0.82
Spain and Portugal	0.79	0.47
Italy	0.68	0.60
Balkan Peninsula	0.61	0.83
Roumania	1.70	1.27
Poland	1.30	1.13
Russia	0.43	1.06
Europe, Total	0.71	0.78

Source: Computed from Helmut Haufe, Die Bevoelkerung Europas (Berlin, 1936), Table 9, p. 227, by use of the formula $P_z = P_o (i+r)^z$, where P_o=initial population, P_z=population at final date, z=number of years elapsed between observations, and r=equivalent annual rate of growth.

a The boundaries of the countries in this table are, in most cases, those of 1914, For more detailed description see Haufe.

b Only the first two digits are significant owing to rounding error. (Applies to all figures.)

Quoted in; Hoselitz, Bert, Advanced and Underdeveloped Countries: A Study in Development Contrasts, in: The Transfer of Institutions.

European countries in their industrialization phase and in the LDCs are first compared, while in the three chapters to follow the explaining variables are analyzed.

2. A comparison of the population growth rates of the European countries at the time when they were undergoing industrialization (table 3) and of the LDCs today (table 4), or, e. g., of the ECAFE-countries today (table 5) show that the population growth rates are considerably higher in the later two than in the former.

The average annual rate of population growth in Europe from 1815–1870 was 0.71%, and from 1870–1925, 0.78%. In contrast, the average rate of annual growth of population in the ECAFE region during the 1950's in the first development decade was 2.2% and it

Table 4 : Estimated and Projected Population, by Regions, in Millions

	Average Annual Growth Rate: Medium Projection 1960—2000
The World	1.8
Less-Developed Regions	2.1
East Asia (ex. Japan)	1.3
If Mainland East Asia grows at rate projected for South Asia :	
The World	2.0
Less-Developed Regions	2.4
East Asia (ex. Japan)	2.3
South Asia	2.3
Melanesia, Micronesia & Polynesia	2.3
Africa	2.6
Latin America (ex. Temperate South America)	2.9

Source: Overcoming World Hunger, (ed) Hardin, C. M., London 1969, p. 16.

Table 5 : Population growth rates of the ECAFE region, estimates and projections, 1970—2000

Region and countries	Growth rate 1970—1980	1980—2000
ECAFE region		
A	2.2	1.8
B	1.8	1.0
Asian part		
A	2.3	1.8
B	1.8	1.0
Oceania part		
A	2.1	1.7
B	1.9	1.4

Source: Demographic situation in the Ecaferegion, POP/APC. 2/3P/1, report by the ECAFE Secretariat, October 1972.

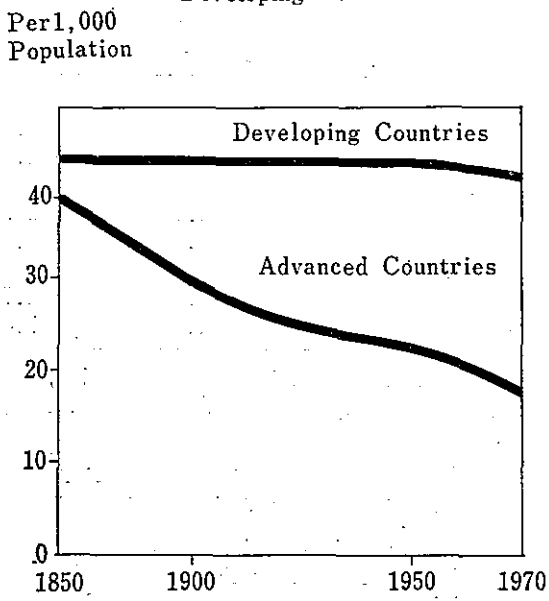
Note: A series for 1970—1980 are medium variant projections as prepared by the United Nations Population Division.
A series 2000 and B series 1970—2000: tentative projections prepared by the ECAFE Population Division, pending further returns from recent censuses.

is expected to reach a peak of 2.3% during the second development decade, 1970-1980. The average growth rate of population in ECAFE countries is expected to be 2% for the second half of the century. When European countries underwent their industrialization, their population growth rate was about half as high.

3. According to the definition of population growth, the differences in the growth rates are to be explained by differences in the birth rates, CBR, and the death rates, CDR. In the period 1850-1970, advanced countries experienced constantly falling CBRs, while the CBRs in the LDCs over the last 120 years have been constant around the high level of 1850 (fig. 1). At present it is estimated that the CBRs for thedeveloping Asian countries are approximately 36 to 37 per 1000 (5).

In 18th and 19th century Europe there were well established

Fig. 1 : Birth Rates Advanced and Developing Countries



Source: International Demographic Statistics Center, Bureau of the Census, quoted in Population Program Assistance, Agency for International Development, Washington, December 1971.

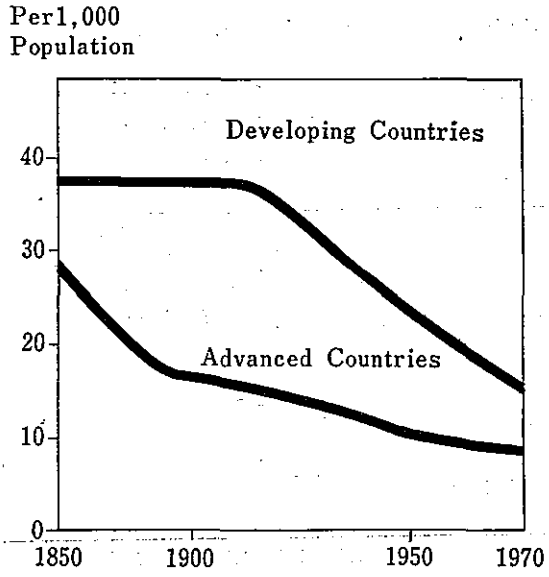
Note : Rates for 1850-1920 based on the Carr-Saunders Wilcox Population estimates, and for 1920-60 on United Nations estimates. Rates for 1960-70 derived by graphically extrapolating trend lines for 1950-60 except in case of developing countries birth rate, this was assumed to have declined to about 40 per 1,000 by 1970.

social mechanisms which led to a decline in the CBRs. The predominant social unit has been the nuclear family—husband, wife, children—as opposed to the extended family system prevailing in developing countries, e. g., Asian countries. In early Europe a man usually married only when he could afford to support his family. Moreover, age and frequency of marriage were usually determined by his economic potential. In Switzerland, e. g., often only the eldest son was able to marry because he inherited the farm or the father's business; and thus, was able to support his family adequately. In

developing Asian countries marriage does not necessarily entail the establishment of a new individual household since the newly married couple and their children may be integrated into the existing family clan. We can conclude that the constant decline of the CBR in the process of European development was an important factor determining the decline in the population growth rates. If a similar decline in the population growth rates of LDCs should be achieved, under the present CBRs only an increase in the death rates, CDRs, could yield this result. This is not what happened in the past, nor it is expected to happen in the future.

4. The CDRs show in 18th and 19th century Europe an incomparably slower decline than the CDRs in the developing countries today. Figure 2 indicates that the decline of CDRs in advanced countries in the time from 1850–1970 was smaller than the decline

Fig. 2 : Death rates Advanced and Developing Countries

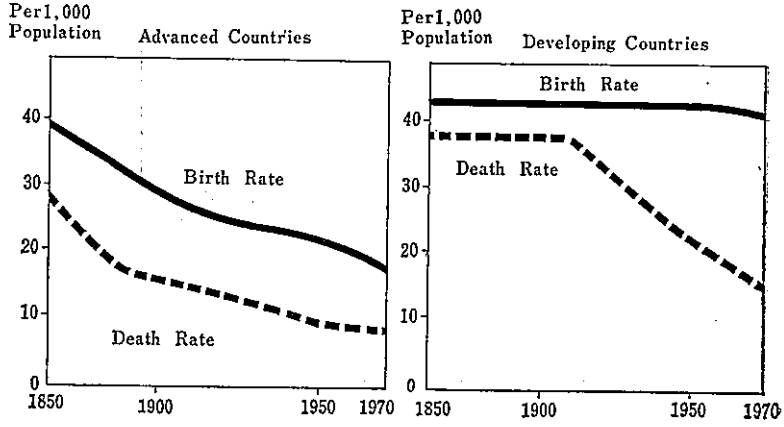


source : see Fig. 1

of the CDRs in the LDCs from 1910-1970. In the ECAFE report the rapid decline in the mortality rate is thought of as the "major factor in the acceleration of the rate of growth of population during the last two decades in the countries of the region" (6). It is estimated that the CDR at present is approximately 13 to 14 per 1000. The contrasting patterns in the rates of change can be easily explained by the fact that changes in the CDR are mainly a function of medical progress. LDCs today can draw from an existing stock of medical knowledge which was not available at the time of their early industrialization in the advanced countries, but which has accumulated slowly over the last 200 years. The effects of medical progress on the CDRs have been distributed over 200 years in advanced countries, while in LDCs today the effects of medical progress on the CDR have been experienced only for a few decades.

5. From (3) and (4) we can conclude that in advanced countries during their industrialization both CBRs and CDRs declined constantly at similar rates, while in LDCs from 1910 to the present

Fig. 3 and 4 : Birth Rates and Death Rates, Advanced and Developing Countries



source: see Fig. 1

only the CDRs declined followed by unchanged CBRs yielding population growth rates which explain the current population "explosion". Compare figures 3 and 4.

6. The discrepancy between the two population patterns widens when we open the closed model to allow for effects of migration. In 18 th and 19 th century Europe migration on a large scale was possible, and had its favorable effects on economic development. Emigration-either to "new" continents or within Europe-mitigated a drop in the per capita incomes in the densely populated areas and stimulated economic development in sparsely populated areas. (7) Immigration, quite in contrast to LDCs today, was frequently used in early Europe as a tool of economic policy. Frederick the Great, e.g., attracted many workers to Prussia in the period of reconstruction after the Seven Years War.(8) Although the pressure from population in LDCs today is considerably higher than it was in 18 th and 19 th century Europe, the LDCs today have no similar effective migration mechanism which would release some of the pressure of their population growth.

III. The growth of total and per capita incomes

1. We know from the relationship (see Appendix Section 4)

$$r_i = r_o - r_p$$

that a percentage increase in population is linearly related to a decrease in the per capita income. Since we can conclude from the previous section that the population growth rates in the European countries in the 18 th and 19 th century were considerably lower than the population growth rates of the LDCs today, it follows that the pressure of the population growth on the per capita incomes is higher in the LDCs today than it was for the European countries at the time when they underwent industrialization.

Nevertheless, despite this burden from the population growth, the per capita growth rates in most of the LDCs, particularly in some of the ECAFE countries, compare very favorably with the

growth rates of various European countries at the time when their per capita income was on a similar level.

2. Since

$$r_t = r_o + r_p,$$

this is necessarily due to the fact that the growth rate of the total product was considerably lower in the presently industrialized countries in the early stages of their development than it is in the LDCs today. In the United Kingdom the growth rate of the GNP between 1790 and 1820 was in average 2%, in Germany between 1850 and 1880, 2.7%, in the USA between 1820 and 1850, about 4%, and in Japan between 1875 and 1900, about 4%. In comparison to the GNP growth performance of this country group the LDCs today increased their total GNP between 1950 and 1967 by an annual average of 4.8%.(9). Particularly successful were some of the Asian countries. Of the nine countries listed in the ECAFE statistic below the performance of seven exceeded the 6.0% growth target of the Second Development Decade in 1970, and the weighted average for the countries of the table was 6.1%(10)

IV. The economic impact of absolute changes in population

1. If the economic growth rates of the LDCs today compare favorably with the economic growth rates of the European countries in their early stages of economic development, what then is the development problem of the LDCs today? Why were the European countries not confronted to the same extent with economic development problems as compared to most of the LDCs today? Indeed, the economic development problem of contemporary LDCs lies not in the relative changes *per se*, but rather in the absolute size at which these changes take place. In the following, first, the pattern of the absolute growth of population will be briefly described pointing out its relevance for the length of the time periods applied. In the subsequent section the economic implications of high absolute changes of population which emerge from the fact that the supply

Table 6 : Selected developing countries in the ECAFE region: Growth rates of GNP at constant prices 1960–1971

	GDP projected growth rate 1970–1980[a]	GNP 1967 (billion US$)	Annual compound rates (per cent) 1960–1970	1965–1970	Changes from previous year (per cent) 1968	1969[b]	1970[b]	1971[c]	1972
India[d]	5.5– 6.5	46.0	3.8	4.4	3.1	5.3	5.3	4.8	4.0
Indonesia	—	11.0	3.3	4.7	6.6	6.5	6.3	6.9	7.0
Iran[d]	8.0–10.0	7.4	7.9	9.2	7.9	11.1	8.6	10.3	14.0
Korea, Rep. of	8.0–10.0	4.8	9.2	12.0	13.3	15.9	8.9	9.8	7.5
Malaysia, West	6.5– 6.5	2.9	6.3	6.9	4.9	8.0	6.1	4.1	4.0
Pakistan[e]	6.0– 7.0	10.8	5.4	5.5	8.2	4.4	6.6	1.4	5.0
Philippines	6.0– 7.0	6.2	5.7	6.3	6.2	6.7	6.2	5.5	5.5
Sri Lanka	4.5– 5.5	1.9	4.5	5.1	8.4	4.7	4.1	0.9	3.0
Thailand	8.0– 8.5	4.2	7.9	8.5	8.6	7.4	6.7	6.1	4.5
Weighted average	6.1– 7.2	—	4.9	5.7	5.6	6.5	6.1	5.6	5.5

Source: Economic Survey of Asia and the Far East, 1971.

a These projections are contained in two ECAFE documents, Feasible Growth and Trade Gap Projections in the Developing ECAFE Region, Developing Programming Techniques Series No. 7, and Sectoral Output and Employment Projections for the Second Development Decade, Development Programming Technique Series No. 8.

b Derived from national official publications.

c Estimates from national official publications.

d Year ending 20 March.

e Year ending 31 March. A suitable adjustment has been made for Pakistan in obtaining the regional weighted average for 1971 and 1972.

of land is constant are discussed.

2. We can write for the absolute rate of population, assuming ideal conditions, that is to say, food and shelter is abundantly available for additional people,

$$\frac{dP}{dt} \propto P \therefore \frac{dP}{dt} = cP$$

We can solve the differential equation by multiplying by $\frac{1}{P}$ and dt

$$\frac{dP}{P} = cdt$$

and integrate this differential

$$\frac{dP}{P} = cdt$$

or $\ln P = ct + k$.

We take e and raise it to the powers on both sides of the equation and we get

$$P = e^{ct+k} = e^{ct} \cdot e^{k} = Ke^{ct}$$

In the exponential growth path,

$$P = Ke^{ct}$$

K represents the initial population at the time when $t=0$, c is a constant which depends on economic, cultural and institutional factors, and t stands for time.

3. From the preceding section two important conclusions can be drawn: (a) the size of the absolute rate of change depends on the size of the initial absolute value, (b) a constant absolute rate of change is accomplished in an increasingly shorter time period.

(a) From the differential equation $\frac{dP}{dt} = cP$ we see that the bigger the population, the bigger the absolute growth rate. The size of the increase in the absolute rate of change is described by the powerful exponential trends expressed in the relationship

$$P = Ke^{ct}$$

Hence, when we make a graph of the population with respect to time t for both European countries at the time of their early industrialization and the LDCs, again particularly the Asian coun-

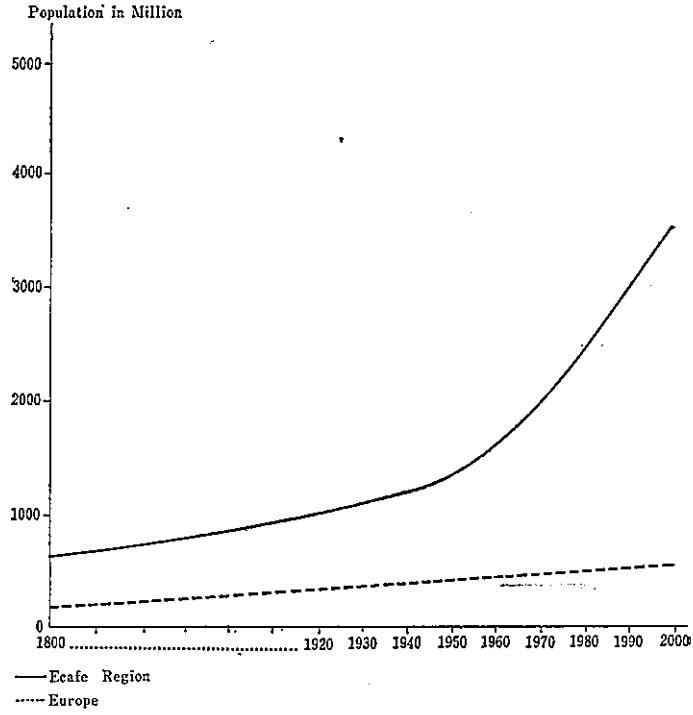
tries, we see that since Europe started with a smaller population, the slope of its graph (and therefore its rate of ascent) is smaller than Asia's. (See figure 5). This trend is, furthermore, much aggravated by the increase over time in c in the LDCs as described in paragraph II.

(b) The relationship between time, the initial population, and the absolute change in population can be expressed by the differential notion

$$dP = cPdt.$$

Let us assume now for the sake of simplicity that the constant c

Fig 5 : Population of Ecafe Region and Europe 1800–2000



Source : Ecafe, Report of the Second Asian Population Conference, Tokyo, 11–23 April 1973, Fig, III.

for the 18th and 19 th century European countries and the LDCs today is the same. Since the absolute population P of today's LDC is much larger than early Europe's we see that in order to produce an equal small change in population dP in LDCs today we need a much smaller change in time dt than in early Europe. If we write P_A for the population of LDCs, and P_E for the population of Europe including North America and Australia, than we can write

$$cP_E\ dt_E = cP_A\ dt_A$$

$$\therefore\ dt_A = \frac{P_E}{P_A} dt_E.$$

4. The economic consequences of an exponential trend of population become clear if we consider the fact that land which supports the additional population remains constant. Denoting the ratio by

$$r = \frac{N}{P}$$

where N stands for land, we see that r being the ratio of N to P soon becomes very small (even though N is large) if P increases exponentially. Since we saw in the above analysis that P_A is increasing at a far greater rate than was P_E the ratio $\frac{P_E}{P_A}$ is below 1 and decreases rapidly further as time goes. If we write for the two ratios

$$r_A = \frac{N_A}{P_A}$$

and $$r_E = \frac{N_E}{P_E}$$

we can express the ratio of the man-land ratios of Europe and the LDCs as

$$\frac{r_A}{r_E} = \frac{\frac{N_A}{P_A}}{\frac{N_E}{P_E}} = \frac{N_A P_E}{N_E P_A} = \frac{N_A}{N_E} \cdot \frac{P_E}{P_A} = \text{const.} \frac{P_E}{P_A}$$

If the ratio $\frac{P_E}{P_A}$ is decreasing— $\frac{N_A}{N_E}$ being a constant—it follows that the ratio of the two land-man ratios $\frac{r_A}{r_E}$ also is decreasing.

Therefore, the conclusion made with regard to the exponential trend of the populations are—mutatis mutandis—valid for change in the land-man-ratio deteriorates much more rapidly in LDCs today than it did in Europe. Similarly, the size of the absolute changes in population in a given time period is relatively larger in LDCs today than it was in Europe, and, therefore, the land-man-ratio deteriorates to a greater extent in the LDCs today than it did in Europe within an equivalent time period.

Economically speaking, we can not say that a decrease in the ratio *per se* is economically detrimental. Already 200 years ago the classical economists, like ADAM SMITH, JOHN STUART MILL, and ROBERT MALTHUS explained that an increase in population, or of labor employed on the land respectively, can have positive effects (in an early stage of production) or negative effects (in later stages of production) on the output derived from the land. The decisive point, therefore, is: Where are we located on the curve of return from land? Posing this question, we arrive at very different answers for Europe and LDCs. Let us first briefly sketch the situation theoretically, and then plot the two empirical cases on a hypothetical line.

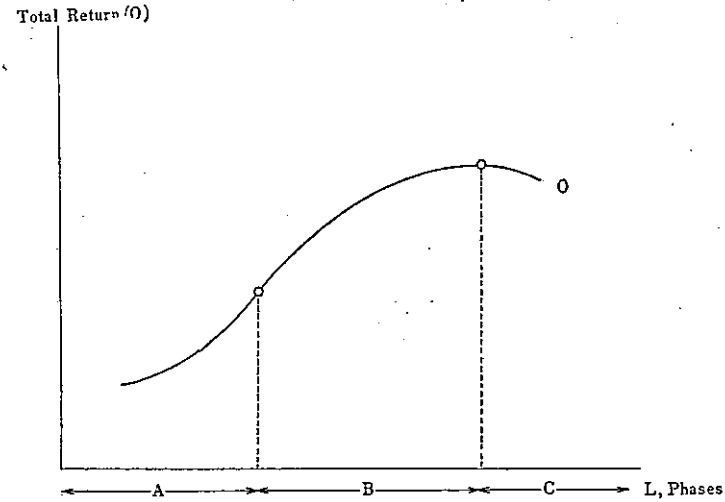
5. Given a fixed quantity of land, the output of the land is a function f of the population L living on the land and the technology applied, e. g.,

$$0=f(N, L, T)$$

where N is the quantity of land being fixed, L is labor engaged in agriculture being roughly proportionate to population, and T is technology. The empirical law is stated as follows: If the original population is small then the growth of output with respect to growth of labor starts to increase in a concave upward way, e. g. the second derivative $f''>0$ (A-phase). As the labor population grows and the land mass remains constant we soon reach a point of inflection where $f''=0$ (end of A-phase). As the labor population continues to grow, we are in a concave downward situation, and

the output still grows but with a smaller increase, that is to say, the second derivative $f''<0$ (B-phase). We soon reach the point of maximum output that the land can sustain and at this point the rate of growth $=0$, or the first derivative $f'=0$ (end of B-phase). If the population continues to grow the output will decrease (C-phase). (See figure 6).

Fig 6 : Hypothetical Total Return Curve of the Agricultural Sector



6. Empirical evidence supports the thesis that Europe at the time of its early industrialization was in the A-phase rather than in the B-phase while the LDCs today are in the B-phase or near the turning point to the C-phase rather than in the A-phase. The empirical verification of this thesis can be established on two grounds : (a) since the location of the empirical points on the output curve depends on the land-man-ratio, the empirical arguments can be derived from the land-man-ratio ; (b) the changes in the relative increase in the agricultural output allow conclusions with regard to the location on the agricultural return curve.

(a) the favorable land-man-ratio in early Europe is demonstrated by the fact that land clearance as a means of enhancement of

agricultural output was feasible. This is particularly true for Eastern Europe where most areas did not reach saturation, so far as population was concerned, until late in the 19th century. Only since the beginning of the present century land clearance has ceased to be of major importance, and a further increase in agricultural population has therefore meant a diminishing amount of land per man working in agriculture(11). In Western Europe there were signs of overpopulation considering the prevailing technological and institutional conditions in the 19th century.

However, the extensive method of land cultivation which was characteristic of a low-technology agriculture offered large reserve-capacities for future increases in agricultural output as soon as adequate technology could be applied (particularly the use of fertilizers). In France, England and Saxony, e.g., in 1760 half of the land cultivated had to be sacrificed as fallow land under the two-field system. With the subsequent change to the three-and four-field system the percentage of fallow land constantly fell over the following 150 years enabling a better land-man-ratio (land defined here as permanently cultivated land). Compare Table 6.

In East-Elbian Prussia from 1815 to 1864 the area under cultivation more than doubled, from 5.5 to 12 million hectars, while in

Table 7 : Percentage of arable land used as fallow land

France		England		Saxony	
Period	% of fallow land	Period	% of fallow land	Period	% of fallow land
1760	50 %	1812	20 %	1657	38 %
1790	40 %	1831	14 %	1713	32 %
1840	27 %	1866	6 %	1760	34 %
1852	20 %	1891	3 %	1800	3 %
1892	13 %				

Source: Bairoch, Paul, Le rôle de l'agriculture dans la création de la Sidérurgie moderne; in:Revue d'histoire économique et social, 1966, No. 1.

Posen the share of arable land rose in the same time span from 11.9% to 60.6%, and in Pomerania from 15.5% to 52.3% of the total land area (12).

There are few similar reserves of virgin lands or extensively cultivated lands in LDCs today. According to COLIN CLARK the supply of land per male engaged in agriculture in the post World War II years is only 0.057 square kilometers in Asia (Japan 0.042), 0.3 square kilometers for Africa, and 0.7 square kilometers for Latin America. In North America and Australasia the supply of land per male engaged in agriculture is for the same time period 1.61 square kilometers, and in non-communist Europe 0.069 square kilometers(13). To put the problem of the low land-man-ratio in LDCs in the proper perspective we have to consider the fact that the climate and quality of soil does usually not allow the cultivation of virgin land. A quater of a century ago MOHR pointed out that it was no mere accident that Java had about 60 million people on 30 million acres whereas Borneo, with four times more acres, supported only 3 million people. 75% of the soil of Java consists of base-rich andestitic lavas or of colluvial and alluvial deposits derived from such lavas, whereas Borneo's soil consists of older sedimentary rocks which are base deficient and inherently infertile. An agricultural potential similar to Borneo's can be found over much of the Amazon and Congo basins and other smaller areas in the humid tropics.(4)

(b) As a result of the relatively favorable land-man-ratio during the past 200 years in Europe the agricultural output increased considerably when the percentage of fallow land decreased, additional technology was applied and the necessary institutional changes were achieved. Compare, e.g. the extension of areas under cultivation for Prussia mentioned in the last paragraph with its respective increases in agricultural outputs. (Table 7)

Considering the unfavorable land-man-ratio in LDCs one is apt to expect slowly increasing, constant, or even decreasing returns in

Table 8 : Prussia (1815 boundaries) : Output of Field Crops (in 10,000 tons)

	1816	1864
Cereals	508.8	1,097.8
Potatoes	93.0	1,135.2
Beets, turnips, and other roots	——	1,090.0
Animal fodder	——	356.1

Source: H.W. Finck von Finckenstein, Die Entwicklung der Landwirtschaft in Preussen and Deutschland 1800—1930, Würzburg, p. 326; quoted in: Landes, D., Japan and Europe: Contrasts in Industrialization, Loockwood, State and Enterprise in Japan, op. cit., p. 162.

agricultural output per additional labor engaged in agricultural activities. In reality, this is only partly the case. The increase in agricultural output is in some areas considerable. The average annual rate of growth in agricultural output between 1960 and 1966 was for all LDCs 2.1%, for Africa 1.4%, South Asia 0.6%, East Asia 3.2%, Southern Europe 3.7%, Latin America 2.9%, and Middle East 4.1%. The industrialized countries averaged in the same span an average annual rate of growth in their agricultural production of 1.8%.(15) In the ECAFE countries the average weighted rate of growth of agricultural output during the First Development Decade was 2.8%. The decade ended at an even substantially higher growth level, since the "Green Revolution" had a strong impact on the growth performance of important field crops.(16)

7. However, the seemingly satisfactory output performance of the LDCs has to be viewed in the light of the proportions of the input factors in the production and the capacity to change the input mix of the production function over a long period of time. It is evident from the preceding discussion that in Europe increases in agricultural output could be achieved to a considerable extent by increasing the supply of cultivated land, while in LDCs today a similar increase in agricultural output can be only achieved by increasing the inputs in labor and, particularly, technology. In other words, while Europe

Table 9 : ECAFE region: Rates of growth by country in agricultural output and food production (total and per capita), between 1959—1961 to 1969—1971

ECAFE	Agricultural production	Food production	Food production (per capita)
a) Developing countries	2.8	2.6	0.1
b) Selected countries			
Afghanistan	1.2	1.1	—1.2
Burma	2.1	2.0	—
India	2.2	2.2	—0.2
Indonesia	2.1	2.2	—0.3
Iran	3.0	2.8	—
Korea, Republic of	4.5	4.0	1.3
Malaysia, West	5.7	5.5	2.4
Pakistan	3.3	3.2	0.1
Philippines	3.2	3.2	—
Sri Lanka	2.9	3.8	1.0
Thailand	5.2	5.2	2.5

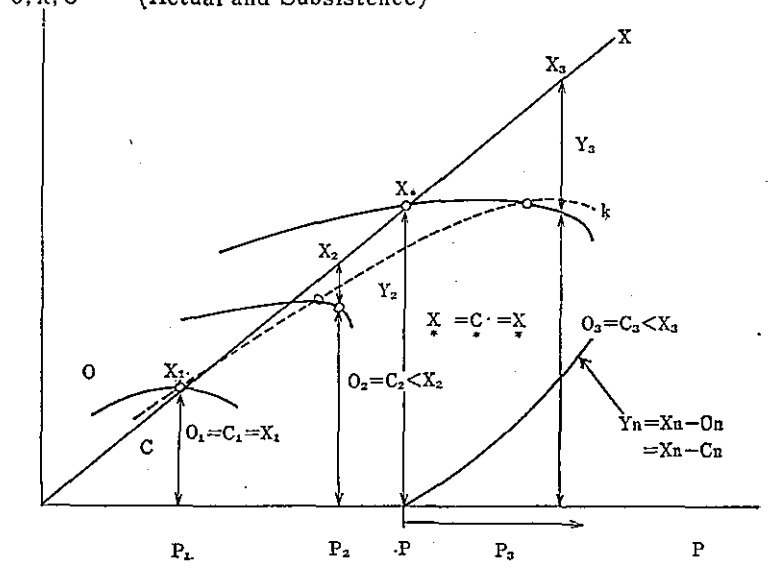
Source: Ecafe, Economic Survey, Part One, Tokyo, 1972, p. 91/92.

possessed reserves in technology which were not necessarily fully utilized in order to increase agricultural output, the LDCs today rely almost solely on the production factor of technology and fertilizer practices when they wish to accomplish a similar increase in their agricultural output. This has grave long-run effects on the agricultural output, because the production factor of technology seems to obey a similar "law of decreasing returns" as does the production factor labor. Therefore, though technology lifts the return curve over a long time span constantly upwards, and enables a situation in which the return curve over a long time span successfully escapes the maximum point where agricultural output stagnates, the potential long-run additional output in LDCs today is to be expected likely to be smaller than it was over the last 200 years in Europe. The long-run production function can be described as an aggregate of the "traditional" production functions, where the shape of the "aggregate" curve is determined by technology "pushes."

In figure 7, k depicts the long-run output or 0-curve; the dotted line connects the maximum points of 0-curves. The X-line depicts the subsistence level of population P. C indicates the actual consumption level of the population P as determined by 0-curves; C_1 the consumption level of which the population P_1 is supported at subsistence-level X_1; C_2 a consumption level where most people starve and some die (assuming $C \equiv 0$, e. g., no food imports). Y_2 is the gap between the subsistence level, X_2, and the actual level of consumption below subsistence, C_2. X_* indicates the "absolute" subsistence level assuming the O-curve cannot be further pushed upwards by technology. At X_* the "maximum" population P_* can be supported. Beyond X_* a long-run gap y_n develops; at X_3 a population P_3 suffers from a gap y_3.

Following our empirical discussion we assume that the LDCs today, particularly the Asian countries, are much nearer the point of absolute population P_* and the point of absolute total subsistence level X_*, than the European countries were during the time of

Fig 7 : Hypothetical long-run Aggregate Return Curve of the Agricultural Sector and Food Consumption (Actual and Subsistence)



their economic development process. European countries could have moved over a long-time period on the slope of the "traditional" return curves, immediately without lifting the return curves upwards, while LDCs today constantly must produce near the maximum points, and an additional agricultural output only can be accomplished by pushing the "traditional" return curves with the help of input "pushes" of technology upwards. Whether such technological achievements can be accomplished in LDCs within the next decades is still open to debate. It might well be that the application of technology was more favorable in Europe than it is today in LDCs; not only due to the different location on the "aggregate" long-run return curve but also due to various different institutional and cultural factors. The long-run return curve might have, therefore, shifted up faster in Europe during the last 200 years than it will in the next decades in LDCs. If this projection

is true-and it will prove to be true if achievements like the "Green Revolution" cannot be repeated-the point of the absolute subsistence level X_* at which an absolute maximum population P_* can be supported will be reached in LDCs at a point when Europe was in the middle of its development process. Such a constellation would have severe repercussions on the development process of these countries, since the productivity performance of the agricultural sector is related to the performance of various other economic key variables as will be shown in the following chapter.

V. The impact of agricultural productivity on other key variables of economic development

The impact of changes of agricultural productivity on the development process in Europe and the LDCs can be adequately described with a model which relates agricultural productivity to some of the economic key variables over a long period of time. In doing so I follow the model by RANIS/FEI which is based on the experience of the long-run economic development process of Europe.(17) The main thesis of the model is that the extension of the agricultural productivity lies at the heart of the European economic progress, and that the telescoping of this experience in the contemporary LDCs is feasible.

According to RANIS/FEI Europe's long-run growth process followed a sequence of three major "epochs": (a) "Simple Agrarianism," (b) "Mercantile Agrarianism", and (c) "Industrial Capitalism."

(a) The epoch of "Simple Agrarianism", can be identified by the dominance of the agricultural production to the exclusion of other forms of economic activity. The capital stock represents only a "wages fund" used for bridging the gap which arises from the non-coincidence of production and consumption periods. Therefore, in the epoch of "Simple Agrarianism" the capital stock (K) is proportional to the population (P), where the proportionality factor

in $K=\theta P$ is positively related to the "degree" of divergence between the production and consumption periods. Similarly, the investment per head (I/P) must be in proportion to the population growth rate, r_p, with the same proportionality factor

$$\frac{I}{P}=\frac{\frac{dK}{dt}}{P}=\theta r_p$$

(b) The epoch of "Mercantile Agrarianism" is characterized by the increasing impact of mercantile activities. What distinguishes "Simple Agrarianism" from "Mercantile Agrarianism" is a newly erected infrastructure pertinent to trade activities spread over a wide geographical area. Total agricultural output (O) is in the "Mercantile Agrarianism" divided into three parts: consumption (C), investment in the "wages fund" (I), and, investment in commercial capital (I'). K' is proportional to the volume of trade (T), i. e., $K'=\theta' T$, being a function of the per capita "trade margin" (q) and P, $T=P_q \cdot^q$ is approximated by $q=p-c$ where p is the average labor productivity and c the per capita consumption of self consumed goods.

Then $K'=\theta' P(p-c)$

and for per capita investment in commercial capital

$$\frac{I'}{P}=\theta'(p-c)$$

Including the demand for capital for the "wages fund" the total investment per head required becomes

$$\frac{I'}{P}=(\theta+\theta'\ (p-c))r_p.$$

From this formula we see that in the "Mercantile Agrarianism", growth is, first, population pulled as in the case of "Simple Agrarianism," and, secondly, determined by the size of the agricultural trade margin.

(c) The epoch of "Industrial Capitalism" is characterized by the establishment of a new form economic dualism between agricultural and industrial production activities. The "Industrial Capitalism" grew out of the "Mercantile Agrarianism" whose productivity

performance allowed the reallocation of labor for industrial activities and the channeling of agricultural surplus as fixed capital in the industrial sector.

2. Before going into the empirical question of the model, a few comments on the theoretical nature of the model should be made.

First, in the theoretical concept presented the per capita investment is equally dependent on the volume of the per capita trade margin, q, and the population growth rate, r_p. An increase in the per capita investment for commercial capital can be achieved either by an increase of q, or of r_p, or of both, q, and r_p. Therefore, we might conclude that it is necessarily favorable for the increase of the volume of the per capita investment to have an increase in r_p. This is misleading. Any change in r_p has repercussions on the productivity and the per capita output. These repercussions can-as the preceding discussion revealed-be either favorable, as in the case of Europe, or unfavorable as in the case of most of the LDCs. Population growth can as in the case of Europe, exert a stimulating "pull"-effect on investment and growth; it can exert as well a depressing effect if the per capita trade margin drops because the increases in the productivity of the agricultural sector drop due to population pressure-this being the case in most of the LDCs.

Secondly, the capita trade margins $q_1 \cdots q_n$ are suggested to be of equal quality if p and c of the trade margins yield the same differance, e. g.

$$p_1 - c_1 = p_2 - c_2$$

$$q_1 = q_2$$

Thus, given the population P, the volume of trade and its stimulating effect on economic growth are the same in, e. g., q_1 and q_2. In a dynamic view, however, the "quality" of q, as expressed by the absolute values of p and c, is as crucial a determinant as the mere volume of q. This decisive development aspect cannot be adequately dealt with in a formula which includes only a proportionality factor. In order to include the long-run growth

potential as well as the potential to accomplish the transition from one epoch to another we have, furthermore, to include

(a) the location of p on the long-run agricultural return curve,

(b) the location of c on the long-run curve of income elasticities of demand for food and agricultural products.

RAINS/FEI refine their model by introducing a productivity coefficient which defines the increase in agricultural productivity as being proportional to the change in the commercial capital stock per head,

$$\frac{dp}{dt} = j \frac{I}{P}$$

This certainly describes a true and important relationship. However, it does not provide any information on how the growth process took place, e. g., in Europe, or, how it will take place, e. g., in the LDCs. Applying the above relationship the growth of p can be constant, decreasing, or increasing due to the specific location on the long-run return curve, as expressed, e. g., by changes in the capital-output-ratio. It can be hampered by an increasing c, or, it can be supported by a decreasing c. The direction of the growth path is open; j does not describe q which determines the change in the commercial capital stock. The following discussion shall shed some light on the empirical long run behavior of q,p, and c during the development process of the European countries in the 18th and 19th century and the LDCs today. The outcome of this disussion will allow us to draw some conclusions about the impact of the changes in q (as a result of changes in p and c) on the economic development process of the respective country groups.

3. When analysing the empirical shape of the long-run trends of p and c, two questions are of particular interest: (i) What is a theoretically plausible pattern of the long-run (a) p-curve, (b) c-curve? (ii) Where on these two curves is p and c located at certain levels of the per capita income?

(a) p-curve:

(i) It can be concluded from the preceding discussion that the growth of the agricultural output increases in the first instance as variable inputs labor and technology are added to the fixed amount of land (A-phase), that the growth of the agricultural output starts decreasing and stagnating when an unfavorable land-man-ratio is being reached (B-phase), and that the agricultural output will even decline in absolute terms if an increase of inputs (due to a growing agricultiural labor population) is detrimental to the efficiency of the production.

(ii) As for the specific empirical locations, it can be concluded that the LDCs today are nearer the long-run maximum point on the agricultural output curve than the European countries during their industrialization phase. Considering the lower absolute values of the per capita output in LDCs today the absolute changes in the agricultural per capita output will be lower in LDCs even if the relative changes can be kept as high as they were in the 18 th and 19 th century in Europe. Both the fact that in LDCs the agricultural per capita output is very low in absolute terms, and the fact that the position of the per capita output on the agricultural return curve is unfavorable is decisive for the changes in q of the LDCs.

(b) c-curve:

Two theoretical generalizations shall be made: First, the lower the per capita income the higher the income elasticity of demand for food, or, the higher the per capita income the lower the income elasticity of demand for food. Secondly, the changes can be broadly classified into three phases. In the first phase (X-phase), when the per capita income is lowest, an increase in the per capita income will induce a higher consumption in non-agricultural essentials than in food. In the second phase (Y-phase), when also the non-agricultural consumption reached some kind of subsistance level, an increase in the per capita income goes into food consumption establishing a constant or slowly decreasing income elasticity of demand for food. In the third phase (Z-phase) the share of

non-agricultural products on the total consumption increases successively, that is, the income elasticity of demand for food decreases successively. These generalizations apply to both urban and rural populations, although there are deviations in degree.

Besides the relative changes, the absolute values of the per capita food consumption are important. The absolute values of the per capita food consumption can be derived from (aa) the absolute level of the total per capita consumption, (bb) the share of the per capita food consumption on the total per capita consumption. The absolute level of the per capita consumption is positively related to the per capita income; therefore, conclusions about the per capita income are-mutatis mutandis-equally true for the level of the total per capita consumption.

(ii) Before analysing c and q the long-run trend of the aggregate value per capita total consumption of food shall be analysed. Recall the conclusion that the levels of per capita income in the European countries at the time before their industrial breakthrough was considerably higher than the levels of the per capita income in the LDCs today. Since the proportions of the personal savings increased from about 1800 to about 1900 only from about 3% to about 10%, the preponderant part of the increase in disposable income (which rose about 3 to 4.5 times the initial level) went into increases in consumption(18). The share of the per capita food consumption on the per capita total consumption follows in the long run the pattern as described in the preceding theoretical generalization in terms of changes in income elasticity. The share of food in total consumption expenditures declined, i. e., in Germany from 44.8% in 1815-1870 to 39.9% in 1871-1890, and to 38.5% in 1891-1910, in the United States from 39.2% in 1886-1908 to 31.0% in 1909-1928, in Sweden from an average of 36.3% in 1864, '73, '82 to 28.2% in 1938-1948. However, the picture also has some features which diverge from this trend. In the United Kingdom and Italy no significant drop in the share of food in the total consumption can

be observed before the post World War II decade. Even in the countries mentioned, where the long-run trend on the whole is downward, there are long periods in which the share fails to decline although per capita incomes rise at marked rates. In Germany between 1871–1910, in Sweden between 1864–1926, in Canada between 1900–1910 and 1941–1950 the share of food hardly changed. One might speak of a dominance of the Y-phase, and a reluctance of the Y-phase to turn to the Z-phase over almost a whole country. This result is the more surprising if we consider the conclusion from the preceding discussion that total consumption expenditures kept pace with the rise in disposable per capita food consumption was proportionate the increase in the disposable per capita income.

If European experience teaches us a lesson, it is the following : the income elasticities of demand for food decrease in the long run as described in text books. This decrease, however, is much more reluctantly accomplished than is usually assumed. It was the Y-phase, rather than the constantly declining income elasticities of the Z-phase, which gave European development in the 19th century its feature.

Can we conclude *per analogiam* from the European experience to the contemporary development process in LDCs? Cross country comparisons reveal that the share of the per capita food consumption on the total per capita consumption decreases as the disposable per capita increases. At a level of $100 the respective share is 55.0%, at $100–200 45.8% at $200–300 37.6%, at $350–575 36.1% (19). The decline in the share of per capita food consumption on the total per capita consumption is accomplished faster in LDCs today than it was accomplished in Europe in the 19th century. We might expect that the Y-phase, establishing a relatively constant share of the per capita food consumption, is not reached in LDCs today ; in fact, this is the case. Since the per capita incomes in LDCs are considerably lower than they were on the average in the 19 th century in Europe, the rapid decline in the food share can be

explained by the pent-up demand with regard to other urgently needed goods. Once the saturation of the basic needs for non-food products is reached, the share of the food consumption is likely to decrease slower than it did in the initial stage when per capita incomes were at their lowest. Empirical data confirm such a retardation in the decline of the share of the food consumption on total consumption. While the respective decline in LDCs with a per capita income between under $100 and $200-$350 is 17.4%, the decline in countries with a per capita income of $200-$350 and $575-$1000 is only 7.1%.(20) A similar conclusion can be derived from a comparison of the income elasticities of demand for calorie consumption in countries with different levels of per capita income. While the difference in the income elasticities between, e.g., India with a level of per capita income of $69 (1958) and Portugal with a level of per capita income of $248 (1958) amounted to 0.43 in the coefficient of elasticity, the difference in the coefficient of elasticity between Portugal or other countries with a similar level of per capita income and the rest of the countries listed in table 9 with a level of per capita income between $248-$370 hardly changed (21). We have, however, to recall the fact that the absolute values of the share might be considerably higher at a high level of per capita income although the relative share or the changes in the relative share are smaller at a high level of per capita income.

4. The increases in the absolute levels of the total food consumption per capita can be channeled either in c or q. In order to analyse the distribution pattern of the per capita total food consumption we have to analyse the factors underlying the channeling of p. Excluding for the moment imports (M) and exports (X) the per capita food consumption of the urban population (c_u) equals q,

$$q = c_u.$$

The capacity to produce q does not depend on the same factors as the demand for q, c_u. The capacity to produce over time an increased q depends-considering only c-on the absolute level of

Table 10 : International Comparison of Income Elasticities for Calorie Consumption *

	Income elasticity	Per capita national income (1958 US Dollars)
Japan, 1878–82 to 1923–27		
Simple per capita	0.18	122 (218)[a]
Per consumption unit	0.19	
Time series, 1950–1958		
India	0.64	69[b]
Taiwan	0.33	90[b]
Philippines	0.44	113[b]
Ceylon	0.49	116[b]
Brazil	0.29	126[b]
Turkey	0.18	245[b]
Portugal	0.21	248[b]
Greece	0.12	287[b]
Mexico	0.30	317[b]
Spain	0.23	331[b]
Japan	0.20	370[b]
International cross-sections		
Hayami-Yamada		
all countries	0.16	650[b]
less than NI $300	0.20	173[b]
Jureen[c]	0.12	125
Ohkawa[d]	0.11	420

Source: * The coefficient of income elasticity estimate for Japan, 1878-1882 to 1923-1927 based on the information collected by the authors.
Time Series 1950-1958 data from FAO, *Agricultural Commodities Projection for 1970* (1962), *Annex on Methods*, A 14-15.
Hayami-Yamada international cross-sections estimates based on data collected by the authors.
Jureen international cross-section estimate from Lars Jureen, "Long-term Trends in Food Consumption: A Multi-Country Study," *Econometrica*, XXIV (Jan. 1956), pp. 1-21.
Ohkawa's international cross section estimate from K. Ohkawa, "Conditions of Economic Progress in Agriculture (Nogyo Sinpo no Shojoken)," *Nogyo Sogo Kenkyu*, II (Oct. 1948), pp. 103-137.
Per capita national income estimate for Japan, 1878-1882 to 1923-1927 based on the national income data as collected by the authors (See Appendix C to this paper) and Population data from the Bank of Japan, *Hundred Year Statistics of the Japanese Economy* (*Honpo Shuyo Keizai Tokei*) (1966), pp. 12-13.
Time series, 1950-1956 estimate of per capita income based on the national income data in U.N., *Yearbook of National Accounts Statistics* (1963), pp. 3-297; and Population data from U.N., *Demographic Yearbook* (1962), pp. 130-141.
a) Figures in parentheses indicate the average of 1923-1927, while figures not in parentheses indicate the average of 1878-1927.
b) National incomes in 1958 were converted into U.S. dollars with the help of purchasing parity rates and then divided by the mid-year population to obtain per capita income.
c) Inserted $r=100$ U.S. dollars in 1949 prices (=125 dollars in 1958 prices) into $E(r)=13/(r+13)$
d) 245 International Units of Colin Clark=420 U.S. dollars in 1958 prices. quoted in: Agriculture and Economic Growth: Japan's Experence (*ed.*) Ohkawa, K, Johnston, /B, Kaneda, H, Princeton/Tokyo, U.P., 1970. p. 120.

the food consumption of the rural population, and on the income elasticity of demand for food of the rural population. The demand for q, the food consumption of the urban population c_u, depends on the absolute level of the per capita food consumption of the urban population, and the income elasticity of demand for food of the urban population. Given these values, the total volume of trade, T, is determined by the size of the rural population, p_r; the total demand for food of the urban population, C_u, is determined by the size of the urban population, P_u. Keeping O and c unchanged, changes in P_r, r_{Pr} change the total trade volume, T, e.g., as P_r increases the total consumption of the rural sector increases, consequently, the trade volume T increases. Similarly, the total food consumption of the urban population, C_u, changes as P_u changes, e.g., keeping c_u constant an increase in the urban population, r_{Pu} increases the total demand for food of the urban population.

To this writer's knowledge we do not have empirical data for the absolute levels of the per capita food consumption and the income elasticities of demand for food for the two categories rural and urban population for the European countries or the United States during the 19 th century. Some indirect indication of the changes in the demand for food in the two categories might be provided by comparing the primary costs and the PTD (processing, transportation, distribution)-component in the total expenditures for food. Changes in the share of the PTD-component might be to some extent proportionate to changes in the share of c_u. The empirical approximation is of a rough nature since the PTD-component also includes processing costs, and for the proportionality to c_u mainly the costs for the transportation and distribution are relevant. (Increased processing might also reflect the trend from rural to urban consumption, but increased processing of food will be carried out to some extent also for the food of the rural consumption.) Empirical data for Sweden and the United States show that the share of the primary costs of food in consumer expendi-

tures declined far more consistently and sharply than the share of the PTD-component in total expenditures on food consumption. The ratio of final costs to primary input rose in Sweden from 1871–1880 to 1921–1930 from 1.40 to 1.89, and in the United States from 1869 to 1919–1929 from 1.41 to 1.79(22). The primary input into food, largely the part received by the agricultural sector, accounted for a sharply declining proportion of consumer expenditures while the PTD-component accounted for a rising share of consumer expenditures(23). Part of the increase in the PTD-component can certainly be attributed to improvements in quality of food achieved while the per capita income increased. However, it can also be expected that a significant share of the PTD-component went into costs of transportation and distribution. This being the case, we can conclude that the urban population accounted for a slower decline in the ratio of the ratio of the per capita food consumption on the per capita total consumption. The income elasticities of demand for food can be expected to be higher in the urban areas than in the rural areas. It follows that the per capita food consumption of the rural population, increased slower than the per capita consumption of the urban area, as per capita income increased. This difference is furthermore accentuated by the fact that the per capita incomes in the European countries in the 19th century tended to increase faster in the urban areas than they did in the rural areas. As a result, the share of the total food consumption on the total consumption is to decline slower if migration from rural areas to urban areas takes place. The per capita trade margin, q, which is provided by the agricultural sector, is favorably effected by a faster decline in the relative share of the per capita food consumption. Since the part of the population engaged in agricultural activities was, despite its relative decreases, until the end of the 19th century in Europe, considerably larger than the part of the urban population,(24), the overproportionate increase in C_u seems to have been easily compensated for by

increases in T. In interpreting these results, however, a cautious attitude is advisable. If we are aware of the relatively constant share of the food consumption on the total consumption over the 19 th century-given the dominance of the rural population over the urban population-it has to be assumed that also the rural population must have devoted a considerable share of the total expenditures to food consumption. It is advisable to resist the temptation to present a smooth thesis that mainly a decrease in c accounted for a decrease in q, and, thus, for the satisfaction of the increased urban demand for food which occured in Europe over the last 150 years. Indeed, the changes in p are likely to have accounted much more significantly for the increase in q than the curtailment of the food consumption of the rural part of the population.

Analysing the relative changes in c and q in LDCs and comparing them with early European development experience, it is necessary for a balanced view to recall the levels of the absolute values to which these relative changes apply. Since c is inversely related to the per capita income, we can expect the share of c on the total consumer expenditures to be higher in LDCs than in Europe in the 18 th and 19 th century, because their absolute levels of per capita income compare unfavorable with those of Europe. Since p is related to the per capita income of the rural population, p will be equally low, and q being the difference between c and p, the absolute level of q will be low.

The capacity of c to decline relative to p is given by the income elasticity of c. Some general information about the income elasticity of c can be obtained from the overall elasticiticies of the per capita total (rural and urban) food consumption since the share of the agricultural population is very large. Thus, it is to conclude that income elasticities decline rather fast at a very low level of the per capita income, later level off, and almost stagnate causing the absolute level of the per capita food consumption to increase prop-

ortionately to the increase in the per capita income. The crucial question is, whether in LDCs the initial drop in the increase of the per capita food consumption of the agricultural population is sufficient to contribute to a significant increase in the per capita trade margin q as measured in terms of c_u. Empirical evidence suggests that only a few LDCs are moving on this path while the large majority of the LDCs, particularly the poorest countries, could not achieve a breakthrough in the provision of q. The decisive causes of this outcome can certainly not solely be attributed to unfavorable factors on the consumption side, but lie as well on the side of the production which could not keep pace with the rapid increases in population. There are, however, various factors detrimental to an increase in q also on the side of c and c_u. At first sight it looks like a simple calculation that if the increases in c decline more rapidly than the increases in c_u, there should be a good chance to meet the demand for c_u by the relative excess amount of c, more so as the rural population represents the larger part of the total population. The average food expenditures as a percentage of the total expenditures are, indeed, considerably higher in rural areas than in urban areas. The differences in the departing points of the absolute levels of the per capita consumption, thus, confirm the differences in the decline of the respective shares of the food consumption on the total per capita consumption. Empirical data, e. g., for the ECAFE-countries, show that the average food expenditures as a percentage of total expenditures were in rural areas considerably higher than in urban areas.

However, these empirical data appear in their proper proportion only if we give up the implicit assumption of income parity between urban and rural areas, and consider that the differences in the shares of food consumption are themselves a result of the great differences in the income levels of the urban and rural areas. Outstanding examples are the cases of Thailand and the Philippines where the average urban income as percentage of the average rural income

Table 11: Selected ECAFE countries: Household food expenditures relative to total household expenditures

Country	Year	Average food expenditures as percentage of total expenditures	Percentage of households with food expenditure ratio higher than the average
India: Rural	1963/64	70.1	74
India: Urban	1963/64	59.6	69
Indonesia: Rural	1964/65	81.3	91
Indonesia: Urban	1964/65	77.2	45
Korea, Republic of	1967	51.5	67
Pakistan: Rural	1965	65.3	87
Pakistan: Urban	1965	51.0	93
Philippines	1965	53.7	86
Sri Lanka	1963	56.2	72
Japan	1964	34.0	62

Source: Statistical Yearbook for Asia and the Far East, quoted in: ECAFE, Economic Survey of Asia and the Far East, op. cit.,p. 125.

was 304 (1962) and 251 (1965) respectively (see Table 12).

The picture, now becomes quite gloomy when evaluating the potential capacity to accomplish an increase in q. The relative decrease in c might be larger than the relative decrease in c_u ; but the relatively greater changes in the growth of the rural per capita food consumption apply to considerably lower absolute levels of the per capita food consumption, and, thus, are outweighted by the multiplicatory effect of the low rural per capita incomes. The slower increase in the per capita food consumption of the urban population is compensated for by the high absolute level of its per capita food consumption yielding an increase in the absolute per

Table 12 : Income disparities between urban and rural sectors in selected ECAFE countries

Country	Percentage of population in urban areas (1960)	Average urban income as percentage of average rural income
India (1961/62)	1 4	176
Indonesia, excluding Djakarta (1964/65)	1 2	137[a]
Java-Madura (1967)	1 6	133[a]
Philippines (1965)	1 7	251
Sri Lanka (1963)	1 2	189
Thailand (1962)	9	304
Japan (1963)	4 6	106
United States (1959)	6 8	150

a Expenditures.

Source: ECAFE Economic Survey of Asia and the Far East, op. cit. p. 50.

capita food consumption, Δc_u, possibly higher than the increase in the absolute trade margin, Δq, $\Delta c_u > \Delta q$. In the discussion of the European case we did not explicitly mention the disparities in the increase in population between urban and rural areas. It did effect the trade volume, T, but not to an extent that statements about q would be invalid in their basic content as the respective structure of population changed. This is not true for the LDCs. The disparities in the changes of the urban and rural population are considerable and determine the proportion of T and C_u to a greater extent than do changes in c and c_u. The average percentage increase in population in the ECAFE countries between 1970 and 1980 will amount to 4.1 in urban areas and to 1.5 in rural areas, and from 1980 to 2000 to 3.6 in urban areas and to 0.3 in rural areas.

The rapid increase in the urban population accompanied by higher absolute levels and higher rates of change in the per capita incomes

Table 13: Total urban and rural population estimates and Projections, countries of the ECAFE region, 1970—2000

Country and year	Population (thousand)								
			Urban			Rural			
	Total	Average increase (%)	Number	%	Average increase (%)	Number	%	Average increase (%)
ECAFE region									
1970	1,994,301	.	507,455	25.4	.	1,486,846	74.6	.
1980	2,496,108	2.2	737,071	29.5	4.1	1,759,037	70.5	1.5
2000	3,568,468	1.6	1,561,491	43.8	3.6	2,006,977	56.2	0.3
Asian part									
1970	1,975,537	.	494,461	25.0	.	1,481,076	75.0	.
1980	2,472,908	2.2	720,538	29.4	4.1	1,752,370	70.6	1.5
2000	3,535,692	1.6	1,537,012	43.5	3.6	1,998,680	56.5	0.3
Oceania part									
1970	18,764	.	12,994	70.2	.	5,770	29.8	.
1980	23,200	2.2	16,533	71.3	2.4	6,667	27.7	1.5
2000	32,776	1.4	24,479	74.7	1.7	8,297	25.3	0.8

Source: "Demographic situation in the ECAFE region", POP/APC.2/BP/1, report by the ECAFE secretariat, October 1972.

Note: Because of rounding, totals are not in all cases the sum of the parts.

a Countries of the subregions of the ECAFE region are:

Mainland and other: China, Hong Kong, Mongolia, Democratic People's Republic of Korea and Republic of Korea.

Middle South Asia: Afghanistan, Bhutan, India, Iran, Nepal, Pakistan, Sri Lanka.

South East Asia: Brunei, Burma, Khmer Republic, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, Republic of Viet-Nam and Democratic Republic of Viet-Nam.

Other Oceania: British Solomon Islands, Cook Islands, Fiji, Nauru, Papua New Guinea, Tonga, Western Samoa.

will lead-despite the lower income elasticities-to a considerable increase in C_u. We are apt to expect a decrease in the rural population as a counterpart of the increase in the urban population. However, the difference in the migration equation does not even equal zero. Indeed, the tiny figures of 0.3% which stands for the average increase in the rural population from 1980-2000 drastically spells out the difference between the European experience and the situation of the LDCs today. While in Europe the increases in population were at least absorbed by the increasing urban population, and the rural population was decreasing in absolute terms in the long run, (see Table 13; the absolute number of workers in agriculture can be taken as approximately proportionate to the rural population),

Table 14 : Absolute Number of Workers in Agriculture in Great Britain, France, and Japan 1831—1931

Year	Britain°° (in millions)	France (in millions)	Japan (in 1000's)
1831	1.8	4.8	
1841	1.9	5.0	
1851	2.1	5.3	
1861	2.0	5.34	
1871	1.8	5.28	14,000°
1881	1.7	5.47	15,810
1891	1.6	5.04	16,784
1901	1.5	5.52	16,799
1911	1.6	5.33	15,824
1921	1.4	4.99	14,271
1931	1.3	4.45	14,217

○1872
○○Forestry and fishing included
Sources: For Great Britain: Phyllis Deane and W.A. Cole,

Sources: For Great Britain: Phyllis Deane and W.A. Cole,
British Economic Growth 1688—1959 (Cambridge, University Press, 1962), Table 31, p. 143.
For France: J.C. Toutain, Le produit de l'agriculture de 1700 à 1958, II (Paris, 1961), 200—201.
For Japan: K. Ohkawa, The Growth Rate of the Japanese Economy since 1878 (Tokyo, 1957), pp. 240—246
quoted in: Hoselitz, B., Advanced and Underdeveloped Countries: A Study in Development Contrasts, op. cit. p. 34.

the rural population in the LDCs increases as the data for the ECAFE countries exemplify.

It is evident that additional increases in the rural population further deteriorate the land-man-ratio and put pressure on the increase of p, and, consequently on the increase in q. On the other hand, additional pressure is put on the trade volume, since the additional rural population will increase the volume of the total food consumption. In a nutshell, the differences in the changes of the per capita values do not necessarily compare unfavorably with those of the European countries in the 19 th century; this is true even if we allow for lower absolute per capita values. The main difference lies in the absolute level and the rate of change of the population as they effect p, q and T, C and C_u.

5. The discussion about the empirical behavior of c and c_u has necessarily to be supported by empirical evidence which can be provided for T. Indeed, rather than from the thicket of tricky figures on consumption and changes in the production function, the empirical pictures becomes immediately transparent when we compare the overall performance of T of the European countries in the 18 th and 19 th century and the LDCs today. If we write

$$T=C_u+X-M,$$

the performance of T can be evaluated by the behavior of the variables X (exports) and M (imports). $X>M$ indicates a trade volume capapable of supporting the rural and urban population as well as of contributing to the financing of the economic development process; $X<M$ indicates a failure in providing enough food for the rural and/or urban population using capital from other sectors, mainly the industrial sector.

European economic history gives an impressive report on agricultural self-sufficiency. In its early stages of economic development no European country relied heavily on imports of agricultural goods. Even England and Japan were not heavily dependent on agricultural imports in the initial stages of their economic develop-

ment. The transition from the agricultural sector to non-agricultural sectors was mainly accomplished by constant increases in the volume of the surplus of the domestic agricultural sector, T.

The situation in contemporary LDCs is different. Most of the LDCs depend on food imports indicating that the total trade volume is too small to meet the demand for food of the non-agricultural population or even negative, $M>T$, a case where the imports exceed the demand for food of the non-agricultural population contributing in addition to the nutritional needs of the rural population. In the case where agricultural imports cannot be paid by respective exports, are not granted as aid, or are curtailed in order to secure imports of industrialized goods, the population suffers from a food deficit. "It is disturbing", the most recent ECAFE-report states, "that, in a number of developing ECAFE-countries, between one-quarter and one-third of households can be considered undernourished"(24). Developing areas untouched by the "Green Revolution" face an even more severe situation in accomplishing the minimum nutritional standards.

VI. Impact of the volume of the agricultural trade volume on the capital formation and the emergence of markets

1. Departing from the conclusions of the preceding chapters the role which the agricultural sector plays in the process of economic development must be expected to be quite different in the European countries of the 18th and 19th century and the LDCs today. It will suffice in this paper to refer to two factors which contribute to economic development: capital formation and emergence of market activities-being well aware of numerous other important determining factors whose impact on the overall performance of the economic development process is positively related to the performance in the agricultural sector.

2. The theoretical framework for the relationship between capital accumulation and agricultural trade margin is given by

$$K' = \Theta T$$

where K' is the amount of capital available from the agricultural sector. If we write for the provision of capital for the non-agricultural (mainly industrial) sector

$$K_i = \Theta' K'$$

or $K_i = \Theta'' T'$

then we can define the contribution of the agricultural sector to the industrial output, O_i, as

$$O_i = a\ K_i$$

where l/a stands for the capital output coefficient. Differentiating with respect to time we get

$$\frac{dO_i}{dt} = a\frac{dK_i}{dt} + K_i\frac{da}{dt}.$$

If we assume no drastic change in the capital output ratio we see that an increase in O_i is mainly determined by an increase in K_i. Assuming $\frac{da}{dt}$ zero the second term drops out and knowing that $K_i = \Theta'' T$ we have

$$\frac{dO_i}{dt} = a\frac{d\Theta'' T}{dt}$$

indicating that an increase in the industrial output is proportionately related to an increase in the volume of trade provided by the agricultural output.

The following discussion will provide some empirical evidence that

$$\frac{d\Theta'' T}{dt}$$

contributed to the increase in the output of the industrial sector in European countries during the early phases of economic development while it does not or does only to a smaller extent in LDCs today– an empirical result which confirms the preceding conclusions.

3. The supply of capital is provided by the agricultural and non-agricultural sectors. The proportion of the agricultural capital supply will be the larger, the larger the share of the agricultural sector on the total economy. Thus. the dependence on the capital supply of the agricultural sector will generally be higher the lower the level of

the per capita incomes. This thesis is well supported by the fact that late comers in economic development depend more heavily on agricultural capital supply as well as on pressure by the state to force the food consumption of the population to remain on the subsistence level squeezing out the last drop of agricultural surplus in order to secure some of the most urgently needed non-agricultural investments or to accomplish an industrialization program.

Russia and Japan are examples. In Russia two of the main preconditions of the industrialization were the emancipation of the farmers (about 1860), and the establishment of a new tax system (about 1880) which absorbed the increased agricultural surplus enabling the state to actively support investment activities in the industrial sector(25). In Japan the government siphoned off a substantial part of the increasing income of the Japanese farmer for industrial and social overhead investment; the Japanese state counted for about 30% of the total gross domestic fixed capital formation during the years after the MEIJI-Restoration, an amount which rose to about 40% for the period 1887–1936(26). The reliance of the economy on the agricultural sector being the higher the lower the per capita income, Western Europe was less dependant on the direct impact of a high capital flow from the agricultural sector to the other sectors. In France in the 1860's about 15% came from taxes on the land and the role of the state in promoting industry was of minor importance compared with that of Russia and Japan(27). The role the net savings of the agricultural sector played in financing economic development seems to be lowest in Britain, the leader in industrialization at that time(28). The modest contribution the agricultural sector made in financing the industrialization in Western Europe was to a great extent the result of the increased capital formation in the agricultural sector itself which lead to the described increases in agricultural productivity releasing agricultural labor to new industrial activities.

The picture in LDCs is in one respect quite similar to that just

sketched: the lower the per capita income the stronger proves to be the reliance on agricultural net savings and on governmental intervention in order to provide compensation for the insufficient private capital supply. The picture is, however, in another respect different from European experience : the low income countries of Europe had already at that time a per capita income which enabled them to pursue a policy of keeping down the per capita incomes on a levewhich was considered a "tolerable" subsistance level, while such a policy seems not to be feasible in LDCs in the light of postulates of humanity and equality as well as economic efficiency since undernourished labor can hardly contribute to an increase in agricultural or industrial productivity. Furthermore, the prospects for increasing the long run productivity of the agricultural sector were probably better in the late comer countries of the now industrialized countries than they are in the poorest LDCs, e. g., in India or countries of Africa. As a result a governmental policy based on creating an agricultural surplus as a means of stimulating industrial activities is hardly a feassible concept of economic policy for most of the LDCs today. Indeed, it seems to be the other way round the European experience: the industrial sector is rather to finance the agricultural sector than to be financed by the agricultural sector. This is certainly true for countries where the export sector is very profitable, e. g., in oil exporting countries, and the balance of trade surplus is being channeled into industrial and agricultural investment as well. It might be equally true for the internal flow of resourses in countries where the foreign investment sector is strong, or the industrial sector claims for a relatively high fraction of the total production. The governmental policy of financing development is, therefore, not mainly oriented around taxing incomes from the agricultural sector to support investment in the industrial sector, but taxing the industrial sector to contribute to the increase of the productivity of the agricultural sector. This general line of causes demonstrates the basic difference in the pattern of development

financing between the now industrialized countries during their early industrialization period and the LDCs today. The agricultural sector depended also in Europe from time to time on the non-agricultural sector; e. g., in Britain from 1790 to 1814 the flew of resources was probably toward the land(29). In the overall picture, however, the reliance of the agricultural sector on external financial resources was never so dominant in the early phase of economic development in Europe and Japan than it is in most of the LDCs today.

4. The emphasis on capital formation is in the tradition of the HARROD-DOMAR model. To be sure, there are numerous other development variables related to the performance of the agricultural sector. One of these, mentioned as the second variable at the beginning, is the impact of agricultural productivity on the emergence of markets. Increases in agricultural productivity stimulated increases in the rural incomes and the demand for industrial or other non-agricultural goods, and contribute to a climate favorable for the rise of entrepreneurial activities.

The supply and responsiveness of the entrepreneurs, of course, are not only related to the land-man-ratio. They are-in terms of our model-to a considerable extent exogenous variables determined by factors, like cultural, sociological, ethical, religious and institutional settings for which the theoretical basis developed here does not provide any explanation. However, an important indication of how entrepreneurial activities depend on agricultural productivity is provided by the fact that rural artisans played a crucial role in the early phases of European as well as Japanese economic development. Professor HISAO OTSUKA suggests in his intriguing article "The Market Structure of Rural Industry in the Early Stages of the Development of Modern Capitalism" to bestowing on the economic activities of the rural artisans the rank of the decisive explanatory variable of the modern economic development process: "...(the) prosperous artisans and their economic activities were the

specificum, or the decisive generative power in the development of modern capitalism."(30). The rise in agricultural productivity provided the basis for an increased demand for industrial and craft products, and the rural artisans and craftsmen, stimulated, in turn, an increase in the agricultural trade volume and agricultural productivity by their higher profits and their increase in the number of people engaged in artisan's activities, which both were powerful forces on the side of demand for agricultural products. Based on this interrelatedness of agricultural and artisan's activities, a new type of economic institution, the "local market area", came into being(31). The creation and spread of "local market areas" can only be thought of in the context of an increase in the agricultural productivity and the agricultural trade margin. Once the agricultural surplus was a constituent part of the system. It first initiated, and later perpetuated a process of circular causation:the class of craftsmen and artisans were not only a product of the creation of a tradeable agricultural surplus, but contributed themselves, once they came into existence, to the accumulation of (particularly fixed) capital. Sir JOHN R. HICKS suggests that the increase in the range and variability of fixed capital goods used in production, otherwise than in trade, constitutes in the late 18 th century in Europe the beginning of what we call industrialization today.(32).

In LDCs the industrial sector is not necessarily developing on the line of a "natural balance-of-growth-relationship" well in accord with the agricultural sector. The term "dualism" implies that there is some degree of unrelatedness between the two sectors besides their quantative disproportionality. An old industrial or craft sector does either not exist or is comparatively small. Under these conditions the basis from where the "new" entrepreneurial class can emerge is narrow. There are, of course, numerous factors responsible for the sluggishness with which artisan's activities come about, "pre-newtonian" technology as well as rigid social structures. The low productivity in the agricultural sector, however, is the determining

variable which perpetuates the existence of this fundamental economic relationship; the agricultural sector absorbs a large part of potential entrepreneurs and its low per capita incomes provide a small basis for the demand of non-agricultural goods. Even if the "prime mover" (ŌTSUKA) is apt to act, he is bound not to do so as long as counteracting "objective" forces on the side of the agricultural sector prevail.

VII. Conclusions

Economic development as a most complex phenomenon does not fit into any simple model of monocausal explanation. However, some explanatory variables are more important than others; they may constitute a chain of causations to which many other variables of the economic development process relate. It is the implicit hypothesis of this analysis that population is a key variable. Indeed, the comparisons between European history and the contemporary situation of the LDCs lucidly demonstrate the pivotal role of the population variable as push or as retardation factor in economic development. The respective differences have two features: first, the relative changes of the population are larger in LDCs today than they were in Europe at the time of its industrialization; secondly, the absolute initial values of the population as related to the available land to which these relative changes apply are considerably larger in LDCs today than they were in a similar development phase in Europe. Given the prevalence of the law of decreasing returns, under the conditions of a deteriorating land-man-ratio changes in the population determine to a large extent the increases in the agricultural per capita production. This, in turn, has repercussions, on the trade margin of the agricultural sector, which proportionatly brings about exchange activities between the agricultural and non-agricultural sectors, enables non-consumptive capital formation in both sectors, and iniates changes in the behavior of crucial economic agents, such as entrepreneurs and the state, which

reinforce the process of continuous and cumulative gowth launched by agricultural productivity.

Nevertheless, the lamentation about the insufficient supply of entrepreneurs and other (particularly administrative) development agents directly caused by detrimental social structures and static cultural settings has a core of truth. Differences of this kind, however, do not reflect the basic differences in the development patterns nor do they explain the basic development problems of the LDCs today. I am in agreement with RANIS and FEI that there is (as far as these factors are concerned) a feasibility of telescoping European experience to contemporary developing non-Western countries. The question more specifically asked is: How much of European experience can be repeated in LDCs today-a question as important as the one of whether or not it can be done at all. This pinpoints the basic difference between the two development patterns: the difference in the quality of the "exogenous" or "given" variables which are underlying the functioning of the process of economic development. It might well be that the development "mechanism" obeys uniform "economic laws" and that the economic agents as the generating force in this mechanism are basically the same in Western and non-Western countries, but that the scarcity of inputs may block the well functioning of this mechanism. We could extend this argument with reflections on the world-wide situation with regard to non-renewable recources and the limiting capacity of the earth to absorb pollution(33). Such a view could be integrated into a production function of the whole economy and supplement the long-run view of the agricultural production function.

Considering a gloomy outcome of further investigation in these development determinants, we can release some of our hesitations to draw conclusions with regard to some policy recommendations on the ground of our modest theoretical and empirical framework. The first policy recommendation is as trivial as crucial : Limiting the

increase in population. No further comment on this policy issue is necessary. The second policy recommendation lacks equally the flair of the revolutionary, but it is less unequivocally agreed upon : Heavy emphasis on modernizing agriculture rather than thinking in terms of Pittsburgh. This conclusion might contradict conclusions derived from short and medium-run investment criteria. However, in the light of the vigorous impact of the productivity of the agricultural sector on other key variables of the economic development process, short and medium-run cost benefit-calculations have to be an integral part of a long-run development concept–ignoring here KEYNES's dictum that we are all dead in the long run.

Appendix: The theoretical relationship between growth of population and per capita income

A simple theoretical exposition of the relationships between population and per capita income in aggregate terms shall be given in this appendix.(34)

1. The absolute level of per capita income (I) is defined by the level of the national product (O), and the level of total population (P), thus

$$I = \frac{O}{P}$$

Simple as this formula is, we can draw from it the important conclusion that I is inversely related to P, $I \alpha P$. The higher the level of total population at a given level of total national product the lower the per capita income. Since the level of I effects important economic growth variables, P effects important economic growth variables.

2. The above relationship reflects a static picture. I, however, is growing as time passes in both the European countries in their preindustrialization phase and in the LDCs today. Growth of I, or, corresponding changes in O and/or P, we can express in the form

$$I+\Delta I=\frac{O+\Delta O}{P+\Delta P}$$

and for the increase in I

$$\Delta I=\frac{O+\Delta O}{P+\Delta P}-\frac{O}{P}$$

3. Since we are interested in the growth patterns over a long time span, it is useful to differentiate the equation with respect to time, so that we get the average and instantaneous rates of change over the period investigated.

The average rate of change of income can be written as

$$\frac{\Delta I}{\Delta t}=\frac{1}{t}\left(\frac{O+\Delta O}{P+\Delta P}-\frac{O}{P}\right)$$

and the instantaneous rate of change as

$$\frac{dI}{dt}=\frac{P\frac{dO}{dt}-O\frac{dP}{dt}}{P^2}$$

The former expression is convenient for statistical computation. We can write $\Delta t=t_1-t_0$, where the subscript stands, e. g., for one year. Since the periods we use for our comparisons of $\frac{\Delta I}{\Delta t}$ are very long, we might wish to be more explicit with regard to the average rate of change and express the average rate of change of I over the whole time span as

$$\frac{\sum_{i=1}^{n} a_i}{n}$$

where a_i stands for rate of change of I in year i, $\frac{\Delta I_i}{\Delta t_i}$, and n for the number of years. The second formula is convenient for a theoretical description of the two key variables. We see from this formula that if the rate of change of population, $\frac{dP}{dt}$, is large, the rate of change of per capita income, $\frac{dI}{dt}$, will be low or even negative if the rate of change of the total national product, $\frac{dO}{dt}$, is not sufficiently large to compensate. Negative rate of I means decrease in I, a case of which was Indonesia in the early 1960's.

It follows from the formula that both the rate of change of population and the rate of change of the national product will determine the rate of change of the capita income.

4. Since for the purpose of our analysis relative changes are some times more important than absolute changes, we have also to establish briefly the theoretical basis for the study of the variables O, I, and P. The concept of relative changes proves to be particularly useful for our purposes because we wish to compare different countries at different times in history. The comparisons of absolute quantities poses practical problems due to the unwieldly computations involved in larges figures weighted often in terms of different measurements. Empirical data on relative changes are more striking visually which is an additional reason that they are used more frequently; and, therefore, are more easily obtainable. We have

$$O=IP$$

and for the increase

$$O+\Delta O=(I+\Delta I)(P+\Delta P)$$

$$\Delta O=IP+I\Delta P+P\Delta I+\Delta I\Delta P-IP$$

We write for the relative change

$$\frac{\Delta O}{O}=\frac{I\Delta P}{O}+\frac{P\Delta I}{O}+\frac{\Delta I\Delta P}{O}$$

and for the percentage change

$$\frac{100\Delta O}{O}=\frac{100\Delta P}{P}+\frac{100\Delta I}{I}+\frac{100\Delta I\Delta P}{I\,P}$$

Since the last term is the product of two small increases, the result is negligible, so we drop the last term; we have the percentage increase of O become conveniently to approximate to the percentage increase in population plus the percentage increase in per capita income. The percentage increase of I is equal to the percentage increase in O minus the percentage increase in population,

$$\frac{100\Delta O}{O}=\frac{100\Delta P}{P}+\frac{100\Delta I}{I},$$

$$\frac{100\Delta I}{I}=\frac{100\Delta O}{O}-\frac{100\Delta P}{P},$$

or $$r_i=r_o-r_p,$$

where r_i stands for percentage change in I, r_o for percentage change in O, and r_p for percentage change in P.

Footnotes

(1) Kuznets, Simon, The Present Underdeveloped Countries and Past Growth Patterns; in Nelson, ed., Economic Growth, Austin 1960; reprinted in Morgan and Betz, ed., Economic Development, Belmont 1970, p. 12.

(2) Comp. Report of the Second Asian Population Conference, ECAFE, 29 th session, 11-23 April 1973, Tokyo, Japan, p. 8.

(3) Economic Survey of Asia and the Far East, 1972; Economic Situation in Asia, Part One, ECAFE, 29 th session, 11-23 April, 1973, Tokyo, Japan, p. 133.

(4) Economic Survey of Asia and the Far East, op. cit., p. 193.

(5) ibid.

(6) idid.

(7) See Habakuk, H. J., Historical Experience of Economic Development; in: Robinson, E.A.G., ed., Problems in Economic Development, New York, 1965.

(8) Henderson, W. O., The Genesis of the Industrial Revolution in France and Germany in the 18 th Century; in Kyklos, IX, 1956, pp. 190-207.

(9) Partners in Development, Report of the Commission on International Development, Chairman Lester B. Pearson, New York/Washington/London, 1969, p. 27. compare also p. 360/361; reprinted in this paper as Table 2.

(10) For empirical data on GNP per capita, 1950-1971, for the ECAFE Countries comp. Economic Survey of Asia and the Far East, op. cit. p. 34; and for a diagramatic presentation for 1960-1969 Trends in Developing Asia, Asian Development Bank, April 1972, Number 3, Chart 5.

(11) The Cambridge Economic History, ed. by Habakuk J. J./Postan, M.,/ Volume VI, Part II, Cambridge U. P., 1966, p. 614.

(12) Landes, D., Japan and Europe: Contrasts in Industrialization ; in : The State and Economic Enterprise in Japan, Lockwood, W, W., (ed.) New Jersey 1965, p. 162.

(13) Clark, C., Conditions of Economic Progress, London 1957, p. 309.

(14) Mohr, E. C. J., The Soils of Equatorial Regions with Special Reference to the Netherlands East Indies, Ann Arbor, 1944. Furthermore, Eyrne, S. R., Man the Pest: The Dim Chance of Survival, in: New York Reviews of Books, November 18, 1971,

(15) Partners in Economic Development, op. cit., p. 32.

(16) Economic Survey of Asia and the Far East, op. cit., p. 90.

(17) Fei, 'J. C. H./Ranis, G,. Economic Development in Hstorical Perspective; in: American Economic Review, LIX, p. 386-399. I am changing some of the notations of the RANIS/FEI paper using the notations introduced earlier in this paper.

(18) The following discussion is based on Kuznets, S., Modern Economic Growth, New Haven and London. 1969, p. 262-270.

(19) ibid. p, 388.

(20) Conclusions drawn from above data.

(21) Agriculture and Economic Growth: Japan's Experience; (ed.) Ohkawa, K., Johnston, B., Kaneda, H., Princeton/Tokyo U. P., 1970, p. 120.

(22) Kuznets, S., op. cit., p. 275-276.

(23) ibid, p. 276.

(24) Economic Survey of Asia and the Far East, op. cit., p. 126.

(25) Comp. Gerschenkron, A., Economic Backwardness in Historical Perspective, Cambridge 1962, p. 16 f.

(26) Comp. Rosovsky, H., Capital formation in Japan: Growth and Structural Change 1868-1938, p. 24, quoted in: Landes, op. cit., p. 100/101.

(27) Landes, op. cit. p. 168.

(28) Recent research has been emphasizing the importance of merchant firms in supplying the industrial sector with circulation capital which accounts quantitatively for the largest part of the capital needs of the industrial sector; comp. Crouzet François, (ed.), Capital Formation in the Industrial Revolution, London, 1972; editor's introduction, p. 44/45.

(29) Landes, op. cit., p. 167.

(30) Otsuka, Hisao, The Market Structure of Rural Industry in the Early Stages of the Development of Modern Capitalism; in: Deuxième Conference Internationale d'Histoire Economique, Paris, 1962, p. 460.

(31) Comp. Otsuka, H., op. cit., p. 462.

(32) Hicks, John R., A Theory of Economic History, Oxford, 1969, p. 142/143. Hicks states that "As long as industry remained at the handicraft stage, the position of the craftsman or artisan was not so different." Only "when fixed capital moves, or begins to move, into the central position... the 'revolution' occurs." Hicks does not give any explanation of *who* accomplished this process. We may assume that the rural artisans (rather than the merchants) contributed to the transformation from a production with simple "tool" capital to a production where industrial "fixed" capital constituted the major part of the capital employed.

(33) Comp., e. g., the Club of Rome study The Limits to Growth, London 1972; and particularly Tinbergen, Jan, Exhaustion and Technological Development: A macro-dynamic policy model, manuscript, August 1973 (this

paper, unfortunately, was not available when writing this article)

(34) For an excellent treatment of related topics see, e. g., Leibenstein, Harvey, A Theory of Economic-Demographic Development, Princeton U. P., 1954.

「人口増加と経済発展の関連性」

——18～19世紀ヨーロッパと今日の開発途上国の比較——

＜抄＞

クルト・ドプファー

本論文は，初期ヨーロッパと低開発諸国，ことに今日のアジアにおける人口変化を比較するとともに，これを農業の生産関数への様々な投入財，特に土地と関連づけたものである。結論的には「限界収入逓減の法則」が初期ヨーロッパにおいて影響したよりは，今日の低開発諸国での生産を大きく抑制しており，技術的進歩は限界収入逓減を補うに足るだけのものでないと言えよう。（Ⅰ—Ⅳ）

結果として，ヨーロッパ，米国，オーストラレーシア及び日本は，農業部門の余剰を有し，これを工業部門における初期資本形成にふりむけたのである。他方，今日の低開発国においては，農業部門を工業部門の財政にふりむけているわけではなく，時にはかえって，工業部門によって支えられているのである。今日の工業国では，同様に，農業余剰を工業部門の市場提供にふりむけ，工業化の初期段階での発展に欠くべからざる，一群のダイナミックな要因を持たらした。今日の低開発諸国の多くには，農業部門からの同様な推進効果は見られない。（Ⅴ—Ⅵ）

今日の低開発諸国の経済発展にとって，製造部門，資源部門の開発は重要なのではあるが，結論的に言えば，農業部門（低開発諸国の約70%の人々が従事する）での生産に実質的進展がない限り，広範な経済発展はなされえない。（Ⅶ）

アペンディックスでは，人口増加と１人当り所得の増加との理論的関連を説明した。

（森山昭郎訳）