CHANGE OF MANUFACTURING OUTPUT*

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There are many things that can make international comparisons misleading. Some are due to the fact that quantitative data are collected in different ways and with different coverages in the various countries concerned and that, despite precautions, accuracy is never perfect. Some are due to differences in conditions in the various countries which mean that if the statistics are in fact correct, it may still be misleading to draw inferences from them without having a lot of other ancilliary information. This may arise from correct calculations of average density of population per square kilometre where necessary auxiliary information would be about the climatic conditions and fertility of the soil or the presence of minerals. Or it could arise from correct information of the proportion of government expenditure on social services where necessary auxiliary information would be on the ratio of government expenditure to national income and the nature of government expenditure not on social services (e.g. on armaments and on economic development).

The purpose of this paper is to show how misleading, in some respects, index numbers can be and quite irrespectively of any inaccuracies in the data from which they are composed. The experiment is made with the current world series of index numbers of manufacturing production based on 1953. In the experiment use is made of other quantitative information all published by the United Nations, of net manufacturing output, of population and of persons engaged in manufacturing in various countries. No doubt these figures are more satisfactory for measuring change in individual countries than for making comparisons between countries. It is felt, however, that the picture presented, though it may be wrong in detail, is reasonably accurate in the aggregate and well worth attempting. Some of the conclusions are quite striking and arise, first from the use of one year as base, and next from the fact that index numbers only indicate proportionate change, and not absolute change. The first requires some consideration of the representative nature of the year 1953 and an acknowledgement that what happened between 1953 and 1960 should also be studied in relation to what happened before 1953. The second requires that the proportionate changes should be related to the size of the factor being measured and, perhaps, also to the possibilities of further change. In a country with almost no manufacturing an increase of 100% may mean very little; in a country with only a small proportion of its labour force in manufacturing an increase in manufacturing labour force and hence output may be more easily undertaken than in a country with already a large proportion of its population in manufacturing; in a country with its manpower inefficiently employed it might be easier to increase by a large proportion the output per person employed than in a country already efficient. In a country which is already efficient further growth in output per person may be dependent upon completely new knowledge and inventions as well as new capital; in a country not so efficient it may mean only the adoption of types of organization and methods already commonly applied elsewhere with some new capital.

In the paragraphs that follow an attempt is made to give numerical values to the factors which have been mentioned above so that they can be isolated. Unfortunately information that seems even remotely useful for this purpose is only available for a limited number of countries. Thus the centralized economies such as Russia and mainland China are excluded, there is nothing for African countries and the further the analysis is taken the fewer are the countries covered so that in the last tables there is nothing apart from information on North America, European countries, Argentina and Japan. Population estimates are available for all countries, and weights proportional to net output in manufacturing for 50 countries. Annual manufacturing output indices are available for 32 countries and indices of employment in manufacturing for 27 countries but not always co-incident with the output indices.

The current indices of manufacturing output, based on 1953, present a well known picture of slow growth in Northern North America (United States and Canada), substantial growth in Europe and outstanding growth in Eastern and Southeastern Asia dominated by Japan. Thus in 1960 with 1953=100, the index for North America was 118, for Europe 158 and for Eastern and Southeastern Asia 249. Latin America showed a record comparable with that of Europe with the index at 164.

It should be recorded that for North America the choice of 1953 as the base year is unfortunate. Manufacturing output in that year was 5% higher than the average for the three years 1952 to 1954. Even when allowance is made for this the relationships remain essentially the same. If the average rate of production in the years 1952 to 1954 is made equal to 100, instead of the rate for 1953 alone, the index for North America in 1960 is raised from 118 to 124, still well below the index of 158 for Europe.

The situation looks very different when the indices, as in table 1, are recalculated on an earlier base (using 1948 net outputs as weights to 1950 and 1953 net outputs subsequently). With 1938=100 the growth recorded in North America, Eastern and Southeastern Asia and Latin America are all of the same order with average rates of increase, compounded, of about 5% per year. In Europe the average rate of increase was less than 4% per year so this measure shows Europe still lagging materially, despite recent rapid growth. With this new base the relative stagnation of North American production in recent years looks like a reaction from a very rapid rate of growth between 1938 and 1950. The recent rapid rate of growth in Europe and Eastern and Southeastern Asia seems to be a catching up again after a stagnation associated with the war years. In Latin America growth continued at a relatively constant rate throughout the whole period.

The remainder of the analysis relates to

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individual countries for the period 1953 to 1960.

There are various ways in which the degree of industrialization of a country can be measured. A typical way is to estimate the proportion of the economically active population which is engaged in manufacturing. That method ignores the efficiency with which those occupied in industry are employed and also ignores the fact that different proportions of the population may be economically active in different countries. Another method is to measure the proportion of the national income which is produced by manufacturing industry but that ignores the fact that some countries produce more per person than others irrespective of the distribution of economic activities. The first method used here is to divide the net output from manufacturing in 1953 by the total population in that year, and to relate these net outputs per person of total population to the result obtained for the United States. The resulting values are called index numbers of industrialization. This method has the advantage that good estimates of population are available for all countries and for many there is reasonable information of net outputs. It has the disadvantage that net outputs are compared by using current exchange rates which may not be realistic for this purpose. They are, however, more likely to be comparable for measuring outputs of material goods, which are likely to enter into international trade, than for total national income which includes a large volume of services. Another disadvantage is that the output of very small manufacturing concerns tends not to be recorded in censuses of production and in the less developed countries this output, as a proportion of total manufactured output, is likely to be higher than in the highly developed countries. This may not be a disadvantage if industrialization is looked upon as the development of production in factories.

The second method is more restricted in scope, it is concerned with production and employment in manufacturing only, shows how much a change in production is associated with the change in employment and how much with a change in output per person employed. Finally it attempts to measure the output per person employed in 1953 and 1960 in absolute terms and relate it to the average output of a worker in the United States in 1953. This might be called an index of efficiency of employment.

The results of the first calculation for 1953 are shown for 49 countries in table 2; the summary at the end for the different areas covers only the individual countries shown in the table. Manufacturing output per head of the total population in the United States and Canada (combined) was more than twice that for Australia and New Zealand, three times as much as the average for Europe, fifteen times as much as for Latin America and nearly fifty times as much as the average for the Asian countries recorded. Japan, the most highly industrialized country in Asia had an industrialization index, in 1953, only one-thirteenth of the value for the United States and some of the countries had an index less than one-hundredth of the United States value.

Since 1953 these values have been changing, mainly under the influence of increased manufacturing production but partly also under the influence of population growth. In the seven years to 1960 population growth was under 10% in European countries and Japan and above 10% in most other countries thus helping to reduce the industrialization of other countries including the United States and Canada related to that of Europe and Japan irrespective of the growth in manufacturing. As manufacturing was growing more quickly in European countries and Japan than in North America the two factors were, not absolutely but comparatively speaking, working for them in the same direction.

From the first two columns of table 4 it can be seen that for most countries with records, the increase in population is quite overshadowed by the much greater increases in manufacturing production and it can be said generally that population growth has almost insignificant effect. Exceptions relate to Canada, United States and Argentina where in each country, both increases were of about the same proportion so that the industrialization indexes were almost unchanged. The only other population growth of special note is the large one of 29% for the Philippines which had the effect of modifying substantially the 90% increase in manufacturing production.

The results of dividing net output of manufacturing industry by total population in both 1953 and 1960 and relating the quotient to that obtained for the United States are shown in table 3 for 27 countries for which information is available. The change from 1953 to 1960 is shown both in absolute terms and as percentages. The two most highly industrialized countries in 1953 as measured by this index (United States and Canada), show almost no change to 1960, and only modest gains when comparison is made with 1952-4 instead of 1953. The industrialized European countries show substantial growth in manufacturing output per head expressed both absolutely and proportionately. West Berlin is, perhaps, a special case and the most striking other advances are by Yugoslavia and Japan especially when expressed as proportions; their absolute advances, however, are exceeded by several European countries, including the United Kingdom, Germany and France. The rapid proportionate growth of Pakistan is very small in absolute terms. In general even the proportionate increases for countries with an industrialization index of less than 200 in 1953 are quite modest when compared with the increases in the European countries already highly industrialized. There is little evidence here that the less developed areas are catching up in manufacturing output per head of total population, but there is evidence that the United States and Canada are lagging.

A new factor can now be introduced into the analysis if the analysis is reduced to cover only 20 countries and that new factor is the use of index numbers of employment in manufacturing industry. By use of these index numbers as well as the index numbers of manufacturing output it is possible to divide the increase in manufacturing output into two factors, that associated with an increase in employment and that associated with an increase in output per person employed. For example with 1953=100 the index of production for Germany was 183 in 1960 and the index of employ-

ment in manufacturing was 137. Dividing 183 by 137 gives 1.34 and the index of production per person employed is therefore 134. This information is given in table 4. In 16 of the 20 countries the increase in output per person was the more important, the exceptions being Yugoslavia, Germany, Hungary and Denmark. Amongst the 16 where output per person was more important than the number of persons employed there were still some countries where the increase in employment has had a big influence and this is especially so in Japan and Austria. A regression line of percentage increase in manufacturing production (Z) on percentage increase in employment in manufacturing (E) gives the equation $Z = 1.94E + 31.3$. This equation suggests a tendency for output to have increased by rather over 30% (31.3) in the seven years irrespective of any change in employment and a further increase of nearly 2% (1.94) for every increase of 1% in the numbers employed. There seems clear evidence of increasing returns from manufacturing; in general the countries with the greatest increases in employment also had the greatest increases in output per person. This effect is not simply the short term effect associated with recovery from depression when there was under-employed labour and capital. In relation to this regression line Japan, France, Italy, Poland and the Philippines have done well and Denmark, the United Kingdom, Ireland, Canada, the United States and Sweden badly.

A final table (table 5) relates to only 14 countries. It attempts to measure, for 1953 and 1960, the output per person engaged in manufacturing. It is more tentative than the earlier tables because of the possibility of errors in the various series having a cumulative effect. In particular it depends upon the 1953 net outputs used as weights in the index numbers of production being consistent with the figures of the numbers of persons engaged in manufacturing industry as well as the reliability of the output and employment indices. For some countries the numbers engaged in manufacturing industries as recorded in population censuses are markedly higher than the values used in the calculations, the differences presumably being accounted for by the home workers, self employed persons and small employers and their employees whose output tends to be omitted from censuses of production and index numbers of production.

The greatest interest in this table 5 relates to the absolute and proportionate growths of output per person in manufacturing. Generally, small percentage growths since 1953 are associated with high outputs per person in 1953. The countries are arranged in this table in order of their efficiencies of employment in manufacturing in 1953 the most efficient at the top and if the relationship were consistent the percentage increases in the last column would rise consistently and there are striking exceptions. The correlation however is not very strong though the regression line gives the equation $Z = -0.0385X + 56.5$ where Z = percentage increase in output per person from 1953 to 1960 and X = output per person in 1953 (U.S.=1000). For Japan, France and Italy the percentage increases were respectively 32, 22 and 17 above the regression line and for Argentina, the United Kingdom and Belgium they were respectively 25, 20 and 15 below.

When consideration is given to the absolute growths of manufacturing output per person employed in manufacturing the increase for the United States is seen to be the second highest in the table, suggesting that though manufacturing is growing less than in most other countries, its efficiency in terms of output per person is still improving rapidly. This may be partly due to the increased use of capital and partly to the more efficient employment of labour. The enormous percentage growth for Japan represents quite a modest increase in absolute terms, 9 of the 14 countries showing a greater absolute growth. The absolute growth for Argentina is by far the smallest for the countries shown, but for Belgium and the United Kingdom, both industrial countries of long standing, the growth is less than the average in absolute as well as percentage terms. The absolute growths for France, Italy and Canada though below that for the United States are very satisfactory and that for Yugoslavia outstanding. In Germany too the growth is good, especially as capital also had to be found for a greatly expanded labour force in manufacturing referred to previously.

The apparent lagging of the United States in manufactured output since 1953 is now seen as a stagnation of total output associated with a very substantial gain in efficiency of production, the very rapid rise in Japan is only in relation to a low level in 1953 and in absolute terms is only about one-half of the growth in output per person in manufacturing in the United States.

Table 1 World index of industrial production

	1960		Rate of increase per year			
	1953=100	1938=100	1938 to 1950	1950 to 1956	1956 to 1960	Whole Period
Northern North America	118	337	7.1%	4.6%	2.2%	5.5%
Latin America	164	328	5.0%	5.4%	6.6%	5.1%
E and SE Asia	249	319	-0.9%	12.4%	13.2%	4.8%
Europe	158	226	1.7%	6.4%	5.6%	3.7%
World[1/]	140	280	4.2%	5.7%	4.5%	4.7%

[1/] Excluding centrally planned economies such as Russia and mainland China.

Source: U.N. Monthly Bulletin of Statistics, August 1960 and August 1961.

Table 2 Indices of Industrialization
Manufacturing output per head of total population, 1953
(United States = 1000)

Country	America and Oceania	Europe	Asia
United States	1000 (950)		
Canada	714 (692)		
United Kingdom		620	
Norway		549 (556)	
Switzerland		547	
Sweden		501	
New Zealand	462		
Germany, Fed. Rep.		438 (441)	
Australia	437		
Denmark		423 (431)	
West Berlin		367	
Belgium		339	
Netherlands		313 (316)	
Austria		310 (324)	
France		291 (301)	
Italy		203	
Finland		198	
Uruguay	147		
Ireland		139 (136)	
Argentina	133 (137)		
Yugoslavia		120	
Spain		108	
Venezuela	101		
Japan			75 (73)
Mexico	71		
Portugal		71	
Chile	69		
Greece		66	
Colombia	48		
Malaya and Singapore			45

Table 2 (continued)

Country	America and Oceania	Europe	Asia
Peru	43		
Brazil	41		
Costa Rica	35		
Turkey		32	
Ecuador	30		
El Salvador	30		
Paraguay	29		
Guatemala	27		
Formosa			18
Philippines			16
Honduras	14		
India			13 (12)
Thailand			10
Nicaragua	8		
Ceylon			8
Korea			8
Pakistan			6
Burma			6
Indonesia			4
Summary			
Northern N. America	976		
Latin America	62		
E and SE Asia			20
Europe		310	
Oceania	441		

Note: Figures in brackets denote values when 1952-54 instead of 1953 is taken as base.

Sources: Relative net outputs in 1953 from the weights in the world index of manufacturing production, see Supplement to the U.N. Monthly Bulletin of Statistics, 1959 and U.N. Statistical Yearbook, 1960.

Population figures from U.N. Monthly Bulletin of Statistics, August 1961.

Table 3 Changes in industrialization, 1953 to 1960
Manufacturing output per head of total population (United States, 1953=1000)

Country	Index of industrialization		Change from 1953 to 1960	
	1953	1960	Absolute	Percentage
United States	1000 (950)	1039	39 (89)	3.9 (9.4)
Canada	714 (692)	702	-12 (10)	-1.7 (1.4)
United Kingdom	620	785	165	26.6
Norway	549	741	192	35.0
Germany, Fed. Rep.	438	738	300	68.5
Denmark	423	557	134	31.6
West Berlin	367	919	552	150.3
Belgium	339	442	103	30.4
Netherlands	313	455	142	45.3
Austria	310	524	214	69.1

Table 3 (continued)

Country	Index of industrialization		Change from 1953 to 1960	
	1953	1960	Absolute	Percentage
France	291	485	194	66.7
Italy	203	354	151	74.4
Finland	198	283	85	43.1
Ireland	139	174	35	24.9
Argentina	133	131	-2	-1.7
Yugoslavia	120	280	160	133.1
Venezuela	101	171	70	69.5
Japan	75	195	120	160.0
Mexico	71	102	31	44.2
Portugal	71	111	40	56.0
Chile	69	69	0	0.0
Greece	66	107	41	61.5
Guatemala	27	31	4	15.5
Formosa	18	27	9	51.1
Philippines	16	23	7	46.8
India	13	18	5	37.8
Pakistan	6	14	8	132.5

Note: Figures in brackets take 1952-54 as base instead of 1953.

Sources: As table 2 with information of growth of manufacturing output from U.N. Monthly Bulletin of Statistics, September 1961, table 7.

Table 4 Factors affecting Industrialization

Country	Increase in Population 1953 to 1960	Increase 1953 to 1960 in		
		Manufacturing Production	Manufacturing Employment	Manufacturing Production per person
	%	A%	B%	C%
Japan	8	180	54	82
Yugoslavia	9	155	74	47
Poland	13	97*	20	64
Philippines	29	90	23	55
Germany	9	83	37	34
Italy	4	81	12	62
France	7	78	6	68
Austria	2	72	25	38
Netherlands	9	59	12	42
Hungary	4	55	27	22
Finland	8	54	8	42
Norway	7	44	5	37
Denmark	5	38	19	16
Belgium	4	36	5	30
Sweden	4	34*	6	26
United Kingdom	4	31	9	20
Ireland	-4	20	1	19
Canada	20	18	-3	22
United States	13	17	-5	23

Table 4 (continued)

Country	Increase in Population 1953 to 1960	Increase 1953 to 1960 in Manufacturing Production	Increase 1953 to 1960 in Manufacturing Employment	Increase 1953 to 1960 in Manufacturing Production per person
	%	A%	B%	C%
Argentina	14	12	-10	24

*General index of production.

Sources: As in previous tables with index numbers of employment in manufacturing from U.N. Monthly Bulletin of Statistics, September 1961, table 4B.

$A = 1.94B + 31.3 \qquad r = 0.88$

$C = 0.42B + 31.8 \qquad r = 0.45$

Table 5 Indices of Efficiency of Employment in Manufacturing
(United States, 1953=1000)

Country	Output per person 1/		Increase 1953 to 1960	
	1953 (X)	1960	Absolute (Y)	Percentage (Z)
United States	1000	1232	232	23
Canada	851	1035	184	22
Norway	743	1019	276	37
Sweden	484	612	128	26
Germany, Fed. Rep.	450	601	151	34
United Kingdom	433	520	87	20
Yugoslavia	431	632	201	47
Netherlands	305	433	128	42
Italy	300	485	185	62
Belgium	283	366	83	30
France	272	457	185	68
Austria	271	373	102	38
Argentina	180	224	44	24
Japan	148	269	121	82

1/In manufacturing industry.

Sources: As in previous tables with information as to numbers engaged in manufacturing from U.N. Statistical Yearbook, 1960, table 66. Some of the values for 1953 obtained by interpolation of figures for nearby years.

$Y = 0.17X + 75 \qquad r = 0.68$

$Z = -0.0385X + 56.5 \qquad r = -0.52$