NOTES AND MEMORANDA

A NOTE ON MEASURING STRUCTURAL CHANGES

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The process of economic growth can be characterized primarily by the rate of growth and the extent of structural transformations accompanying it. An indicator will be suggested here for measuring the extent and the speed of structural transformation and an example will be given for its application concerning the sectoral pattern of industry.

The extent of structural transformations can be measured by comparing the distribution ratios describing the pattern of industry:

$$\frac{P_i^1}{P^1} : \frac{P_i^0}{P^0} \tag{1}$$

where P_i denotes any element of the structure (e.g. the output by sectors), $P = \Sigma P_i$ – the sum of the elements (e.g. the output of the industry as a whole), and 1 and 0 indicate two periods. The same result may be obtained by comparing index number ratios calculated on the basis of time-series:

$$\frac{P_i^1}{P_i^0} : \frac{P^1}{P^0} \tag{2}$$

Mathematically, formulae (1) and (2) are identical. Furthermore, logical considerations indicate that structural transformations arise just from the growth of the elements at different rates. Calculations based on index numbers is especially advantageous when the transformation of the volume-structure is to be measured. In this case, since the structure defined on the basis of value figures is influenced by the changes on both quantities and prices the effect of the latter should be eliminated. By help of index numbers measuring changes of quantities, as in the case of the index numbers of production, the indicators calculated according to formula (2) characterize directly the transformation of the volume-structure.

Ratios calculated according to the formulae (1) and (2) can be compared only if they refer to periods of the same length e.g. to 5-year, 10-year, 15-year periods respectively. However, the problem is often to compare the structural transformation of a relatively near 5-year period with that of a 10-year one preceding it; or the comparison is to be carried out among different countries where the data available do not permit the comparison of periods of the same length. This problem can be overcome by calculating and comparing the indicators of the average *annual* structural transformation. This kind of indicator can be obtained in two ways, either according to formula (1)

$$\sqrt[n]{\frac{P_i^1}{P^1}} : \sqrt[n]{\frac{P_i^0}{P^0}} \tag{3}$$

or according to formula (2)

$$\sqrt[n]{\frac{P_i^1}{P_i^0}} : \sqrt[n]{\frac{P^1}{P^0}} \tag{4}$$

The latter procedure is more familiar: it corresponds to the comparison of the average annual growth rates. In case these indicators are available in percentage form, an indicator in percentage form may be applied as follows

$$s_i = \left[\frac{1 + (r_i/100)}{1 + (\bar{r}/100)}\right] \quad 100 - 100 \tag{5}$$

where r_i denotes the average growth rate of any element of the structure, e.g. that of the output of any industry, and $\bar{r}$ the average growth rate of the sum of the elements, e.g. that of the output of the industry as a whole.

With the help of these indicators, the change of the individual elements of the structure can be examined. The average speed of the structural transformations can also be characterized from the absolute values of the s_i indicators calculated according to formula (5)—by simple or weighted arithmetic means. If indicators of similarly important structural elements are taken as a base, the simple arithmetic mean may be suggested:

$$v = \frac{\Sigma|s_i|}{n}$$

On the basis of data on five significant industries the example below investigates the transformation of the sectoral pattern of the Hungarian industry. Of the five industries, four belong to manufacturing: engineering, chemical, textile and food processing industries; the fifth industry is mining (fuel industry in case of socialist countries, which is not quite of the same contents). Table 1 gives the average growth rates of the industrial production, the s_i coefficients of the five industries and the v coefficients of manufacturing and total industry calculated on their basis. The first part of the table was calculated on the basis of gross production index numbers of seven socialist countries, and the second one on the basis of index numbers of value added of nineteen countries. The statistical publications of the United Nations constitute the source of the data.

The figures in the table demonstrate clearly the substantial similarity of the tendencies prevailing in the sectoral pattern of the industry.

Expressing the speed of structural transformations by help of a single indicator enables us to investigate its relation to growth rate and level of development.

Table 2 gives the average growth rates of industrial production, the v indicators on manufacturing and industry as a whole; furthermore, a ranking of the individual countries is given according to the former indicators (by decreasing order) and in relation to the per capita industrial output (by increasing order). The relationship was tested by means of the Spearman rank correlation coefficient. In the case of the relation between growth rate and speed of structural transformations in the manufacturing industry this figure is 0.655 and for the industry as a whole 0.693. (Eliminating the fractional structural transformation in GDR

TABLE 1

INDICATORS CHARACTERIZING THE CHANGES IN THE PATTERN OF INDUSTRY FOR 1950–1965

Country	Average Growth Rate of Industrial production	Coefficients (s_i percentage) of the Yearly Average Changes of the Share of					The Average Yearly Change (v) of the Pattern of	
		Engineering	Chemicals	Textiles	Food	Mining[1]	Manufacturing	Total Industry
1	2	3	4	5	6	7	8	9
Hungary I (gross output)	10.0	1.8	6.6	−3.5	−2.1	−1.9	3.5	3.2
Bulgaria	13.9	6.1	6.5	−3.2	−3.0	0.3	4.7	3.8
Czechoslovakia	8.8	3.9	4.7	−3.0	−3.5	−1.5	3.8	3.3
Poland	11.7	7.3	3.8	−2.3	−3.8	−5.6	4.3	4.6
GDR	10.4	1.9	0.2	−3.0	−1.4	−4.2	1.6	2.1
Rumania	13.9	4.7	6.8	−3.9	−4.1	−4.0	4.9	4.7
USSR	10.7	3.4	2.7	−3.5	−2.2	−2.4	3.0	2.8
Hungary II (net output)	9.6	2.4	5.0	−3.7	−0.8	−3.8	3.0	3.1
Yugoslavia	10.3	2.0	4.6	−2.8	−1.7	−2.9	2.8	2.8
Austria	6.6	0.2	1.9	−2.0	−1.9	−1.3	1.5	1.5
Belgium	4.2	1.5	3.2	−2.7	−1.0	−5.1	2.1	2.7
Denmark	5.1	1.7	0.2	−3.6	−0.9	0	1.6	1.3
United Kingdom	3.1	0.7	2.6	−3.7	−0.4	−3.5	1.9	2.2
Finland	6.7	0.5	3.3	−3.8	−0.6	0.9	2.1	1.8
France	5.7	1.3	4.4	−4.8	−2.9	−3.0	3.4	3.3
Greece	8.8	3.3	−2.1	−3.0	−2.6	10.7	2.8	4.3
The Netherlands	5.9	1.3	2.9	−2.3	−2.1	−3.3	2.2	2.4
Ireland	4.7	1.7	1.6	1.2	−2.6	3.6	1.8	2.1
GFR	8.3	2.2	3.5	−2.4	−1.4	−5.3	2.4	3.0
Norway	5.5	0.9	2.6	−4.7	−2.8	−1.0	2.8	2.4
Italy	8.2	−0.6	5.5	−6.7	−4.2	0.5	4.3	3.5
Sweden	4.9	0.5	1.9	−3.1	−1.9	−0.1	1.9	1.5
USA	4.4	1.1	2.5	−1.9	−1.7	−2.1	1.8	1.9
Canada	5.6	−0.9	1.4	−2.2	−1.6	−2.2	1.5	1.7
India	7.0	7.9	3.7	−2.6	−1.9	−1.3	4.0	3.5
Japan	14.5	6.2	2.1	−1.9	−4.2	−9.6	3.6	4.8

[1]In socialist countries above the line, fuel industry.

this pair of coefficients are 0.728 and 0.721, respectively.) The relationship between level of development and speed of structural transformations is almost as close; the values obtained for the rank correlation coefficient are 0.625 and 0.5292 (omitting the most outstanding figure of Ireland, the corresponding values are 0.667 and 0.650). Finally a close connection appears between level of per capita industrial output and rate of growth; the figures for the rank correlation coefficients are 0.624 and 0.626.

This investigation is presented as an example and centers around the problem of assessing the position of Hungary. In respect of the speed of structural transformations in industry—considering only manufacturing—Hungary takes the

TABLE 2

DATA INDICATING THE RELATIONSHIP BETWEEN GROWTH RATES AND CHANGES IN PATTERN OF INDUSTRY FOR 1950–1965

Country	Average Growth Rate of Industrial Production (%)	The average yearly Change (%) of the Pattern of		Ranking[1] of the Countries according to			
		Manufacturing	Total Industry	(1)	(2)	(3)	(4)[2]
	(1)	(2)	(3)				
Japan	14.5	3.6	4.8	1	7	1	10
Bulgaria	13.9	4.7	3.8	2–3	2	5	5
Rumania	13.9	4.9	4.7	2–3	1	2	3
Poland	11.7	5.3	4.6	4	3–4	3	7
USSR	10.7	3.0	2.8	5	10	12–13	12
GDR	10.4	1.6	2.1	6	22–23	18–19	17
Yugoslavia	10.3	2.8	2.8	7	11–13	12–13	4
Hungary I	10.0	3.5	3.2	8	8	10	9
Hungary II	9.6	3.0	3.1				
Czechoslovakia	8.8	3.8	3.3	9–10	6	8–9	16
Greece	8.8	2.8	4.3	9–10	11–13	4	2
GFR	8.3	2.4	3.0	11	14	11	23
Italy	8.2	4.3	3.5	12	3–4	6–7	11
India	7.0	4.0	3.5	13	5	6–7	1
Finland	6.7	2.1	1.8	14	16–17	21	8
Austria	6.6	1.5	1.5	15	24–25	23–24	15
The Netherlands	5.9	2.2	2.4	16	15	15–16	13
France	5.7	3.4	3.3	17	9	8–9	14
Canada	5.6	1.5	1.7	18	24–25	22	24
Norway	5.5	2.8	2.4	19	11–13	15–16	19
Denmark	5.1	1.6	1.3	20	22–23	25	21
Sweden	4.9	1.9	1.5	21	18–19	23–24	20
Ireland	4.7	1.8	2.1	22	20–21	18–19	6
USA	4.4	1.8	1.9	23	20–21	20	25
Belgium	4.2	2.1	2.7	24	16–17	14	18
United Kingdom	3.1	1.9	2.2	25	18–19	17	22

[1] In the case of (1), (2), (3) decreasing, in that of (4) increasing, order.
[2] Per capita level of industrial production (estimated).

eighth place among the twenty-five countries analyzed and taking in to account mining as well (i.e. all the five industries examined) the place taken is the tenth. This fits well the position taken with respect to the level of industrial development, and to the average growth rate. The conclusion may also be drawn from the investigations that in the case of the Hungarian industry, a slow-down may be expected with respect to the speed of structural transformation.