## THE SOCIO-ECONOMIC DIFFERENTIATION OF POLAND'S SPATIAL STRUCTURE

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### THE DIMENSIONS OF SOCIO-ECONOMIC SPACE

The subject of this analysis is the total socio-economic space of Poland. Geographical theory contains two approaches to an operational definition of socio-economic space. Firstly, the ontological approach conceives of socio-economic space as a mode of existence of economic processes; secondly, the mathematical and economic-geographical approach considers socio-economic space as a set, or subset, of geographical objects with specific inter-dependences. This study of Poland's socio-economic space consists of defining and explaining the regularities in the spatial occurrence of economic processes by analysing the properties of sets of objects and their vertical and horizontal interdependences. Thus conceived, the analysis of socio-economic space is closely linked to the study of the level of the country's economic development.

The present study is based on the assumption of a latent structure of socio-economic space. The total socio-economic space may be viewed as a set of partial socio-economic spaces comprising different features of socio-economic life, for example, demographic, industrial and agricultural and those relating to transportation and services. In spite of its plurality, this set is finite. The partial socio-economic spaces, though comprising different socio-economic phenomena, refer to the same reality in that they are reflections of some of its different aspects. Such partial spaces are interdependent, though clearly non-identical (Dziewoński [2], p. 37). The total socio-economic space is a resultant of all partial spaces that together constitute the latent structure of total space.

## METHOD OF IDENTIFYING STRUCTURE

As a method of identifying this latent structure, factor analysis has been employed. A fundamental postulate of factor analysis is that there is a set of latent factors underlying a given space. The latent factors help towards the explanation of the interdependences between observable features of phenomena. The relationships between the variables are related closely to the presence or absence of particular latent factors. Factor analysis provides, in this way, remarkable new possibilities for the identification of latent phenomena. By using this method economic-geographical studies need not be exclusively confined to analysing the features of visible economic processes, it may

he observed. Factor analysis is the model for measurements insofar as the identification of directly unobservable factors is concerned (Czvź [1]).

Factor analysis, in its function as a model for measurements of fundamental magnitudes in socio-economic studies, employs scaling. The student often wants to develop a scale in which individual phenomena are attributed a definite value and made comparable. The scale may refer to such phenomena as urbanization, industrialization or other conceptual variables. A fundamental problem in the derivation of a scale is the weighting of the component variables. Factor analysis furnishes solutions by dividing variables by their independent causes of variation. Each factor represents a scale based on empirical interdependences between variables. For the connected variables, factor analysis uses loadings derived from a mathematical model. The resulting factor scores are interval (not absolute) scales derived by linking these variables and taking into account definite loadings.

Thus, the factor analysis of the differentiation of the structure of socio-economic space in respect of measures of socio-economic reality:

(1) reveals the essential patterns of socio-economic phenomena in Poland in the language of partial spaces and establishes their hierarchy.

(2) defines the homogeneity of these spaces and determines if they have a regular regional structure.

(3) examines the horizontal and vertical spatial relationships.

Our point of departure is a set of 33 variables reflecting the economic life of Poland:

- (1) Population density
- (2) Population increase per 1000 inhabitants
- (3) Percentage of urban in total population
- (4) Percentage of economically active in total population
- (5) Percentage of economically active outside agriculture in total number of economically active population
- (6) Percentage of non-agricultural employment in total population
- (7) Agricultural population per 100 ha of agricultural land
- (8) Per capita investment expenditure at current prices (Zlotys)
- (9) Investment expenditure at current prices per 1 sq. km (.000 Zlotys)
- (10) Value of fixed assets per 1 sq. km (.000 Zlotys)
- (11) Industrial employment per 1000 population
- (12) Industrial employment per 100 sq. km
- (13) Per capita gross industrial output (Zlotys)
- (14) Percentage of agricultural land in total area
- (15) Share of cereal cultivation in total sown area  $(^{0}/_{0})$
- (16) Share of potato cultivation in total sown area  $(^{0}/_{0})$
- (17) Share of sugar-beet in total sown area  $(^{0}/_{0})$
- (18) Cattle per 100 ha of agricultural land (head)
- (19) Pigs per 100 ha of agricultural land (head)
- (20) Per capita wheat crops
- (21) Percentage of electrified private farms in total private farms
- (22) Forest area per capita (ha)
- (23) Share of forest in total area
- (24) Length of railway lines per 100 sq. km
- (25) Length of roads covered by bus routes per 100 sq. km
- (26) Number of train-kilometres within 24 hrs per 100 sq. km
- (27) Number of bus-kilometres within 24 hrs per 100 sq. km

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- (28) Number of train-kilometres within 24 hrs per 10,000 population
- (29) Number of bus-kilometres within 24 hrs per 10,000 population (30) Population per socialized retail-trade establishment
- (31) Sales by socialized retail-trade per capita (Zlotys)
- (32) TV subscribers per 1000 population
- (33) Physicians per 10,000 population

The variables comprise population, industrial and agricultural outputs, transport, and services in 1965.<sup>1</sup> Socio-economic phenomena have a definite location within a modified administrative division consisting of a total of 324 areal units at the level of poviats (Fig. 1). The modifications to this division consisted in, firstly, including 61 towns with the status of poviat in adjoining rural poviats, and secondly treating the 5 city-voivodships, the 10 towns of the Upper Silesian Industrial District, and the Trójmiasto (i.e., the three coastal towns of Gdańsk, Gdynia and Sopot) as separate areal units. The inclusion of town poviats in the rural poviats seemed reasonable, for a town is integrally connected with the territory of the rural poviat. The adopted frame of reference of the phenomena corresponds directly with the administrative division, which is itself closely connected with the pattern of the spatial organization of economic activity.

It ought to be emphasized that, from the standpoint of the aims of the present study, the statistical data at hand unfortunately fail to represent all the essential properties of socio-economic space and, besides being based on relatively large spatial units (the poviats), they furnish an all too generalized picture. This results from the difficulties in collecting more complete or detailed statistical material.

# RESULTS OF THE STUDY

The factor analysis of a matrix of variable correlations made by the principal factor method with Hotelling's iteration algorithm produces 3 significant common factors, accounting for 66.13% of the total variance.2 The factor structure is hierarchic in its nature (Table 1).

TABLE 1. Factor structure

		Common variance explained by factor	
Factor	Eigenvalue	% explained	cumulative % explained
<b></b>	11 475	38.33	38.33
<b>F</b> 1 <b>F</b> 2 <b>F</b> 2	4.751	15.90 11.90	54.23 66.13

<sup>1</sup> For lack of space the set of initial statistical data and their sources are not given. Figures 1-6 at the end of the book.

\* The programme for factor analysis written in the Gier-Algol language employed the principal factor method on a Gier computer.

The identified factors represent the fundamental dimensions of the 33-variable socio-economic space. These theoretical metafeatures are linked with definite clusters of observable variables. The nature of the factor must be inferred from the contents of these features (Table 2). Since the factors are bipolar, they express a property that may have either a positive or a negative score.

TABLE 2. Factor matrix

Variable	F <sub>1</sub>	$F_2$	$F_3$
1	0.7885	0.4675	-0.1579
2	-0.1530	-0.6501	-0.0471
3	0.8825	-0.2012	-0.0903
4	-0.4681	0.6551	-0.0298
5 <b>5</b>	0.8921	-0.2851	-0.0708
6	0.8570	-0.3281	-0.0542
7	-0.0678	0.7837	0.1561
8 -	0.2631	-0.0485	-0.0388
9	0.7816	0.4346	-0.1712
. 10	0.7896	0.3987	-0.1647
. 11	0.7754	-0.0468	0.0740
12	0.7668	0.4220	-0.1682
13	0.7461	-0.0162	0.1239
14	-0.3682	0.3192	0.6970
15	-0.6064	0.1167	-0.2220
16	-0.0061	0.3974	-0.5177
17	0.0591	-0.1270	0.7255
18	0.0995	0.0535	0.4253
19	0.2076	0.3504	0.1486
20	-0.1435	-0.2506	0.7208
21	0.5356	-0.4860	0.1756
22	-0.2450	-0.5018	-0.6424
23	-0.0512	-0.4888	-0.6563
24	0.7858	-0.1584	0.2190
25	0.4858	-0.2506	0.5745
26	0.7803	0.2945	-0.0935
<b>27</b>	0.7467	0.3883	0.0901
28	0.1527	-0.5610	0.0758
29	-0.2966	-0.2825	0.1173
30	-0.2099	0.5386	0.0303
31	0.8620	-0.1589	-0.0091
32	0.8945	-0.2464	0.1217
33	0.7743	0.1075	-0.1797
Per cent of common		· · · · · · · · · · · · · · · · · · ·	
variance explained by factor	38.33	15.90	11,90

Factor  $F_1$ , which explains 38.33 per cent of the total variance, is the major factor. Its structure, in terms of features correlated positively with this factor, is composed of the following elements: (1) urban and non-agricultural population, (2) industrial activity, (3) transport, (4) services. Thus, this factor comprises an assembly of fundamental features which are indicators of urbanization and industrialization. The criterion of urban population and, as a corrective. that of the percentage of nonagricultural employment, are in Polish conditions the fundamental indicators of the urbanization level.

According to Leszczycki and Wróbel [4], the processes of rapid urbanization in Poland find their expression not only in the growth of urban settlement patterns but also in the penetration of urban modes of life into rural areas. Statistically, this is reflected in changes in the occupational structure of the rural population seen in terms of the growing share of non-agricultural occupations. The most important cause of the quantitative domination of non-agricultural population in the rural areas is the daily commuting to work in industrial establishments in towns. Moreover, those among the rural population who are employed in industry do not always give up their work on the farm. Hence the growing number of what are called "worker-peasants". Another cause is the process of industrialization of the rural poviats.

Factor  $F_1$  contains also "pure" indices of industrialization: industrial emplovment, total industrial output, the value of fixed assets, investments, and the level of transportation development. It must be pointed out that the aggregation of the observable features of urbanization and industrialization into the category of factor  $F_1$  is fully justified due to the existence of different feedbacks between these two processes. Factor  $F_1$  is identified as the factor of the level of urbanization and industrialization.

Urbanization and industrialization are elements of a more general process of modernization. The identification of the syndrome of modernization may thus be of some use for the determination of the level of the country's economic development.

TABLE 3. Distribution of factor variation\*

Factor	Maximum value	Minimum value	Difference
<i>F</i> <sub>1</sub>	65.86	-15.71	81.57
$\vec{F_2}$	19.33	-10.67	30.00
$\overline{F_3}$	10.41	-11.55	21.96

\* Factor scores are expressed by normalized non-denominated numbers, i.e., with an arithmetic mean equal to 0

Factor  $F_2$  explains 15.90 per cent of the total variance and reveals the second pattern of linkage of variables. This factor exhibits positive correlation with the features of agricultural population per 100 ha of agricultural land, economically active population, and population per establishment of socialized retail trade. It is striking that the agricultural population density is in strict positive correlation with the economically active population. This is due to the imprecision of the population's activity coefficient, caused by the application of a specific principle in distinguishing the active population. Polish statistics include among the working population all women living in rural areas and thus the number of economically active people in agricultural areas is overestimated. Thus it can be said that the feature "agricultural population density" is a leading variable of this pattern. Factor  $F_2$  is thus the human factor in agriculture.

Factor  $F_3$  is similar to factor  $F_2$ , as far as the percentage of the common variation explained (11.90) is concerned. Interpretation of factor  $F_{3}$  is based

on its positive correlation with some measures of agricultural intensity of productivity, such as the percentage of agricultural land, the share of intensive crops in the total cultivated area, the density of livestock, and yields of wheat per capita. Factor  $F_3$  is identified as the factor of the level of intensity in the agricultural economy.

As expressed in terms of factors, the fundamental information on the basic socio-economic situation in Poland is contained in a matrix of factor scores of the order  $324 \times 3$ .

The frequency distributions of the values of the three factors are notably different. The form of these distributions is closely related to the amount of spatial variation of the phenomena indicated by these factors (Table 3).

The examination of the spatial pattern in the dimensions of the respective factors is indicated by a one-factor classification of the spatial units. There are 9 homogeneous classes of areal units. Their respective scores are given in Table 4.

TABLE 4 Class intervals of factor scores

Class (type)	Class intervals
I	-20 to $-10$
11	-10  to  -3
ш	-3 to $-1$
1V	-1 to 0
V	0  to  + 1
VI	+ 1 to + 3
VII	+ 3 to +10
VIII	+10 to $+20$
IX	+20 to $+70$

The presentation of the morphology of the respective factor spaces is begun with the human factor in agriculture  $(F_2)$ , which, although being on a lower level in the factor hierarchy, has a conspicuous regional character (Fig. 2).

A preliminary comparison of the distribution map of factor  $F_2$  with that of the socialized forms of agriculture shows that the distribution of agricultural population is, to a wide extent, the reverse of the distribution of socialized farms. Thus, in virtue of two value classes of factor  $F_2$  (positive and negative), two types of area may be distinguished. The first type are areas of normal, or relatively insufficient, saturation with agricultural population and predominantly of socialized farms. The second, opposite type indicates areas of a high density of agricultural population and private farms.

The analysis of the distribution of these types leads to a division of Poland into two large, distinctly delineated regional units, which are fundamentally opposed to each other in the specific social structures of their agriculture. The Region of Western and Northern Poland is marked by a density of agricultural population below the national average, a well-developed socialization of agriculture, and a predominance of middle-sized and large farms in the private sector. This Region includes the voivodships of Szczecin, Koszalin, Gdańsk, Olsztyn, the north-western part of the Białystok voivodship (*poviats* of Gołdap, Olecko, Ełk, Augustów), Zielona Góra, Poznań without its eastern poviats (Słupca, Konin, Kcło, Turek, Pleszew, Kalisz, Ostrzeszów), Bydgoszcz without the south-eastern part (Radziejów, Włocławek, Aleksandrów Kujawski, Lipno, Golub-Dobrzyń, Rypin poviats), Wrocław, Opole, and the poviats of Lubliniec, Tarnowskie Góry, Gliwice and Zabrze in the voivodship of Katowice. This Region is homogeneous in terms of the space under discussion and it contains only two small enclaves of the second type, the city-voivodship of Poznań and the Trójmiasto.

The Region of Central and Eastern Poland (embracing the voivodships of Łódź, Warsaw, Białystok, Kielce, Lublin, Katowice, Cracow and Rzeszów), with surplus agricultural population and a conspicuous predominance of small private farms, exhibits less homogeneity. The south-eastern part of the Region, where socialized farms were established on land formerly belonging to Ukrainians; the south-western part, which is strongly industrialized; and a few enclaves, with agriculture of the suburban type, together represent the opposite type.

The economic space of social forms of ownership can be regarded as a frame of reference for the economic activities in agriculture, i.e., the space of factor  $F_{3}$ .

The examination of the geographical distribution of factor  $F_3$  reveals a high heterogeneity of the space of the level of intensity of agriculture. The spatial pattern of the types of agriculture, which are based on 8 classes of value of factor  $F_2$ , constitutes a mosaic structure (Fig. 3).

The particular types of agricultural intensity interlace with each other in space, yielding a fairly complex picture. Only after a generalization of the patterns of agricultural types effected by joining related, "positive" or "negative", types into contiguous territorial units can the delineation of two zones of highly intensive agriculture be achieved. The first of these zones constitutes the axis of the space discussed here; it runs from the south-west to the north. This zone has a distorted shape suggestive of several sections, namely the Silesian district, the Great Poland district (the south and east of Great Poland), the East-Pomeranian district, with its extensions into Kujawy, and the Łódź-Warsaw area. The second zone, in southern Poland, which extends roughly parallel from west to east, is much weaker in its delimitation and is composed of the areas of Miechów-Sandomierz and Lublin. The interzonal area, as well as those on the outer margin of the distinguished zones, exhibit, generally, a low intensity of agriculture, but they include three enclaves of highly intensive agriculture, the areas of Pyrzyce, Przeworsk and Kętrzyn.

By synthesizing the space of the level of intensive agriculture with its background of the social forms of ownership in agriculture, we obtain a resultant configuration of the integrated space representing the vertical and horizontal relations of the components. In terms of numerical taxonomy, this type of approach denotes a two-factor classification of the set, using, for simplicity, four types by quadrants (Fig. 4).

The geographical picture of this type of pattern is marked by the occurrence of types without spatial contiguity (Fig. 5). The original morphology of the space-basis of a strongly regional character has been distorted. The relatively high coefficient of agreement (0.53) of the system  $F_2F_3$  requires some careful comments on its spatial aspect. The inner area of the Region of Western and Northern Poland has been subjected to a differentiation in terms of the types: firstly non-accordant, with agricultural population density below the national level and a high intensity of agriculture; and secondly, accordant, showing the opposite position.

#### 2 Geographia Polonica

The first type covers the southern and western parts of the voivodship of Opole, nearly all of that of Wrocław, the southern and north-eastern parts of those of Poznań and Bydgoszcz, the eastern part of Gdańsk voivodship, the western and northern part of that of Olsztyn, and the areas of Gryfice, Pyrzyce, Szprotawa, Szamotuły. Thus, it is represented by areas of high agricultural intensity. This is a consequence partly of the proximity of large population groupings and industrial agglomerations, and partly of the occurrence of good soils without any notable surpluses of agricultural manpower

The second type covers the voivodships of Szczecin, Koszalin, the western part of Gdańsk, the northern part of Bydgoszcz and southern part of Olsztyn voivodships, the voivodship of Zielona Góra, the western part of Poznań voivodship and the borderland between it and Koszalin voivodship, the eastern part of Opole voivodship and enclaves in Wrocław voivodship. These, especially in the north of Poland, are marked by a low population density, a relatively low percentage of agricultural land and by the extensive character of their agricultural economy.

In the Regional of Central and Eastern Poland, the accordant type, positively correlated with intensive agriculture and surpluses of manpower, occurs in several distinct areas, notably,

(1) Kujawy, the western part of Warsaw voivodship and the northern part of Łódź voivodship,

(2) The northern part of Cracow voivodship, the southern part of Kielce voivodship, the voivodship of Lublin, the areas of Przeworsk. These areas have very good soils with a low intensity of agriculture and a high level of fragmentation of farms and hence have considerable latent surpluses of agricultural manpower.

Generally, it can be said the differentiation of agricultural space has, on the one hand, its historically-conditioned demographic reasons and, on the other, its physiographical justification particularly in respect of soil fertility.

In addition, the pattern of the level of urbanization and industrialization is superimposed upon the spatial differentiation of the agricultural economy. The specific character of the industrial-urban pattern consists in the extreme non-contiguity of the space of urbanization and industrialization (Fig. 6).

Areas of the industrial-urban type of development occur scattered throughout agricultural areas, especially in the eastern part of the country, comprising the areas of Łódź, Warsaw, Płock-Włocławek (including Kutno), Giżycko-Ełk, Tarnobrzeg and the individual cities of Cracow, Tarnów, Rzeszów, Kielce, Radom, Lublin, Białystok and Olsztyn.

The western part of Poland has a well-developed industrial zone, which, however, is not homogeneous. Within this zone the following sub-spaces may be distinguished:

(1) The Upper Silesian area, consisting of 10 poviats with a very high level of urbanization and industrialization. These *poviats* are relatively contiguous, linked through the southern part of the Opole voivodship to the Lower Silesian area, which in turn extends to the north into the areas of Zielona Góra and Gorzów, while in the east it passes into the area of Great Poland.

(2) The coastal area, which is non-contiguous.

(3) The area of the lower Vistula.

The forms occurring in these urban and industrial zones are externally differentiated. Their cores, where the phenomenon reaches its maximum, are situated in the Upper Silesian Industrial District, Bielsko-Biała, Wrocław city, Poznań city, Szczecin and the Trójmiasto.

### CONCLUSION

This analysis of the spatial structure of Poland indicates three factors determining the spatial patterns representative of the overall socio-economic situation of the country.

The spatial patterns created by the first factor, which is interpreted as the pattern of urbanization and industrialization, exhibit the formation of regional groupings of the semi-urban type, that is represented by metropolitan and urban areas as well as by industrialized areas within areas of actively developing agriculture. This factor furnishes essential data for the appraisal of the level of socio-economic development. At the same time, it discloses the specific properties of the urban economy and allows the determination of the position of an area within an urban-rural continuum. This factor pattern can therefore be treated as a classifying category in the study of urban-rural duality. The high position of some poviats in the scale of industrialization and urbanization is a manifestation of the complexity of particular urban economies.

The other two patterns of the socio-economic space, viz. the human factor in agriculture and the factor of level of intensity of agriculture, do not represent definite stages of development in the socio-economic continuum. Thus they do not enable us to establish the position of an area in the lower part of the evolutionary chain of economic structures. Consequently, they are useless for the identification of the type of rural economy, for they do not refer to the differentiation of rurality. On the other hand, factors  $F_2$  and  $F_3$  constitute component elements of the space of agricultural phenomena. They affect the stratification of the spatial structure of agriculture in its horizontal aspect.

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Fig. 4. Topology in a two-factor system

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PWN Warszawa 1972