

THE STRUCTURE OF ECONOMIC REGIONS IN POLAND  
ANALYZED BY COMMODITY FLOWS

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1

Between the elements of spatial economic structure there are various types of linkage. Among these, of particular areal significance are those revealing the spatial links which occur between various phases of the production process, as well as between production and consumption. These are expressed above all in the exchange of all kinds of goods and services. That exchange is reflected most strikingly in commodity flows. These establish a basic measure of the links, i.e. inter-regional links, binding the fundamental elements of the structure of space economy; these elements are the economic regions. That the phenomenon of commodity flows is a measure of inter-regional connections is substantiated by the fact that such flows reveal the magnitude of goods exchange which, in turn, expresses a geographical division of labour seen in the specialization and complexity of individual economic regions.

So far economic geography has been concerned to only a limited degree with the problem of commodity flows. Yet from the results of spatial analysis of these phenomena, the possibility arises of investigating inter-regional connections as well as determining the characteristics of the structure of economic regions. N. N. Baranski has drawn attention to this possibility, writing: "In the transportation connections between countries and between regions of individual countries is summed up the whole pattern of complex geographical division of labour; maps of commodity flows reveal perfectly the regions of surpluses and deficits, as well as the links existing between them" [1].

The break-through in research on inter-regional connections (based on commodity flows) was achieved by E. Ullman who worked out for the U.S.A. the pattern of commodity flows between the states, and

presented the characteristics of certain states from an interpretation of flow phenomena [13]. However, it was only later through W. Isard that the theoretical conclusions resulting from such analyses were applied to the investigation of regional pattern [8, 9]. According to W. Isard, investigations of commodity flows establish the essential contents of inter-regional dependence which are not taken into account in the model of economic region of A. Lösch [10]. They also throw light on the existence of regions of different order in a hierarchical arrangement of regional structure.

Any attempt at presenting the structural pattern of Poland's economic regions in the light of commodity flows depends on the relevant statistical material for railway freight haulage in 1958. This gives statistics for movements arranged in 16 classified freight groups between the 17 voivodeships<sup>1</sup>.

It is possible to achieve a valuable analytical estimate of the pattern of commodity flows using railway freight statistics since in Poland the railways share the largest part of the total freight tonnage moved (84.7 per cent) and of all transportation movements (96.7 per cent). This justifies to a high degree the representative character of railway transport as an indicator of commodity flows. However, the value of commodity flows based on the statistics of railway freight haulage, from the point of view of their application to regional analysis, is limited with respect to the following:

1. The voivodeships as the consigning-receiving units provide too little spatial detail and permit an analysis of commodity flows only on a macro-regional scale. It thus limits analysis to regions of higher order only.

2. There is insufficient differentiation in the generic grouping of freight in 16 classified groups. From the economic point of view these do not have homogeneous character and make impossible any differentiation in the individual types of raw materials and finished products. This also applies for any introduction of economic accounting in terms of monetary value.

3. Other limitations result from the existence of crosshauls, extended hauls and back-hauls which do not represent true economic links.

<sup>1</sup> The statistics of the National Statistical Office for freight hauls by railway in Poland in 1958 are the sources for obtaining the pattern of commodity flows. These are given in the form of chequerboard tables of freight hauled between all voivodeships including the city-voivodeships according to the following freight groups: (1) bituminous coal (2) brown coal and coke, (3) ores and pyrites, (4) stones, (5) sands and gravels, (6) crude and refined petroleum, (7) metals and metal manufactures, (8) bricks, (9) cement, (10) artificial fertilizers, (11) chemical products, (12) grains, (13) potatoes, (14) sugar beets, (15) other crops and processed agricultural produce, (16) timber and timber manufactures.

Despite this, however, a comparison of railway freight flows on the inter-regional scale does show the existence of basic regional contrasts which, from the point of view of regional analysis, possess fundamental significance: they permit one to grasp the chief inequalities in the distribution of the output of raw materials and mass products, and they reflect the major elements of the geographical division of labour.

The definition of Poland's regional structure on the basis of the statistical material characterized above is limited to the existing voivodeship framework. There is no possibility of achieving a correction of this division and as a result, one can only approximate in reality.

Recognition of this limits the investigation of regional structure to the voivodeships as the basic elements, establishing therefore the administrative-economic units as the economic regions. It must be emphasized that the degree to which such an analysis is adequate is closely defined by the suitability of this initial system; only to that degree can one accept this analysis of regional economic structure of the country. Verification of the system, however, falls outside the scope of the present work, and has been considered by K. Secomski [12], K. Dziewoński [6, 7], St. Berezowski [2], B. Rychłowski [11], and A. Wróbel [15].

Analysing the structure of the system of economic regions in this form is an exercise in definition based on flows, types of commodities of the economic regions, as well as on the links occurring between them<sup>2</sup>. This establishes a substitute for research on regional structure for it permits one to recognise the whole feature of these structural elements as well as the existing relations between them. This emerges only from investigation of regional peculiarities, and results from the individual features which distinguish one region from other regions.

Referring the investigation of regional structure to that of the spatial regional structure as given, the analysis can proceed to the first important problem, that of the complexity of the system of economic regions regarding their character as elements of that system, and the links between them.

The definition of the scope of the differentiation and integration lie in its fundamental peculiarities, which, from the point of view of the aims of regional analysis, remain to be studied.

The aim of investigating regional differentiation is to define the character of the commodities of the regional elements by means of separating the types of these elements. It is necessary, however, to seek criteria which can define the type of economic region; of prime impor-

<sup>2</sup> Investigation of the system's structure depends on the working out of the kind of relationships arising between the system's elements. The complex of these relationships can be named according to the nature of the connecting elements.

tance here is its economic productive-market function, and secondarily the intensity and character of exchange within and between regions. This may be done according, above all, to the size and character of the contribution of its products to the national economy as defined by the nature of goods dispatched, the range of specialized commodities, as well as the regions commodity balance.

An investigation of the system's integration aims at defining the degree of linkage arising between elements of the system regarding the intensity and character of its binding connections and the type of regional elements.

## 2

The role of the economic region in the geographical division of labour within a country, as well as the character and type of economic region, are reflected in the share and contribution of that region to the national economy. Thus the differentiation in the productive-market character of the regional elements in the geographical division of labour of the country permits definition of the economic region's profile according to the character and intensity of its commodity exchange. One should take into account as basic criteria:

- (A) The character of commodities dispatched from the region.
- (B) The degree of goods specialization of the region.
- (C) The degree of commodity balance in the region.

(A) The character of goods dispatched from the region can be understood according to the structure of commodities dispatched in the individual groups of freight. The following grouping of goods has been made in order to separate the basic raw materials and products which determine the chief sources of mass commodities. The percentage division of railway freights is given below.

- |  |       |
|--|-------|
| 1. Raw materials for fuel and power, as well as ores and pyrites. These include bituminous coal, brown coal and coke, crude and refined petroleum, metal ores, and pyrites | 53.7  |
| 2. Raw materials for building purposes including building stone, sands and gravels   | 15.1  |
| 3. Industrial products among which metals and metal manufacture, bricks, cement, artificial fertilizers, and other chemical products may be mentioned                      | 15.6  |
| 4. Agricultural crops: grains, potatoes, sugar beet, other crops as well as processed produce  | 9.0   |
| 5. Timber and timber manufactures  | 6.6   |
|  | 100.0 |

Although this classification does not provide groups with homogeneous characteristics, it nevertheless permits division of the chief commodity groups according to their commodity destination.

The dispatch of goods from individual regions was established on the basis of the above classification. However, it must be observed that such a five-fold classification of commodities compared with the 16 classified groups of freight does not permit a division into groups homogeneous from the economic viewpoint. It is less detailed and precise and this limits its importance to the major sources of mass commodities.

The structural pattern of freight dispatched from individual regions is presented in the table below.

TABLE 1. THE STRUCTURE OF RAILWAY FREIGHTS DISPATCHED BY VOIVODESHIPS 1958\*

Voivodeships including city-voivodeships	Dispatches in percentages for respective voivodeships					Total
	E	B	I	A	T	
Warszawa	7.7	21.5	27.9	30.5	12.4	100
Bydgoszcz	1.6	23.0	21.7	37.2	16.5	100
Poznań	7.1	6.4	22.5	45.9	18.1	100
Łódź	5.3	23.3	20.0	36.2	15.2	100
Kielce	10.5	57.2	21.0	4.9	6.4	100
Lublin	4.2	10.5	27.4	40.2	17.7	100
Białystok	0.7	36.1	6.8	15.8	40.6	100
Olsztyn	0.3	24.5	10.8	24.6	39.8	100
Gdańsk	3.2	28.8	22.2	25.2	20.6	100
Koszalin	0.2	11.9	12.5	24.9	50.5	100
Szczecin	2.7	8.8	34.7	31.8	22.0	100
Zielona Góra	15.6	15.0	19.4	18.0	32.0	100
Wrocław	30.8	33.5	13.9	14.7	7.1	100
Opole	19.4	30.2	30.8	13.3	6.3	100
Katowice	82.2	5.1	11.3	0.4	1.0	100
Kraków	44.4	32.5	18.2	1.6	3.3	100
Rzeszów	21.1	28.0	15.3	13.8	21.8	100

\* The following symbols denote individual commodity groups:

E, e, e' — Raw materials for fuel and power, and ores

B, b, b' — Raw materials for building purposes

I, i, i' — Industrial products

A, a, a' — Agricultural produce

T, t, t' — Timber and timber products

To establish the structural characteristics of freight dispatched from individual regions it is necessary to combine the method of standard deviation with a simple method adopted by J. C. Weaver to define the character of crop region [14]. The adaption of standard deviation for showing type characteristics of freight dispatched by a region depends upon the discovery, for each region, of that combination of average commodity dispatches which gives least standard deviation  $\sum d^2/n$  (4).

Calculations of standard deviations have thus been made for all the combinations of averaged groups of dispatched freight. By defining the least deviation for individual combinations, the following characteristics of the commodities of individual regions can be given:

TABLE 2. THE CHARACTERISTICS OF COMMODITIES DISPATCHED BY VOIVODESHIPS 1958\*

Voivodeships including city-voivodeships	Characteristic commodities				
Warszawa	A	I	B	T	
Bydgoszcz	A	B	I	T	
Poznań	A	I	T		
Łódź	A	B	I	T	
Kielce	B	I	E		
Lublin	A	I	T		
Białystok	T	B	A		
Olsztyn	T	A	B		
Gdańsk	B	A	I	T	
Koszalin	T	A	I	B	
Szczecin	I	A	T		
Zielona Góra	T	I	A	E	B
Wrocław	B	E	A	I	
Opole	I	B	E	A	
Katowice	E				
Kraków	E	B	I		
Rzeszów	B	T	E	I	A

\* For explanation of symbols see table 1

The table establishes a basis defining commodity types of regions. It is a means for expressing the contribution of each economic region to the national economy.

Any attempt at defining the commodity type of regions must be based throughout upon the similarity of qualitative features which characterize the marketability of the region. The complex of features of commodities dispatched from the individual regions makes possible a division into groups of regions or single regions which are distinguished by the complex of their own features or by one feature. This group feature or features distinguishes the commodity type of region. In order to define these features it is essential to classify the regions so that regions possessing the same features throughout are put into the same group identified by a given complex of features.

The following groups of features create individual commodity types of regions:

- B,T,E,I,A — Rzeszów and Zielona Góra
- B,E,A,I — Wrocław and Opole
- A,B,I,T — Bydgoszcz, Łódź, Gdańsk, Warszawa and Koszalin
- A,I,T — Poznań, Lublin and Szczecin
- T,A,B — Olsztyn and Białystok
- E,B,I — Kraków and Kielce
- E — Katowice

B) The degree of commodity specialization of a region is an expression of the differentiation of regional structure. It thus has a similar basic significance for recognising the complexities of the regional system as do the characteristics of commodities dispatched. The process of differentiation in regional structure is manifest in regional commodity specialization. This in turn expresses the individuality of the regions. It is necessary to detect such individuality in order to understand the degree of complexity in the regional system under investigation.

A basic measure of a region's specialization will be the product of the region's share in a given commodity group as a percentage of the total of that group divided by the population of the region as a percentage of the country's population. This product is called the coefficient of commodity specialization of the region. If one denotes the population of region  $i$  as  $S_i$ , the country's population as  $\Sigma S_i$ , with  $a_i$  as the sum of the region's share in a given commodity group, and  $\Sigma a_i$  as the sum of total freight in that group, then:

$$\text{Coefficient of commodity specialization of the region} = \frac{a_i}{\Sigma a_i} / \frac{S_i}{\Sigma S_i}$$

The definition of commodity specialization according to this coefficient is given in the table below. This presents coefficients formed for the chief commodity groups for the voivodeships.

TABLE 3. THE COEFFICIENTS OF COMMODITY SPECIALIZATION BY VOIVODESHIPS 1958\*

Voivodeships including city-voivodeships	Coefficients of commodity specialization				
	e	b	i	a	t
Warszawa	0.02	0.18	0.24	0.48	0.24
Bydgoszcz	0.02	0.72	0.70	2.29	1.18
Poznań	0.04	0.14	0.52	1.87	0.93
Łódź	0.01	0.17	0.16	0.51	0.27
Kielce	0.09	1.77	0.66	0.26	0.46
Lublin	0.01	0.14	0.40	1.04	0.58
Białystok	0.00	0.60	0.10	0.47	1.57
Olsztyn	0.00	0.83	0.40	1.53	4.13
Gdańsk	0.02	0.78	0.60	1.24	1.26
Koszalin	0.04	0.39	0.43	1.47	3.73
Szczecin	0.04	0.36	1.44	2.28	2.00
Zielona Góra	0.23	0.69	0.92	1.46	3.34
Wrocław	0.72	2.53	1.09	2.04	1.23
Opole	0.67	3.38	3.54	2.70	1.61
Katowice	7.47	1.49	3.47	0.21	0.69
Kraków	0.94	2.24	1.30	0.22	0.52
Rzeszów	0.10	0.46	0.26	0.42	0.85

\* For explanation of symbols see table 1

The coefficients greater than 1 qualify given groups for inclusion as groups specialized in the region eg. groups (e), (b) and (i) in Katowice voivodeship.

The sphere of commodity specialization formed on the basis of this coefficient is presented as follows:

TABLE 4. THE SPHERE OF COMMODITY SPECIALIZATION BY REGIONS, 1958\*

Voivodeships including city-voivodeships	Commodity specialization by groups				
Warszawa		—			
Bydgoszcz	a	t			
Poznań	a				
Łódź		—			
Kielce	b				
Lublin	a				
Białystok	t				
Olsztyn	t	a			
Gdańsk	t	a			
Koszalin	t	a			
Szczecin	a	t	i		
Zielona Góra	t	a			
Wrocław	b	a	t	i	
Opole	i	b	a	t	
Katowice	e	i	b		
Kraków	b	i			
Rzeszów		—			

\* For explanation of symbols see table 1

This examination of the sphere of commodity specialization permits a division of the regions into four groups:

1) The first type includes those voivodeships specialized in one group. These are: Poznań and Lublin in agricultural produce (a). Białystok in timber and timber products (t). Kielce in building materials (b).

2) The second group is characterized by specialization in two commodity groups: Bydgoszcz, Olsztyn, Gdańsk, Koszalin and Zielona Góra (t and a). Kraków in building materials (b) and industrial products (i).

3) The third type specializes in three commodity groups. These are: Katowice in e, i, b, and Szczecin in a, t, and i.

4) The fourth type is distinguished by specialization in four commodity groups: Wrocław and Opole in groups b, a, t, i.

It will be noticed that three voivodeships — Warszawa, Łódź, and Rzeszów do not specialize in any of the basic commodity groups.

(C) The degree of balance in a region's commodities permits definition of the complexities of regional structure, since it takes into account differentiation in the character of regional economy regarding the balance between intra-regional and inter-regional flows [3]. The criterion of flow balance for individual regions is contained in the distinction between regions with a closed economy and those with an open econo-

my. This principle of distinction was introduced by K. Dziewoński. It is based on the contention that a region with a closed economy is separated from other regions to the degree that its economy is balanced. It is this balance which establishes a region's character. According to K. Dziewoński, however, this balance need not be complete; a region is not self-sufficient in a given sphere. Additional inter-regional flows exist within the sphere of balanced phenomena, for the quantities being balanced in a particular region are determined also by fulfilling their true role in the regional economy. On the other hand, balance is not such an important feature in region with an open economy [5].

If one accepts, as a measure of the commodity balance of the economic region, the index of the regional balance of commodity flows, one must accept it as a measure of the balancing of these commodity flows within individual regions. By this measure the relationship is the sum of the intra-regional flows of individual commodities to the sum of the inter-regional flows of the same goods. If  $I_i$  is the index of regional balance and  $x_{ii}$  is the sum of freight in a given commodity group dispatched in region  $i$  to region  $i$ , then:

$$I_i = \frac{x_{ii}}{a_i - x_{ii}}$$

This index can be treated as a means for singling out the highly balanced regional units, ie. the closed regions, from the open regions. The size of the indices of regional balance so formed are presented in the table 5.

TABLE 5. INDICES OF THE REGIONAL BALANCE OF COMMODITY FLOWS BY VOIVODESHIPS, 1958\*

Voivodeships including city-voivodeships	Indices of regional balance in relation to dispatches				
	e'	b'	i'	a'	t'
Warszawa	0.07	2.30	0.47	0.65	1.05
Bydgoszcz	0.28	3.84	0.51	2.16	1.10
Poznań	0.35	1.90	0.70	1.75	1.29
Łódź	0.65	5.00	0.43	1.18	0.89
Kielce	0.18	0.26	0.25	0.57	1.19
Lublin	0.27	6.39	0.20	0.59	1.30
Białystok	2.30	0.42	0.63	0.16	0.34
Olsztyn	0.28	0.25	0.66	0.72	0.38
Gdańsk	1.39	4.96	0.74	1.86	1.19
Koszalin	1.67	0.48	0.76	0.64	0.17
Szczecin	0.39	2.70	0.15	1.91	0.31
Zielona Góra	0.49	0.32	0.16	1.34	0.15
Wrocław	0.64	0.24	0.35	3.23	1.19
Opole	1.65	0.25	0.14	1.45	0.75
Katowice	0.33	4.34	1.10	1.41	2.51
Kraków	0.45	0.92	0.25	1.21	3.40
Rzeszów	0.41	1.53	0.41	1.19	0.62

\* For explanation of symbols see table 1

The size of this index is important for dividing the highly balanced regional units (the closed region) from the poorly balanced (open) regions. The closed region will be one in which intra-regional flows are greater than the inter-regional flows, giving an index greater than 1, and separating these from the open regions with an index of less than one. Since the principle of balance relates to only the important freight groups (which have real significance for the respective region), the examination of regional balance will take into account only those commodity groups which are characteristic for the region and which thus define its commodity type; for example, groups a, i, b and t for Warszawa.

TABLE 6. THE INCIDENCE OF INDICES OF REGIONAL BALANCE GREATER THAN 1 FOR DEFINED COMMODITY GROUPS, THE COMMODITY TYPES OF REGIONS

Voivodships including city-voivodships	Indices of regional balance characteristic for the respective region		
Warszawa	b' (2.30)	t' (1.05)	d' (1.10)
Bydgoszcz	b' (3.84)	a' (2.16)	
Poznań	a' (1.75)	t' (1.29)	
Łódź	b' (5.00)	a' (1.18)	
Kielce			
Lublin	t' (1.30)		
Białystok			
Olsztyn			
Gdańsk	b' (4.96)	a' (1.86)	d' (1.19)
Koszalin			
Szczecin	a' (1.91)		
Zielona Góra	a' (1.34)		
Wrocław	a' (3.23)		
Opole	e' (1.65)	a' (1.45)	
Katowice			
Kraków			
Rzeszów	b' (1.53)	a' (1.19)	

In parentheses the size of the index of balance for respective goods.

These indices confirm that the following regions can be defined as closed types of region: Warszawa, Bydgoszcz, Poznań, Łódź, Lublin, Gdańsk, Szczecin, Zielona Góra, Wrocław, Opole, and Rzeszów. The regions with open-type economies are thus the voivodships of Kielce, Białystok, Olsztyn, Koszalin, Katowice, and Kraków.

3

The foregoing analysis emphasizes the existence of considerable differentiation between the character of these regional elements regarding their commodity type, their specialization and degree of regional balance.

A definition of the character of the system's regional elements has fundamental importance for recognising regional structure. However, the study of relationships is expressed in terms of the spatio-economic linkages between these elements. Such investigations permit the definition of the degree of linkage in the system, and thus also of the degree and character of its integration. The nature and strength of the links resulting from commodity flows binding the regional elements express directly the economic links in the system under examination; these spatial links throw light on the pattern of the spatial structure of the regional system. The consolidation of this structure is of prime importance for studying the spatial structure of the national economy, for it opens the way for analysis also of the spatial aspect of economic activities.

Examination of economic links is of prime importance in analysing regional structure, since these reflect the objective existence of complex economic activities. They arise from the reciprocal dependence of regional elements which itself results in commodity flows between them.

The pattern of intensity of inter-regional freight flows is set out in table 10. This serves for estimating the degree of integration between the regional elements. The measure of inter-regional flows between two regions is conceived as the sum of freight dispatches and receipts between them. Thus the measure of the intensity of flows between region *i* and region *j* is equal to the sum of inflows and outflows from region *i* to region *j*. Such a measure is reversible. The following classification of flow intensities can be introduced based on the sizes of measure used in the analysis:

TABLE 7. CLASSIFICATION OF THE SIZE OF FLOW INTENSITY

Group number	The size of flow intensity (in tons)	The definition of the intensity of flows of the group
I	over 600,000	high
II	300-600,000	average
III	150-300,000	low
IV	under 150,000	very low

Such a measure of the magnitude of connections shows that, the greater the intensity of flow between a given regions, the stronger is their linkage. The pattern of flow intensity thus defines the scope and degree of linkage between the regional elements of the system in terms of the size of those connections.

Linkage in the regional system, however depends not only on the strength of these links but also on their character and on the type of dependence. The basic formula defining these in terms of flow intensity is the coefficient of dependence. The coefficient of dependence between region  $i$  and region  $j$  is the relation between the volume of flows from region  $i$  to region  $j$  and from region  $j$  to region  $i$ . If  $W$ , is the coefficient of dependence, this can be expressed in the formula:

$$W_{ij} = \frac{X_{ij}}{X_{ji}}$$

The size of this coefficient determines the type of dependence.

In this example, when  $W_{ij}$  is greater than unity, region  $j$  is more dependent upon region  $i$  than *vice-versa*; when  $W_{ij}$  is less than unity than region  $i$  is more dependent on region  $j$ . When  $W_{ij}$  is near or at unity then mutual dependence of the two regions is indicated, and this can be considered as occurring within the range  $W_{ij} = 0.90$  and to  $W_{ij} = 1.10$ . The type of dependence of regions  $i$  and  $j$  can thus be classified as follows:

TABLE 8. CLASSIFICATION OF THE TYPE OF DEPENDENCE

Coefficient of dependence	Type of dependence
0 to 0.90	passive (P)
0.90 to 1.10	mutual (M)
over 1.10	active (A)

Definition of the quantitative nature of the links rests on the same principle as the definition of the type of dependence, and also on the size of the coefficient of dependence. It follows that the relation between the volume of outflows to inflows from one region to another is the means for calculating the quantitative aspect of links between the two regions. Such a relationship is called a unilateral connection when either inflows or outflows dominate between two regions; but when the relationship is one of quantitative equilibrium between inflows and outflows from one region to another it is called bilateral linkage. The quantitative character of links may be classified as follows:

TABLE 9. THE CHARACTER OF LINKS CLASSIFIED QUANTITATIVELY

Coefficient of dependence	Character of connection
0 to 0.50	unilateral (u)
0.50 to 2.00	bilateral (b)
over 2.00	unilateral (u)

Table 10 contains a description of the system of inter-voivodeship links in terms of their character, the types of dependence, and above all, the types of economic region. The degree of integration which results from inter-regional connections is expressed in the characteristics and types of their dependence and defines the relationships between the regional elements. These relations are of a diverse nature. Two relationships, however — equivalents and subordinates — must be mentioned as being important in the degree of integration of the regional system. These however, do not exhaust all the possible combinations which characterize the various connections and dependence between types of economic region.

Relationships of equivalent character signify bilateral connections of a mutual kind between regional units of the same economic type. The mutual nature of these relations gives a uniformity.

Relationships of subordinate character denote unilateral connections and passive or active dependence. They occur between units of the same kind as well as between those of a different type. Such relations express the subordination of one regional element to others, leading to the development of a nodal organization.

4

The pattern of connections presented in table 10 establishes a synthetic description of the complexities of the country's regional structure in terms of voivodeships from the point of view of regional analysis. That complexity is expressed in the differentiation of fundamental types of regional elements as well as in various forces integrating the inter-regional links.

An examination of this synthetic description emphasizes the preponderance of relationships of subordinate character compared with those of equivalent character. This preponderance, expressed in unilateral and active or passive dependence and in highly intensive interregional flows, serves to confirm that the dominating feature of the country's regional structure is its focal character.

The focal character of individual elements is determined by an analysis of the intensity and type of dependence of unilateral links. Such an analysis opens the way for defining the regions with the greatest intensity of commodity flows, linking them with other regions. The pattern of interregional flow intensity indicates that such a region is Katowice.

The connections with Katowice occupy first place in the inter-regional flows of all other regions, endowing Katowice with a focal chara-

TABLE 10. THE DEGREE OF INTENSITY OF INTER-REGIONAL FLOWS, THE CHARACTER OF THEIR LINKS, DEPENDENCE, AND THE TYPE OF ECONOMIC REGION

Voivodeships including city-voivodeships	Warszawa	Bydgoszcz	Poznań	Łódź	Kielce	Lublin	Białystok	Olsztyn	Gdańsk	Koszalin	Szczecin	Zielona Góra	Wrocław	Opole	Katowice	Kraków	Rzeszów
Warszawa	c	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb
Bydgoszcz	IIAb	c	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb
Poznań	IIAb	IIAb	c	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb
Łódź	IIAb	IIAb	IIAb	c	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb
Kielce	IIAb	IIAb	IIAb	IIAb	c	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb
Lublin	IIAb	IIAb	IIAb	IIAb	IIAb	c	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb
Białystok	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	c	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb
Olsztyn	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	c	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb
Gdańsk	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	c	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb
Koszalin	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	c	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb
Szczecin	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	c	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb
Zielona Góra	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	c	IIAb	IIAb	IIAb	IIAb	IIAb
Wrocław	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	c	IIAb	IIAb	IIAb	IIAb
Opole	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	c	IIAb	IIAb	IIAb
Katowice	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	c	IIAb	IIAb
Kraków	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	c	IIAb
Rzeszów	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	IIAb	c

The symbols given in this table are explained in the tables: (1) The degree of intensity of commodity flows in table 7, (2) The type of dependence in table 8, (3) The character of the connections in table 9, (4) The type of economic region is defined as open (o) or closed (c).

ter on the national scale. This defines the role of Katowice (the Upper Silesian Industrial District) as that area upon which are focussed the productive-industrial activities of the country, the basic sections of heavy industry: coal-mining, metallurgy, engineering, and chemicals. The high degree of its specialization links it with a wide area, and, as a result, gives a unity which is the functional basis of its ability for full complex economic development; thus simultaneously it also establishes its own inner coherence. The high intensity of the commodity flows of Katowice, the uniformity of its links, the active type of dependence and its character as an open economic region reflect the predominant role played by the raw materials and industry of this region in the structure of the national economy. As a result of its nodal organization, therefore, Katowice can be considered as the focal economic region in the national system.

Having accepted the highest intensity of inter-regional flows and the unilateral character of links as defining nodal elements of the first order one can proceed to stipulate similar elements of a lower order. Two such regional elements exist — Wrocław and Kraków voivodeships. After Katowice they dominate the connections with other regions.

Wrocław establishes a closed region of wide market specialization and a wide range of dispatched commodities. It is preponderantly active in the character of its dependence and has unilateral connections. On the other hand Kraków is an open region showing less specialization and a narrower range of commodities dispatched, though with a greater intensity of flow (than Wrocław). Likewise, however, it has active unilateral connections.

This division of Poland into parts, one linked with Wrocław, the other with Kraków as nodal regions, indicates that those are definite spatial units of higher order (above voivodeships level). Yet in those units spatial integration is weak.

Upon the basis of flow intensity binding individual regions with Wrocław and Kraków one can make the following division. The most intense flows of the Wrocław region are with Opole, Poznań, Zielona Góra, Łódź, Bydgoszcz, Szczecin and Koszalin; those of Kraków with Rzeszów, Kielce, Lublin, Warszawa, Gdańsk, Białystok and Olsztyn.

Yet further differentiation of these units is possible using criteria which approximate more closely to their functions. If one recognizes as such a criterion the integration of the units according to the nature of their connections and dependence, then the following division into regional complexes may be made; active, unilateral links bind Wrocław with Poznań and Łódź (IAu), Szczecin and Bydgoszcz (IIAu), as well as with Koszalin (IIIAu); unilateral connections of passive character link



Wrocław with Zielona Góra (IPu), while an active bilateral connection exists between Wrocław and Opole (IAb). This arrangement introduces a certain hierarchy since more intensive flows occur between Koszalin and Poznań than between Koszalin and Wrocław. The relationships between Koszalin and Poznań can be classified as a secondary complex therefore. This secondary complex, moreover, shows a different structural character resulting from its economic type. Differentiation of the region of higher order (Wrocław) according to the simple economic model shows that it has uniform closed character with the exception of Koszalin which is of open type.

The inter-regional flows of Kraków bring this region into the category of a developing unit of higher order. The character of its connections and dependence are presented as follows: unilateral active connections link Kraków with Rzeszów, Warszawa, and Lublin (IAu) and with Gdańsk (IIAu); bilateral connections with mutual dependence exist between Kraków and Kielce (IMb), and of active type with Białystok and Olsztyn (IIIAb). Simultaneously, however, an analysis of flows shows more intense flows from Olsztyn and Białystok to Warszawa than to Kraków. This provides a subdivision of the regional unit of higher order of which the nodal area is Warszawa with Białystok and Olsztyn as regional elements. The connections linking Warszawa with these two regions are unilateral (IPu) and passive. According to the simple economic model this system can be divided into the closed type of economic region including Rzeszów, Lublin, and Warszawa, and the open type represented by Kielce, Białystok and Olsztyn.

Despite the preponderance of subordinate relationships in the system's structure, the role played by relationships of equivalent character does come to the forefront. These relations permit one to find certain elements for division into structures of uniform regional organization. The existence of these should be interpreted as a shift from the subordinate to the equivalent relationships as well as from nodal organization to the uniform. If one accepts the assumption that bilateral links where both sides are mutually dependent in the exchange of goods are dependent on, and tie, the regional elements more strongly than unilateral links with active or passive characteristics, then one should accept the role of uniform complexes as being parallel to those of nodal organization in the regional structure.

Bilateral connections of mutual type occur only between those types of economic region which feature equivalent relationships. These occur between the following regional units: Warszawa and Lublin (IIMb); Bydgoszcz, Gdańsk, and Poznań (IIMb); Kielce and Kraków (IMb); and between Zielona Góra and Szczecin (IVMb). It should be pointed out

that only one complex (Bydgoszcz-Gdańsk-Poznań) cuts across the regional units of higher order and nodal organization. This group, which has intense links and relationships, cuts across the existing nodal organization since it includes units of both the nodal regions of Wrocław (Bydgoszcz and Poznań) and Kraków (Gdańsk). This introduces a uniform element, emphasizing a different hierarchy of the regions of higher order as bases for the internal spatial division of the country.

In the analysis of the complexity of the regional system for purpose of organization into a hierarchy one must emphasize that the linkage of regional structure on a scale lower than the national scale is too weak to be a basis for a division into economic regions of higher order and consequently compels one to treat the regional system as the basic economic region. The attempt at differentiating the system into units of higher order demonstrates that two such units (Wrocław and Kraków) become apparent, yet these regions cannot be treated as basic regions, not even regions of higher order. This is because of the small differences occurring in the character of their connections, the type of dependence, as well as the intensity of flows. Differentiating the character of regional organization in this system shows that the uniform elements are close to the nodal organization which should be considered as parallel. As a result of the connections between the regional elements resulting from economic function of the regions give a varied organization, and one which is insufficiently integrated to establish the clearly diverse regions of higher order as bases for the internal spatial division of the country.

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The foregoing attempt at defining the complexities of regional structure based on the criterion of commodity flows can have only an introductory character. Further research on the same methodological lines as the present work must not only be based on more exhaustive and conclusive methods of regional analysis in more homogeneous units, but should dispose of detailed statistical material (in terms of reality and space) giving also the monetary values of flows.

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