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An Approach to the Analysis of Functional Urban Regions: A Case Study of Poland

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AN APPROACH TO THE ANALYSIS OF FUNCTIONAL
URBAN REGIONS: A CASE STUDY OF POLAND

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Preface

One of the principal objectives of the Human Settlement Systems Research Task is to delineate functional urban regions within the industrially-advanced nations. These regions, which exhaust the respective national territories, usually each contain an urban core and its functionally-related hinterland area. The organization of small-area data in terms of these areas provides the basis for comparative analyses of demographic and economic structure and development. These studies are intended to enhance our knowledge concerning the nature and significations of geographic differences in the structure and evolution of human settlement systems, and thus to aid policy makers concerned with these phenomena.

This paper explores some of the conceptual dimensions of the notion of functional urban regions and presents a relevant delineation for Poland. Summary population, employment, and housing stock data are presented and evaluated.

Summary

The notion of functional urban regions can be derived from at least six earlier concepts of urban regions, which include the following:

(1) "the nodal region" in regional analysis and regionalization theory;
(2) "city-hinterland" in central place theory;
(3) "city-region" in the theory of urban economic base;
(4) "metropolitan region" in the theory of metropolitan dominance'
(5) "regional settlement system" in the national settlement systems concept, and
(6) "urban field", or "daily urban system" in spatial interaction theory.

These concepts overlap considerably. However, they may be ranked according to the spatial scale to which they pertain and also according to the temporal sequence of the phenomena and interrelations described. A specific characteristic of the functional urban regions notion is its heavy emphasis on the intensive daily movements of people, which, it is usually claimed, gives evidence of the existence of advanced functional specialization and related flows of goods and information over space.

When confronted with a broader concept of national settlement systems, functional urban regions can be treated as one of a few basic dimensions within such systems. This is implied in the integration of two major interpretations of settlement systems development, (namely, the "intra-regional" and "inter-metropolitan" approaches) and provides a conceptual rationale for monographic studies of sets of functional urban regions, such as the present study. Studies of the anatomy of urban regions are also intended to facilitate the restructuring of existing models of spatial interaction.

A delineation of functional urban regions in Poland was based on the commuting-to-work survey conducted in 1968. The results of the survey were adjusted to fit more highly aggregated basic spatial units. To delineate a set of regions covering the whole national territory, it was necessary to use supplementary criteria, based mainly on central place considerations and the provisions of long-term plants of physical development. The resulting pattern of 45 urban regions is quite close to the new administrative division into 49 voivodships. Differences between the two patterns can be found mainly in the vicinities of the largest cities, whose administrative regions fail to cover the respective commuting sheds.

It was found that functional urban regions differ in terms of
(a) degree of "maturity", and (b) degree of internal closure.
These variations are reflected in core-periphery proportions
with respect to the distribution of population, workplaces,
and housing stock. The data presented indicate the existence
of a negative correlation between population size of the core
and its share in the total regional population, and the mag-
nitude of change in these proportions over the 1950-1973 period.
The change of housing-stock distribution patterns is similar.
With respect to the distribution of industrial jobs, the trends
towards spatial concentration have been basically absent in
the 1970s. It is postulated that interrelations between the
internal change of urban regions as places of residence on one
hand, and as labor markets on the other, should be studied in
considerable detail.

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1. THE NOTION OF FUNCTIONAL URBAN REGIONS

"The urban region" and other related terms have been in
use for quite a long time and have been defined in a number of
ways. One can identify at least six versions of this notion,
each of which refers to a different concept of settlement net-
work and regional structure. These variants are the following:

(1) "The nodal region" in regional analysis and regional-
ization theory (see A. Wróbel, 1965). According to D. Whittlesey
(1954), specific characteristics of such regions include:
(a) uniform internal organization, (b) existence of a focus,
usually represented by a town, or city, (c) existence of an
internal circulation system, i.e. flows of people, goods and
information, (d) "readable" morphology - division into the core
which contains the focus, and a marginal zone.

(2) "City hinterland" or "the tributary area" in central
place theory. It is also sometimes referred to as "the func-
tional region" (M. Ray, 1968) and defined as an area within
which the flows of people and goods interconnect the given set
of urban and rural communities into a functional whole. The
regional boundary, according to this concept, corresponds to
zero demand for goods and services available in the center,
and is determined by the structure of transportation costs and
the distribution of alternative (competitive) centers. The
less steep the gradient of transportation costs with distance
from the center, the less the spatial concentration of economic
activity within the region and the larger is the tributary, or
service area of a particular urban center.

(3) "City-region" in the theory of urban economic base and
functional structure of cities (K. Dziewoński, 1967). This
notion refers to an analogy between the city and the economic
region, defined as a sub-space in the general socioeconomic time-
space. To delineate an economic region within the time-space

in question, it is necessary to determine its identity in re-
lation to other (peripheral) areas, as well as to reveal its
connections with those areas. The procedure followed in urban
economic base studies is largely similar to the one described
above; the identification of city-exogenous functions allows
one to determine relations between the city and the socio-
economic space (rest of economy), while the endogenous func-
tions and their range can be interpreted as delimitation of
the city (i.e. a sub-space) within the general space. The
relative "openness" and "closure" of the urban economy is
treated as a function of the spatial mobility of the popula-
tion. Increasing mobility leads to the identification of the
city with what was originally its service area. As a conse-
quence of this, the lower-order centers located within such
an area become transformed into elements of the internal
structure of the city-region.

(4) "Metropolitan region" in the theory of metropolitan
dominance (O.D. Duncan et al., 1960). According to their con-
cept the emergence of a metropolis is considered as an effect
of advanced economic specialization and territorial division
of labor. This development leads towards a transformation of
the settlement structure described by central place theory,
i.e. concentration of productive, commercial, as well as mana-
gerial functions of a large region within a single metropolitan
area. Concentration proceeds at the expense of smaller urban
places situated in the zone of metropolitan dominance (metro-
politan shadow). These towns gradually lose their former func-
tions, or specialize in a few functions, thus becoming sub-
dominant centers. The stage of metropolitan economy is asso-
ciated, in the concept under discussion, with technological
improvement in transportation and the replacement of local
linkages in production and commercial activity by regional
linkages.

(5) "Regional settlement system" in the national settle-
ment systems concept, in both its positive (K. Dziewoński, 1971),
and normative (B. Khorev, 1971) versions. The former claims
that at an advanced stage of a system's integration, its major
structural dimension is represented by interrelations among

urban agglomerations, while relations of each agglomeration
with its surrounding region pertain mostly to consumption,
public services and administration, rather than to specialized
manufacturing functions. In the concept of unified settlement
systems (B. Khorev, 1971), which in fact refers to a higher
level of spatial aggregation, local systems correspond to
regional settlement systems, while the latter are identified
with territorial-production complexes.

(6) "Urban field", or "daily urban system" in spatial
interaction theory (J. Friedmann and J. Miller, 1965; B.J.L.
Berry, 1973). The spatial extent of such units (containing
a core and periphery) is determined by the range of daily
contacts (basically trips) of the local population. Following
this definition settlement systems are built of mutually over-
laying networks of places performing residential, employment,
service, educational, social and recreational functions, inter-
connected by a pattern of everyday flows. Along with the de-
clining transportation costs, the boundaries of urban fields,
or daily urban systems, are pushed away from their centers and
the peripheral zones are gaining functions which were originally
concentrated in the core. This process may ultimately lead to a
reversal of the traditional core-periphery proportions. Limits
to spatial expansion of urban fields are usually identified
with economic factors and restrictions on individual time-
budgets, rather than with technological barriers to movement.

It follows from the above discussion that the six versions
of the notion of urban region are not mutually exclusive, and
that at least some of them do overlap considerably. Still,
they should be treated separately, as each has been generated
within a different conceptual framework. One can rank these
notions following the spatial scale to which they pertain, as
well as according to the temporal sequence of the phenomena
and interrelations described. The former approach was already
taken by R. Dickinson (1964), who pointed to four distinct
aspects of regional ties of the city, namely to the respective
spheres of: (a) urban land use, (b) urban settlement (i.e.
daily commuting), (c) social and cultural relations, and (d)
economic relations. This division shows the multi-dimensional

character of the urban region notions listed earlier. Thus
the content of the notions of nodal regions, metropolitan re-
gions, regional settlement systems and urban fields (daily ur-
ban systems) refers to both the economic and socio-cultural
linkages, as well as to daily person-trips. Only in the case
of city hinterlands as postulated in the central place theory
(and perhaps also city regions following urban economic base
assumptions) can city-region relations be interpreted as uni-
dimensional. Nevertheless, at a higher disaggregation level
they become split again into a multitude of levels, referring
to individual goods shipped or activities performed.

How then, in view of this brief background discussion,
should one approach the question of the definition of the
functional urban regions to be used in the remaining sections
of this paper? An unequivocal delineation of such regions
should be based on a single diagnostic feature, representing
an important aspect of city-region relations. According to a
paradigm prevailing in urban and regional studies today, such
a characteristic is identified with the existence, within a
given territory, of intensive daily movements of people, in
particular of trips to work and school as well as to service
centers. Intensive trip patterns, however, give evidence of
the existence, within the same area, of other linkages as well,
and in particular of an advanced functional specialization and
related flows of goods and information over space. In addition,
spatial variations in population characteristics, such as the
occupational structure, demographic structure, and the educa-
tional level, are all highly correlated with the spatial pat-
tern of travel to work. Hence, the functional urban regions
defined according to the range of commuting to, and between,
urban centers can also be treated as multi-dimensional socio-
economic regions (see E. Alayev and B. Khorev, 1976; N. Hansen,
1976).

2. URBAN REGIONS WITHIN SETTLEMENT SYSTEMS

There are three basic interpretations of the formation
and development of national settlement systems. Again, each
of these interpretations can be traced back to a separate con-
cept of settlement structure, or to a set of such concepts.

The first approach is the one implied in the analysis of
urban rank-size patterns. It has been generally found that
the regularity in city rank-size distributions for individual
countries tends to increase over time and that it is positively
correlated with the intensity and stability of human occupancy
and economic activity patterns. Taking this as a premise, the
rank-size regularity has been postulated to represent a measure
of the integration of national settlement systems (see the dis-
cussion in B.J.L. Berry and F.E. Horton, 1970, Chapter 3; see
also K. Dziewoński, 1975), and the development of such systems
has been depicted by the evolution of rank-size curves. This
concept, unlike the remaining two, has no explicit spatial
dimension.

The second interpretation of the formation and develop-
ment of settlement systems on a national scale is closely re-
lated to the notion of urban regions, and to the concepts which
stand behind it. The starting point in this approach is a
hierarchical pattern of central places which evolves as a re-
sult of exogenous economic and technological factors (such as
industrialization and declining transportation costs). The
spatial change involves, inter alia, the growing territorial
division of labor and functional specialization (including a
dissociation of places of residence from those of work and
recreation), as well as trends towards concentration and,
subsequently, deconcentration of population and economic ac-
tivity. These phenomena bring about a diminution of earlier
differences between urban and rural areas in terms of conditions
and patterns of life, a trend which is emphasized in particular
in centrally-planned economies. If one assumes that a
concentration-deconcentration syndrome operates on a regional
scale in the form of a cycle, then the former trend may bring
about a pattern of metropolitan regions (as described in the

metropolitan dominance theory) while the latter may in a long run result in a pattern of urban fields. Thus, according to this interpretation, the development of national settlement systems is to be seen as an evolution of linkages between cities and regions, and in terms of the emergence of functional urban regions.

The third interpretation starts basically from the same point as the first, i.e. from a hierarchical central place model, but the change of this pattern over time is attributed not so much to intraregional linkages as to growing specialization and functional interdependence on an interregional, or even national scale. The evolution of a settlement system is therefore depicted in terms of a growing range and spatial scale of interactions. At an advanced stage of a system's development, it is claimed, interrelations among large cities (metropolitan areas, urban agglomerations) on a national scale become more important and intensive than relations between an individual city and its region. Such assumptions prevail for example in the "large-city focussed model of city system development" developed by A. Pred (1973). This approach to the structure of settlement systems, therefore, is based on the analysis of spatially discontinuous linkages, in the case of which the friction of distance, usually represented by a distance-decay function, is of lesser importance.

A review of the theoretical assumptions and empirical evidence in support of either of the two latter interpretations of settlement system evolution reveals that they are complementary rather than contradictory (P. Korcelli, 1976). Each deals with a different set of functions, which are characterized by a specific spatial scale of interaction. It is plausible to assume that this is true of every single function under given conditions, but if individual functions are plotted against a measure of distance (i.e. the spatial range of interactions which are generated), the resulting frequency distribution curve would reveal that most of the functions fall into a few distance intervals. These intervals and the relevant sets of functions (interactions) represent major dimensions in the organization of human settlement systems. Two such intervals,

which seem to account for a disproportionately large share of
interactions, relate to the spatial scale of functional urban
regions on the one hand, and to the distance range separating
major metropolitan areas (urban agglomerations) on the other.

There are other intensive interactions within settlement
systems which are not accounted for by either of the two di-
mensions identified. They include, for example, the linkages
between specialized manufacturing centers or interactions gen-
erated by one or a few highly-specialized centers on the na-
tional level. Nevertheless, it follows from the existing
typologies of national settlement systems (see L. Bourne,
1975; K. Dziewoński, 1975; E. Alayev and B. Khorev, 1976) that
the two dimensions listed above tend to dominate the overall
pattern, irrespective of the size of a country and the intensity
of its human occupancy. Despite the seeming plausibility of
this generalization, it should be subjected to tests. Empirical
analysis can follow either of two approaches. First, investi-
gations can be made of the spatial range of individual inter-
actions (linkages) within settlement systems on a national
scale, and of their shifts over time. Such temporal trends,
if identified, might support hypotheses according to which
certain dimensions are replaced by others in the course of
settlement system development (for example, interactions which
were on an intra-urban scale in the past may now be typical of
the scale of urban regions). Second, monographic studies can
be made of individual spatial dimensions within human settle-
ment systems. This approach is represented by the analysis of
the internal structure of, and interrelations between, functional
urban regions. More specific objectives and initial hypotheses
should include the following:

(1) The identification of interactions (linkages) which
are typical of the scale of a functional urban region, as well
as of interrelations (both causal and statistical) between those
linkages.

(2) The determination of the degree to which the pattern
of functional urban regions is reflected in the spatial struc-
ture of population, economic activity, and infrastructure, and

finding out whether this pattern is becoming more pronounced or "readable," over time.

(3) A typology of functional urban regions from the point of view of their internal structure and proportions between concentration and deconcentration forces which shape the spatial patterns of population and economic activity. This involves a delineation of hierarchical components in the structure of functional urban regions.

(4) An interpretation of intra-regional changes in population using the structure of labor and housing markets as explanatory variables.

(5) An interpretation of the structure of functional urban regions and their evolving role within human settlement systems on a national scale in terms of social and economic development.

(6) An unfolding of interdependence between the range of individual interactions (linkages) and the internal structure of urban regions.

This list of questions and objectives is by no means exhaustive (see, for example, research priorities in this area set forth by J.G. Lambooy, 1969; and by B. Greer-Wootten, 1972). These questions simply seem to have particular significance from the point of view of human settlement systems concepts which were alluded to earlier. On the other hand, they also seem to be important from a planning and policy perspective, since the conceptual foundations for predicting impacts of sectoral resource allocation decisions upon the structure of settlement systems are rather limited in scope. A more comprehensive cognition of the anatomy of functional urban regions should also make it possible to re-structure the existing models of spatial interaction (see A.G. Wilson, 1974), which in both their analytical and planning versions are based on a rather oversimplified view of interrelations between the spatial patterns of residences, work-places and services within a city (and within an urban region), as well as of the friction of space mechanisms operating between those individual patterns.

3. A DELINEATION OF FUNCTIONAL URBAN REGIONS

As noted earlier, the main criterion followed in definitions of functional urban regions is the commuting range, either actual (B.J.L. Berry, 1973) or hypothetical (potential), based on the pattern of spatial accessibility (H. Lüdemann and J. Heinzmann, 1976). However, such a simple regionalization procedure cannot be strictly adhered to because (a) commuting sheds of individual urban centers tend to overlap, (b) some areas are not covered by the commuting sheds, (c) commuting sheds are frequently non-continuous in space, and, (d) the commuting pattern is not fully hierarchical. Thus, delineations of functional urban regions usually require a generalization of the commuting-to-work pattern (for example, elimination of those centers attracting some commuters, but which fall below an arbitrarily established population size threshold), as well as the use of secondary regionalization criteria. These criteria should refer to other major types of regionally-oriented spatial interaction, such as service linkages and interrelations based on the structure of local administration, whose spatial range, under planned-economy conditions at least, tend to be highly intercorrelated. The introduction of supplementary criteria makes it possible to delimit a set of functional urban regions that exhaust the whole national territory, even when a part of this territory is situated beyond the commuting sheds of large and medium-size urban centers. Since urban regions are treated as one of a few major spatial functional dimensions of national settlement systems, it is possible to assume that these peripheral areas would eventually become pulled into the orbit of major urban centers which generate the streams of daily human interactions.

These general delineation principles imply a definition of a set of functional urban regions which vary substantially with respect to the degree of their "maturity." On one extreme of the scale there are full-fledged urban agglomerations (metropolitan areas), while on the other one finds "potential" urban regions which are at present characterized by a traditional polycentric and hierarchical settlement network structure.

In Poland a commuting survey was carried out in 1968 by the Central Statistical Office (Głowny Urząd Statystyczny, 1973), covering all cities with a population of 50,000 and over. At that time there were 49 such cities. In addition, the survey was extended to cover four cities with a little less than 50,000 inhabitants, as well as one twin-city with a combined population of over 50,000. (According to the 1970 census there were at that time 50 urban places in the 50,000 or over category; all had been covered by the 1968 survey). In the case of polycentric agglomerations, the central zones (core areas) of the commuting regions were defined using the following working rules: (a) territorially contiguous cities were considered as one core area, even if some of them had less than 50,000 inhabitants; (b) two or more territorially non-contiguous cities were considered to form one core area if those cities were situated close to one another and shared a common commuting shed.

As a result, the 55 cities initially selected were aggregated to form 41 core areas, which, following rule (a), were expanded to cover 18 smaller urban places. Thus, the survey of 1968 covered the commuting sheds of 73 urban places. Rule (b) implies, one should note, that commuting sheds of smaller urban places are fully nested within those of larger centers, which may not always be the case. Similarly, rule (a) carries an implication that, for example, commuters travelling from rural areas to a medium-size industrial town live within the daily urban system (i.e. labor and service market) of a large metropolitan center, situated about 30-50 kilometers from that town and even farther away from their place of residence. Although such assumptions are frequently not very realistic, they can be used in broad, cross-sectional analysis of urban regions. In fact, B.J.L. Berry (1973) and (to a lesser extent) P. Hall (1973), in studies which are regarded as classical in this research area, also made certain simplifying assumptions which allowed them to treat two or more neighboring cities as single core areas.

Another question concerns the boundaries of commuting regions. The Central Statistical Office study used as a

commuting ratio the percentage of commuters among the economi-
cally active, non-agricultural population. Such an index can-
not be directly compared with a more conventional measure, i.e.
the ratio of commuters to all employed population, since a cer-
tain percentage of commuters are part-time farmers (the "peasant-
workers"), who may not be very precisely allocated to either
the agricultural or non-agricultural employment category. De-
spite the comparability problems, the former index is basically
consistent as an interaction measure, although rather difficult
to use, since rather detailed employment data are necessary for
its calculation. In the Central Statistical Office study the
threshold value representing the extent of commuting regions
was 20 percent. The resulting units cover approximately one
third of the national territory.

A precise commuting-ratio threshold as a basis for de-
lineating functional urban regions is less important for our
present purposes than identification of the outer commuting
range. The latter, when interpreted as a regional boundary,
assures a high degree of closure of employment and residence
within individual regions. In fact it was necessary not only
to allow for lower commuting intensity (as compared to the CSO
study) to represent the existence of spatial labor linkages
over a given territory, but also to shift from third-level to
second-level administrative units (i.e. poviats instead of
communes) as basic building blocks in the regionalization
procedure. Such a relaxation of delineation criteria, i.e.
more liberal threshold values as well as bigger basic units,
expanded the area of commuting regions by about 80 percent as
compared to the CSO regions. In at least several cases indi-
vidual poviats turned out to be split in terms of their com-
muting patterns between two or even three competing employment
centers. In such cases the allocation of basic units among
neighboring commuting regions followed the principle of admin-
istrative hierarchy.

The rigorous application of the 50,000 population thresh-
old criterion in the Central Statistical Office study resulted
in the omission of several important regions of intense com-
muting oriented towards newly-developed industrial centers.

They include in particular the regions of Tarnobrzeg, Konin, Lubin-Glogow, and Krosno-Jasło. The inclusion of these regions permitted filling some of the gaps in the commuting pattern appearing on the CSO map. However, the extension of functional urban regions over the whole national territory required the introduction of supplementary criteria, in addition to the commuting criterion. These involve (a) the role of individual cities as central places and (b) the economic and population potential of urban places as estimated for 1990 by plans of physical development at the national level. Following these considerations, six additional functional regions were established around the cities of Piła, Nowy Sącz, Siedlce, Zamość, Ełk-Suwałki and Łomża-Ostrołęka. These places traditionally have performed quite important economic and cultural functions as sub-regional capitals. They also rank high among middle-size Polish cities in terms of the development of tertiary sector functions (see Zagożdżon, 1976; P. Korcelli and A. Potrykowska, 1976). Furthermore, in the national plan of physical (spatial) development all these cities fall into the category of "major growth centers" (K. Fiedorowicz, 1976). According to the plan estimates, the 1990 population size of each of the relevant cities should increase to 60,000 - 70,000 persons and in one case (the city of Piła) to over 100,000, as compared to their present 40,000 - 45,000 inhabitants.

The identification of functional urban regions (a total of 45 units) for the purpose of the present study was accomplished, therefore, in three steps. The first step was based on the survey of commuting-to-work, whose results have been adjusted to fit more aggregate basic spatial units. The second step involved the inclusion of several regions of intense commuting, oriented around newly-developed industrial centers which so far have not reached the 50,000 population threshold, although they are quickly approaching this size. Finally, in the third step several new regions were established on the basis of central place considerations as well as the provisions of the existing plans for physical development. As shown in Figure 1, the resulting spatial units cover the whole national territory. One needs to emphasize that as far as the commuting range criterion
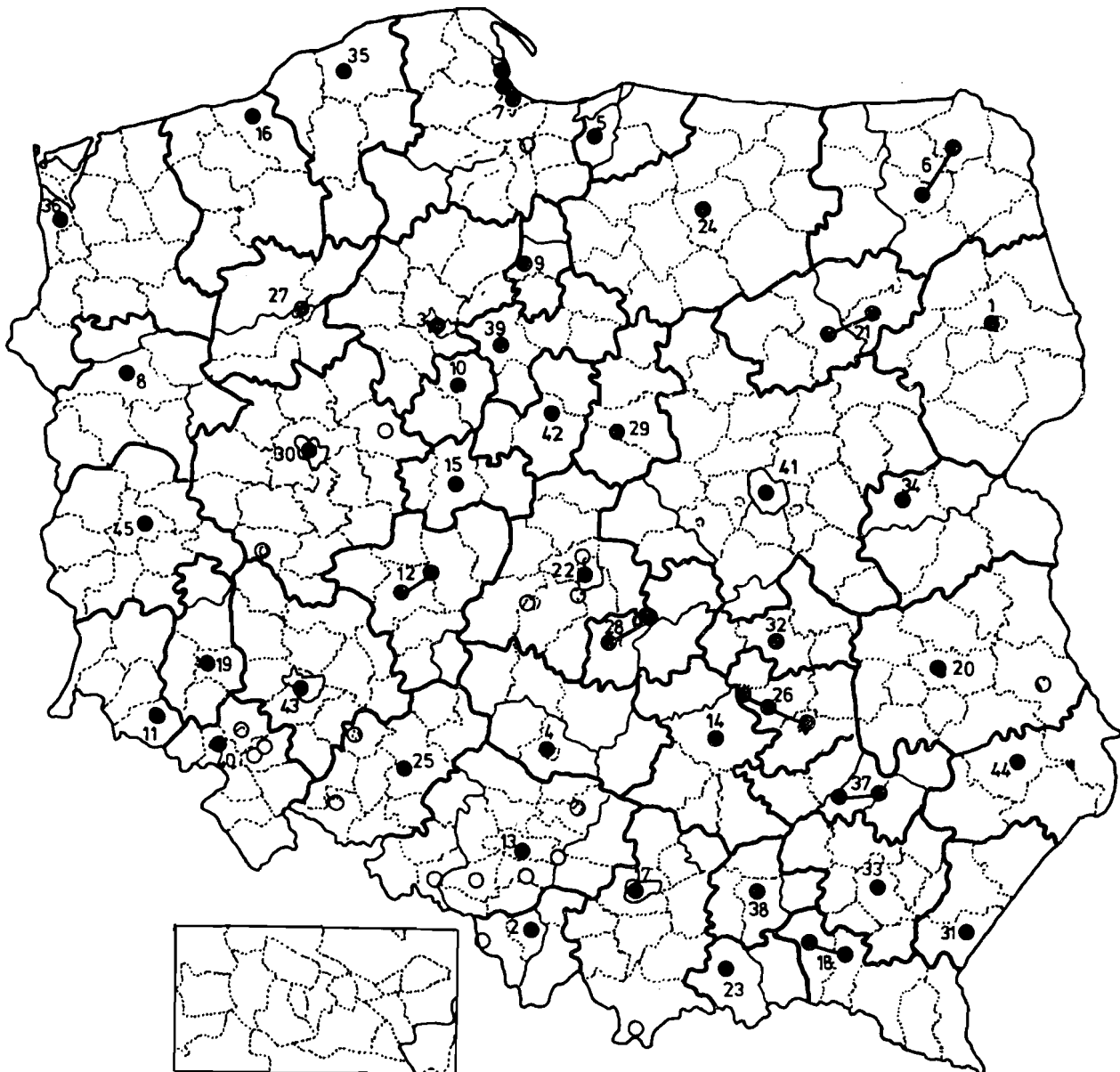
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Figure 1. Functional urban regions in Poland: 1968-70.

List of Functional Urban Regions (see Figure 1).

1.	Białystok	24.	Olsztyn
2.	Bielsko-Biała	25.	Opole
3.	Bydgoszcz	26.	Ostrowiec Sw.-Skarżysko Kam.-
4.	Częstochowa		Starachowice
5.	Elbląg	27.	Piła
6.	Ełk-Suwałki	28.	Piotrków Tryb.-Tomaszów Maz.
7.	Gdańsk	29.	Płock
8.	Gorzów Wlk.	30.	Poznań
9.	Grudziądz	31.	Przemyśl
10.	Inowrocław	32.	Radom
11.	Jelenia Góra	33.	Rzeszów
12.	Kalisz-Ostrów Wlk.	34.	Siedlce
13.	Katowice	35.	Słupsk
14.	Kielce	36.	Szczecin
15.	Konin	37.	Tarnobrzeg-Stalowa Wola
16.	Koszalin	38.	Tarnów
17.	Kraków	39.	Toruń
18.	Krosno-Jasło	40.	Wałbrzych
19.	Legnica	41.	Warszawa
20.	Lublin	42.	Włocławek
21.	Łomża-Ostrołęka	43.	Wrocław
22.	Łódź	44.	Zamość
23.	Nowy Sącz	45.	Zielona Góra

is concerned, the units identified extend substantially beyond
zones of intense commuting, their boundaries being closer in
fact to maximum commuting range. Because the Central Statis-
tical Office study disregarded the travel-to-work oriented to-
wards places smaller than 50,000 inhabitants (unless they were
situated close to cities of over 50,000), it produced a some-
what partial picture of spatial commuting patterns. The addi-
tion of nine centers in the present study resulted in a some-
what more comprehensive picture, but at the price of using
somewhat non-uniform and non-rigorous criteria. Nevertheless,
the spatial units identified seem generally consistent with the
concept of functional urban regions, i.e. they are not only
characterized by a rather high degree of closure with respect
to the distribution of workplaces and residences, as well as
places offering tertiary and quarternary (especially adminis-
trative) functions; but also by an intense pattern of intra-
regional flows. Eighteen of the 45 functional urban regions
have core cities of 100,000 inhabitants and over, and out of
the remaining 27 core cities approximately 12 will probably
reach this threshold within the next ten years. It is recog-
nized that cities of that size are likely to provide a broad
range of central functions, as well as to represent a labor and
housing market large and diversified enough to generate a re-
gional system of daily human interaction (even assuming that
spatial mobility is very high and that skills, as well as living
patterns, are greatly diversified).

The pattern of functional urban regions (Figure 1) is rela-
tively close to the new administrative division into voivodships
(first-order units). This finding, however, is hardly surprising,
since it was a basic objective in the recent administrative reform
to create regions with a high degree of internal coherence and
closure with respect to the economy and the settlement network.
(This reform was conducted during 1973-75, and it involved a
shift from a three-level division with 22 voivodships, 391 poviats,
and some 4300 communes, to a two-level structure with 49 voivod-
ships and some 2200 townships.) Major differences between the
two patterns can be found in the vicinities of the largest cities
- i.e. Warsaw, Łódź and Kraków. In the administrative division

these regions have been defined so as to encompass the respective urban agglomerations, rather than their much larger labor and service-supply sheds.

An interpretation of similarities as well as differences between the pattern of functional urban regions as defined in the present study, and the new administrative structure, can be briefly presented in terms of Figures 2, 3 and 4, which show basic data on commuting-to-work between, as well as within, individual voivodships. Figure 2 gives values of an index:

$$S^1 = (T._j - T_j.) \ P_j^{-1} \ ,$$

where $T._j$ is the number of persons commuting to voivodship j from all other voivodships, $T_j.$ is the number of persons living in T_j but working in other voivodships, and P_j is the population of voivodship j. Figure 3 shows the values of a similar index:

$$S^2 = (T._j + T_j.) \ P_j^{-1} \ .$$

Figure 4 gives spatial variations of an index S^3:

$$S^3 = (T._j + T_j.) \ (\hat{T}_j + T._j + T_j.)^{-1} \ ,$$

where $\hat{T}_j$ represents the number of persons commuting to work within the voivodship j (i.e. those travelling across city and township boundaries).

The spatial distribution of the values of the indices clearly demonstrates that those administrative regions which are situated in the proximity of the city-voivodships of Warsaw, Łódź, and Kraków are characterized by a lower degree of closure than the other units. This finding is consistent with the earlier observations as to relations between the boundaries of administrative regions on one hand, and of functional urban regions on the other. A comparison of the two spatial patterns under discussion suggests that a hierarchy of urban regions may in fact exist, i.e. the smaller regions are nested, with respect
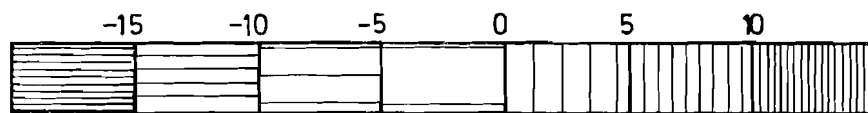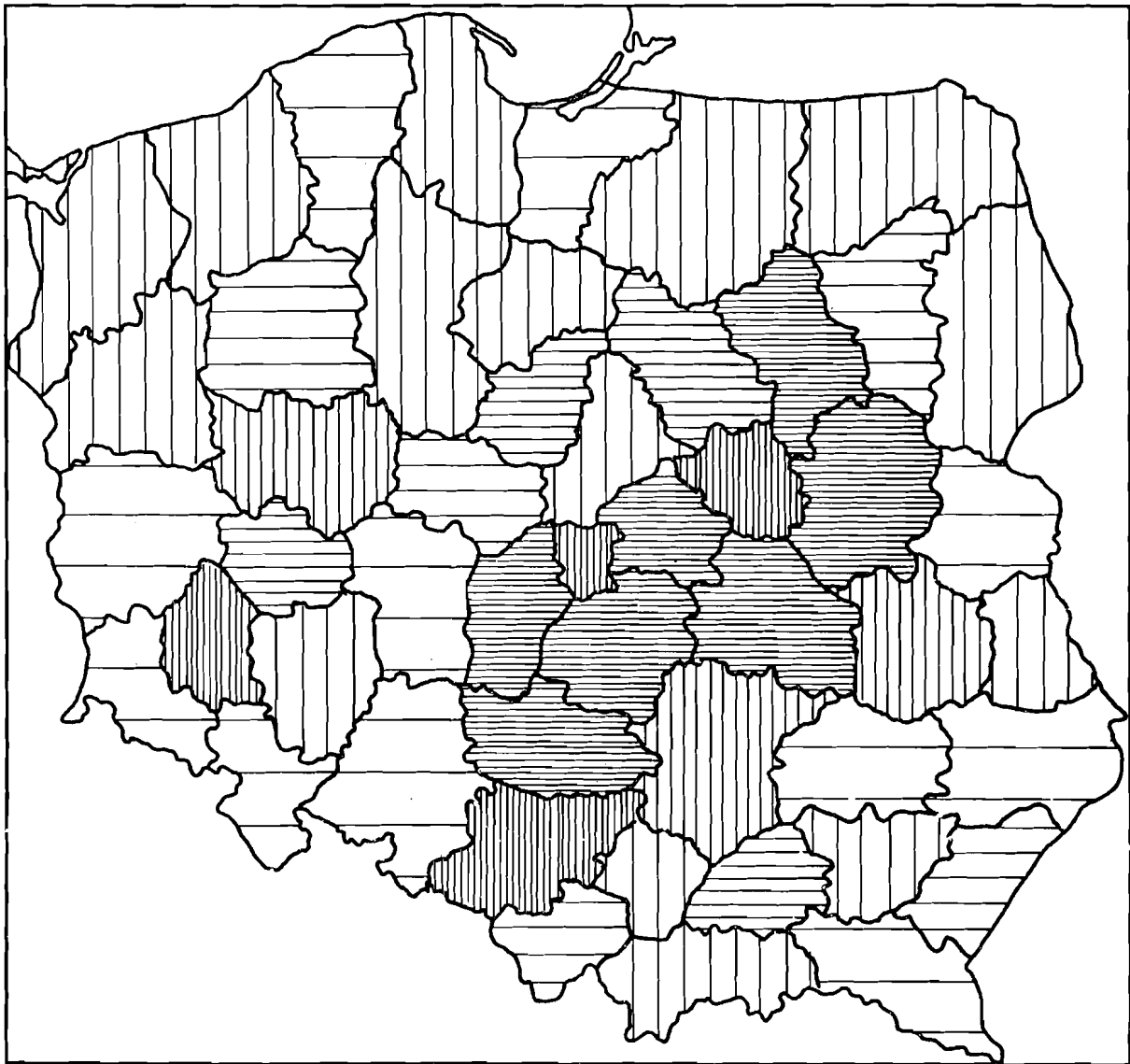
Figure 2.   Travel to work between voivodships, 1973.
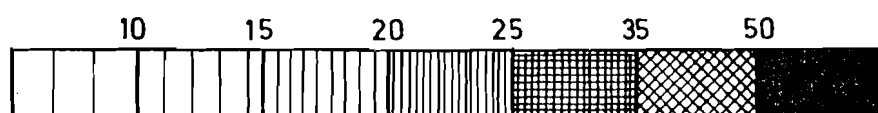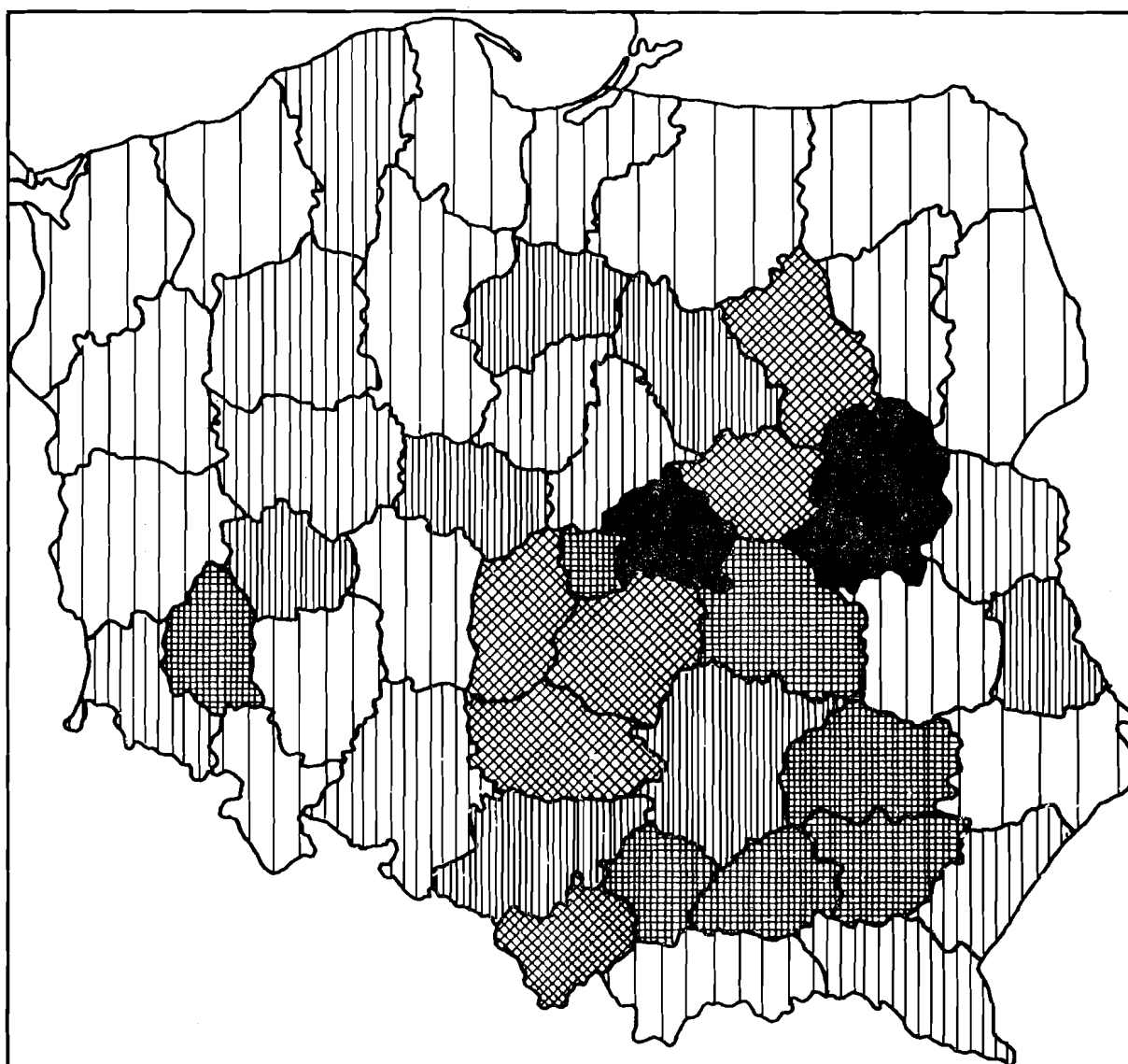Distribution of S^1 values.

Figure 3.   Travel to work between voivodships, 1973.
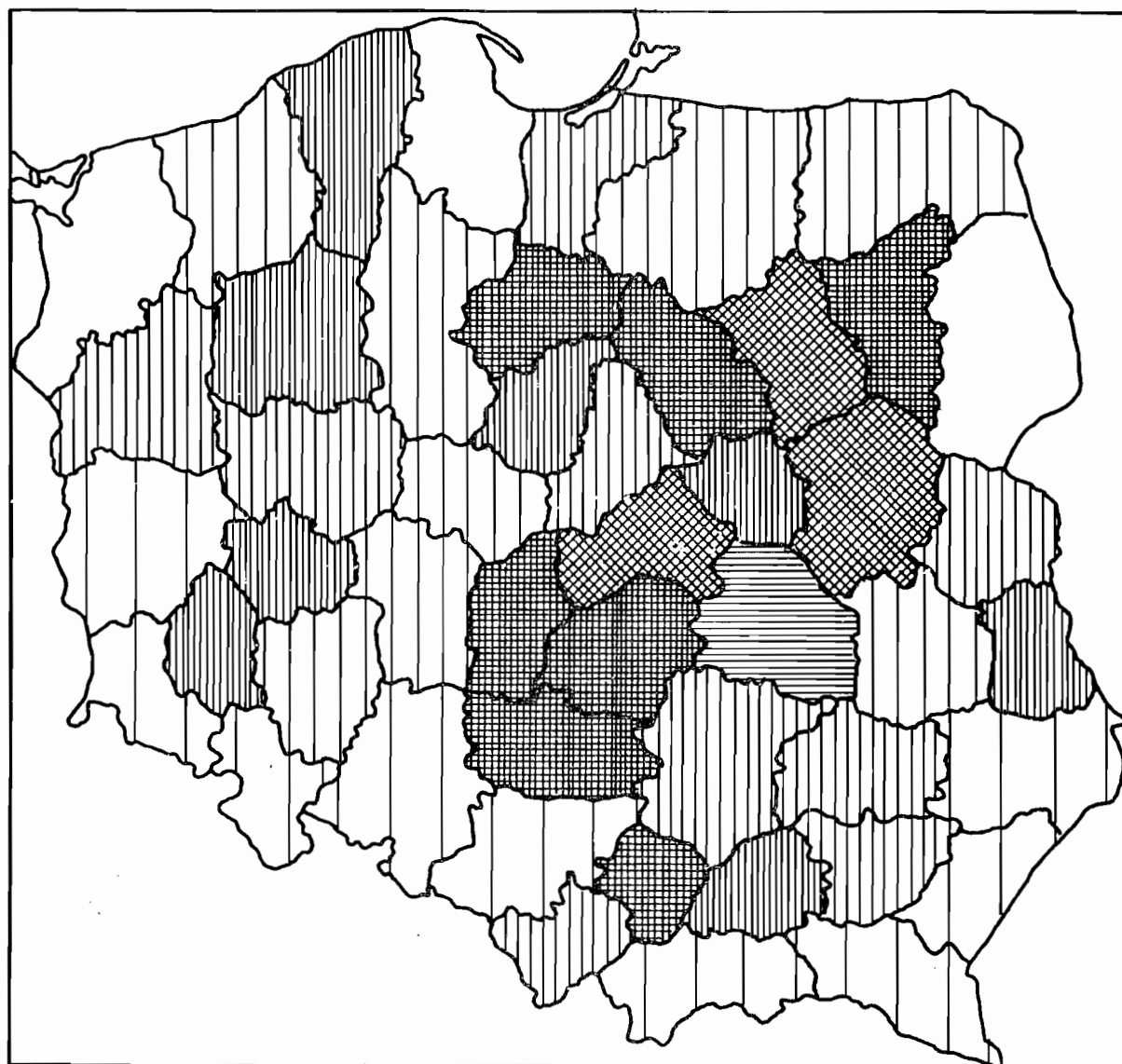Distribution of S^2 values.

Figure 4. Travel to work between and within voivodships, 1973. Distribution of S^3 values.

to higher-order functions and the interaction patterns general-
ized by those functions, within the functional urban regions
dominated by large urban agglomerations (metropolitan areas).
The patterns of internal migration as well as of economic link-
ages between cities in Poland strongly support a hypothesis of
hierarchical relations between individual urban regions, which
had been strengthened by the former three-level spatial admin-
istrative structure.

In the analysis of the internal structure of urban regions
it seems instructive to use the two sets of regions discussed
above in a parallel way. The functional (i.e. primarily commuting-
oriented) regions are preferable in retrospective studies, because
of the existence of data and a rather high stability of basic
units (i.e. poviats) during the 1950-1973 period. On the other
hand, the new administrative regions perhaps would have more ad-
vantages in a cross-sectional study of the present structure,
based on cities and townships as basic spatial units. One can
predict that the latter pattern will have a substantial impact
on the formation and development of functional urban regions and
that the two patterns will tend towards convergence. This is
largely due to the role of spatial administrative units, under
planned economy conditions, as planning and also economic regions
(see S. Leszczycki, 1971). Without going into a more detailed
treatment of this important question, one should note a feed-
back relation existing between the pattern of administrative
regions and of spatial economic patterns. For example, an ex-
plicit policy in establishing townships since 1973 has been that
these units should have a sufficient size, population, and eco-
nomic potential to stimulate the transmission of agricultural
innovations and the efficient organization of modern community
services (particularly educational systems, which, like other
tertiary and quaternary activities, are spatially organized on
the basis of administrative divisions). On a regional scale,
the division into 49 voivodships reflects the spatial structure
of social and economic interactions, but it also constitutes a
major factor in the evolution of the socioeconomic structure.

It was suggested earlier that because of changing statistical
series an analysis of the internal structure of, and interrelations

between, functional urban regions in Poland could benefit from
a parallel use of the two somewhat different sets of spatial
units. Another argument in support of such an approach follows
from specific and largely complementary characteristics of the
two spatial divisions. Namely, each of them puts emphasis on
a different aspect of interregional linkages (i.e. commuting-
to-work on one hand, and central place and administrative link-
ages on the other). Although the spatial ranges of these two
types of interactions are superimposed one on the other, they
do not overlap completely. It should be noted that about one-
half (48 percent in 1968) of all trips to work (recorded as
commuter trips, i.e. involving a crossing of an administrative
boundary) are accounted for by the industrial sector, whose
internal organization is primarily vertical (non-spatial) in
character. One can therefore treat the pattern of functional
urban regions (i.e. primarily commuting-oriented regions) and
of administrative regions, as two specific, although partly
overlapping spatial interaction frameworks respectively (a) rep-
resentative of spatial relations between places of work and
places of residence, and (b) representative of linkages gener-
ated by central functions, public administration and economic
management.

4. DIFFERENTIATION OF URBAN REGIONS AND SELECTED FEATURES OF THEIR INTERNAL STRUCTURE

In the earlier sections it was pointed out that functional
urban regions tend to differ in terms of: (a) degree of "matu-
rity," and (b) degree of internal closure. These variations are
reflected in relations between core areas and peripheral zones
of such regions, in particular in core-periphery proportions with
respect to the distribution of population, work-places, and housing
stock. It is suggested that the way these proportions change is
influenced by both the level of "maturity" and the degree of clo-
sure. Tables 1 and 2 partly support such a hypothesis. These
tables refer to functional urban units (i.e. commuting-oriented
regions), arranged according to population size of the core area
(as of 1973), which serves as a proxy for maturity. The data
presented indicate the existence of a negative correlation between

Table 1: Population growth and distribution within the functional urban regions, by core and periphery

Urban regions by population size of the core (1973)	Population increase for region as a whole			Population increase in the periphery			Percentage of population living in the core			
	1950-60	1960-70	1970-73	1950-60	1960-70	1970-73	1950	1960	1970	1973
1. Above 1 000 000 (2)	121.1	112.1	103.7	117.9	112.3	103.5	40.0	41.6	41.5	41.6
2. 500 000 - 1 000 000 (5)	120.3	112.5	102.6	115.0	109.3	99.5	36.5	39.4	41.1	42.9
3. 200 000 - 500 000 (3)	124.7	113.8	103.2	122.3	105.9	101.2	24.4	26.0	31.1	32.5
4. 150 000 - 200 000 (3)	113.7	107.2	101.1	106.6	101.9	99.3	18.9	23.9	27.7	29.0
5. 100 000 - 150 000 (5)	119.6	109.7	102.0	117.0	107.2	100.6	14.5	16.3	18.2	19.3
6. 75 000 - 100 000 (10)	120.4	111.8	106.1	116.6	109.0	105.9	14.7	17.4	19.4	19.6
7. 50 000 - 75 000 (8)	119.4	109.5	102.4	116.1	107.1	101.6	11.5	13.7	15.5	16.2
8. Below 50 000 (9)	113.1	106.9	101.7	110.8	104.9	101.0	5.7	7.7	9.5	10.2

Table 2: Industrial employment and housing stock within the functional urban regions, by core and periphery

Urban regions by population size of the core (1973)	Growth of industrial employment for region as a whole		Percentage of industrial employment in the core			Percentage of housing units in the core			
	1960-70	1970-73	1960	1970	1973	1950	1960	1970	1973
1. Above 1 000 000 (2)	123.7	104.7	49.0	52.8	51.0	41.2	43.2	45.5	45.1
2. 500 000 - 1 000 000 (5)	129.0	108.0	59.6	65.0	62.8	37.6	40.8	44.1	45.8
3. 200 000 - 500 000 (3)	151.8	117.3	54.8	56.6	53.9	24.4	27.3	31.2	32.2
4. 150 000 - 200 000 (3)	141.7	114.5	54.6	58.5	57.0	20.9	24.9	29.3	30.2
5. 100 000 - 150 000 (5)	136.1	107.8	22.3	33.9	34.4	15.1	17.7	19.7	20.6
6. 75 000 - 100 000 (10)	147.8	114.6	32.7	41.0	40.4	15.8	17.9	19.0	21.2
7. 50 000 - 75 000 (8)	147.5	117.7	24.9	31.3	31.3	12.5	14.3	16.5	16.9
8. Below 50 000 (9)	164.4	125.7	15.7	28.7	28.3	6.9	8.5	10.8	11.3

population size of the core and its share in the total population of the region on one hand, and the magnitude of change in this proportion over the 1950-73 period. In fact, this negative relation is true of the four categories of urban regions at the top of the scale (i.e. those with core areas of over 150,000 inhabitants), in the case of which the total change expressed in percentage points amounted to 1.6, 5.4, 8.1, and 10.1, respectively. For the remaining size categories of urban regions the relevant values were nearly uniform, i.e. 4.8, 4.9, 4.7, and 4.5, respectively. Individual time-periods were characterized by substantial variations in the rate of change, although one can observe that the highest rates have been moving up the size-scale of urban regions. Generally, population concentration was growing over the whole 1950-73 period in all groups of regions, but they were most pronounced in those regions whose core areas were cities of 200,000 - 600,000 inhabitants. In the case of the two largest units, i.e. Warsaw and the Upper Silesian conurbation, the percentage of population in the core areas has been rather stable, and in 1960-1970 it even declined slightly. This trend has to be largely attributed to urban growth limitation policies followed during the sixties; nevertheless, it is also characteristic of "mature" urban regions, whose structures evolve towards that described in the well-known concept of urban fields.

The change of core-periphery proportions in terms of housing stock (Table 2) are, according to expectations, quite close to the trends in population distribution presented above. The share of core areas has been growing even faster with respect to the number of dwelling units than with respect to population size. This is partly explained by variations in family size, but it also indicates that improvement in housing conditions has been relatively faster in the core areas.

The change in the distribution of industrial employment has followed a somewhat different pattern. The 1960-70 decade showed a trend towards concentration of industrial jobs in the core areas, but the early seventies saw a decline of the share of central zones, in particular in the three largest size-categories of urban regions.

This is a very characteristic phenomenon in the evolution of the internal structure of urban regions; according to the existing evidence it is not fully evident whether it precedes or follows the population deconcentration. The question should be studied in greater detail in both spatial and sectoral terms. It constitutes in fact one aspect of a broader problem, i.e. that of interrelations between the internal change of functional urban regions as places of residence on one hand, and as labor markets on the other.

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