TRANSFORMATION OF POLAND'S SPATIAL-ECONOMIC STRUCTURE IN THE YEARS 1998–2008

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ABSTRACT. The article consists of two parts. Part one offers a diagnostic description of the current spatial-economic structure of Poland in which regions are divided into core and peripheral ones. The division rests on a systemic measure of the level of economic development, viz. the income potential /population potential ratio. Part two is an analysis of changes in Poland's spatial-economic structure over the years 1998–2008 where an attempt is made to determine how far those changes coincided with visions of the country's spatial structure presented in planning conceptions.

KEY WORDS: spatial-economic structure, core and peripheral regions, method of potential ratio, transformation of spatial structure, planning conceptions, Poland

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1. Introduction

The systemic transformation that took place in Poland after 1989 and then the process of modernisation of its society and economy in the conditions of European integration have a spatial dimension. But changes in the spatial structure, given its permanence and inertia, occur only slowly and seriously lag behind socio-economic ones.

The aim of this article is to diagnose Poland's current spatial-economic structure. An attempt is also made to determine if new forms appeared in it at the breakthrough transition stage, and how far the transformation taking place coincides with visions of the country's spatial development presented in forecasts and planning documents.

The analytical category adopted in the description of the spatial-economic structure of Poland is a dichotomous spatial model moulded on Friedmann's (1967) core-periphery conception. The core-periphery model shows the spatial structure of a territorial system based on the assumption of its uneven development and describes the relative location of developed and underdeveloped areas in it[1]. In this model the chief components of a country's territorial system are core regions and peripheries. A core region shows a high level of socio-economic development, as opposed to the

[1] Friedmann's (1967) classic conception provides a general model of regional development. The terms 'core' and 'periphery' not only denote spatial relations, but also symbolise the domination of the core and the subordination of the periphery (cf. Domański 2004: 13; 2008: 137).

neighbouring peripheral area at a low development level. The notion of the core region formulated by Friedmann corresponds to Boudeville's (1978) conception of a polarised region that falls in the core-region category. A polarised region is a heterogeneous, hierarchical and integrated subterritorial system composed of a pole and its zone of influence. Areas surrounding a core region are its periphery, so the delimitation of core regions also means an identification of areas lying outside them, i.e. peripheries, which make up the rest of a country's territory.

2. Use of the potential model in the construction of an index of the development level

The starting point in an analysis of the spatial-economic structure of Poland is an examination of spatial relations occurring in its territorial system. Spatial relations are intertwined with socio-economic interactions, i.e. with binding relations that determine the shape, performance and structuring of the country's territorial system. A significant cognitive problem arises here: What is the relation between the spatial structure of the territorial system and the pattern and intensity of binding relations in this system? (cf. Chojnicki 1988: 504–506).

In the methodological solution of this problem use was made of a systems approach involving a mathematical model of potential (Chojnicki 1966, Sheppard 1979, Ratajczak 1999: 211–232). In an analysis of a territorial system, potential is interpreted as a measure of interaction of objects (territorial units) making up this system. Potential defines the intensity of interaction among the territorial units as a variable dependent not only on their properties, but also on their relative locations, i.e. the distance separating them. It is a systemic measure because each territorial unit is characterised with reference to the remaining ones and to itself. A territorial unit may have low self-potential, but owing to its advantageous place in the system of interactions its potential increases.

The many applications of the potential model in geographical inquiry make use mostly of its two forms: an income potential model and a population potential model (cf. Rich 1980). Income potential is a measure of the accessibility of income in the territorial system. The income potential of unit *i* is a function of the income generated in this unit, incomes generated in other units, and the distance separating them. It thus makes it possible to accommodate the effect of income transfer within the system on the spatial variability of the income. Population potential, in turn, describes the accessibility of the given territorial unit *i* to the residents of all the other units in the system. The population potential of unit *i* is a measure of the influence of the populations of all the units of the given system on unit *i*, augmented by the influence of the unit on itself.

A methodological proposal enabling an integral, but also complementary, approach to income potential and population potential is the quotient of those potentials. The quotient of potentials P_i, given by the formula:

$$P_i = \frac{U_i}{V_i}$$

is calculated on the basis of the two versions of the potential model (cf. Czyż 2002), namely:
(1) Income potential U_i

$$U_i = \frac{z_i}{d_{ii}} + \sum_{j=1}^{n} \frac{z_j}{d_{ij}}$$

where:
z_j – Gross Domestic Product in unit *j*,
d_{ij} – the distance between unit *i* and unit *j*, and
z_i/d_{ii} – self-potential of unit *i*.

It is assumed that d_{ii} = 1 (cf. Pooler 1987), which means that the self-potential of a unit is equal to its income.
(2) Population potential V_i

$$V_i = \frac{l_i}{d_{ii}} + \sum_{j=1}^{n} \frac{l_j}{d_{ij}}$$

where:
l_j – the population in unit *j*.

The quotient of income potential and population potential in a territorial unit is an equivalent of per capita income; it does not differ from this index in terms of denomination. Its superiority as a measure of socio-economic development of the unit consists in the fact that: (1) it is a systemic measure; (2) it accommodates the influence of spatial relations and binding relations holding in the country's entire territorial system on the development level of the given unit; (3) as a systemic measure, the quotient of potentials causes

a 'contraction' of the scale of development level and tends to blur spatial contrasts to some extent by 'depressing' the highest and 'elevating' the lowest values in the distribution[2]; (4) it is a variable with a continuous spatial distribution; and (5) the map of the distribution of the quotient of potentials as a development index is a continuous surface with a specific spatial configuration expressed by isolines (peaks, depressions, slopes, gradients).

3. Basic territorial units and the database in the analysis of Poland's spatial structure

In the analysis, socio-economic data refer to territorial units of the NUTS 3 type that are subvoivodeship, supra-poviat units called subregions in official statistics. Their use in establishing facts can be justified as follows: (1) they ensure more spatial detail than an analysis by voivodeship (NUTS 2); (2) a spatial analysis should also embrace the intra-voivodeship system because of wide differences in the level of socio-economic development within individual voivodeships; (3) being of a lower order than voivodeships, NUTS 3 units are more homogeneous in terms of development level; and (4) the use of NUTS 3 units makes it possible to delimit core regions and peripheries the boundaries of which exceed the administrative limits of voivodeships.

In 2008, the NUTS 3 network in Poland consisted of 66 units. In the present analysis, this set was reduced to 58 by combining the NUTS 3 urban units of Warsaw, Gdańsk, Łódź, Poznań, Cracow, Szczecin and Wrocław with those NUTS 3 units that surround them. It was assumed that the aggregated systems of those units corresponded to urban agglomerations, and in the case of Warsaw, to a metropolitan area. The further research procedure sought to find if the urban agglomerations (and the metropolitan area), within their borders established *ex ante*, coincided with growth poles. The 2008 income and population data by NUTS 3 unit come from the publication by the Central Statistical Office (GUS), *Gross Domestic Product. Regional accounts in 2008* (2010).

In calculating potentials, the relations between the territorial units of the system were determined with the help of the Euclidean distance between the centroids of those units as reference points of the data. Using the grid of reference points, values of income potential and population potential were estimated, on the basis of which the quotient of the potentials was then calculated[3]. Its values ranged from 22 to 66 thous. zlotys per head[4]. The spatial distribution of those values was continuous, which is shown on the map by isolines at constant intervals.

On the map of the quotient of potentials, isolines present the spatial variability of its values and show the configuration of its distribution surface (Fig. 1). The spatial distribution of the quotient of potentials is also presented in the form of a hypersurface (Fig. 2). In the further research procedure, this distribution as an index of socio-economic development served as a basis for distinguishing core regions and peripheries in Poland's spatial structure.

4. Core regions and peripheral areas in Poland's spatial structure

On the map of the distribution of the socio-economic development index, or the quotient of potentials, there is a clear spatial division into core regions and peripheries (Fig. 1). A core region consists of a pole and a zone of its influence. The pole of the region is a spatial concentration of socio-economic activity and has a strong effect on its hinterland. It is assumed that poles have development indices of more than 40 thous. zlotys per head, and the boundary of the zone of their strong influence is a closed isoline of 30 thous. zlotys per head (the mean value of the index). The zone of influence of a pole is delineated by a high-density pattern of concentric isolines (which means steep gradients of the development level), either regular or deformed, going round

[2] A mathematical approach to the relation between the potential quotient (P_i) and per capita income (g_i) can be found in Czyż (2002: 9).

[3] The program *The quotient of potentials, Poland 2008* was designed and run by A. Stach.

[4] The range of values of the quotient of potentials is smaller than of the statistical index of per capita income (19–68 thous. zlotys).

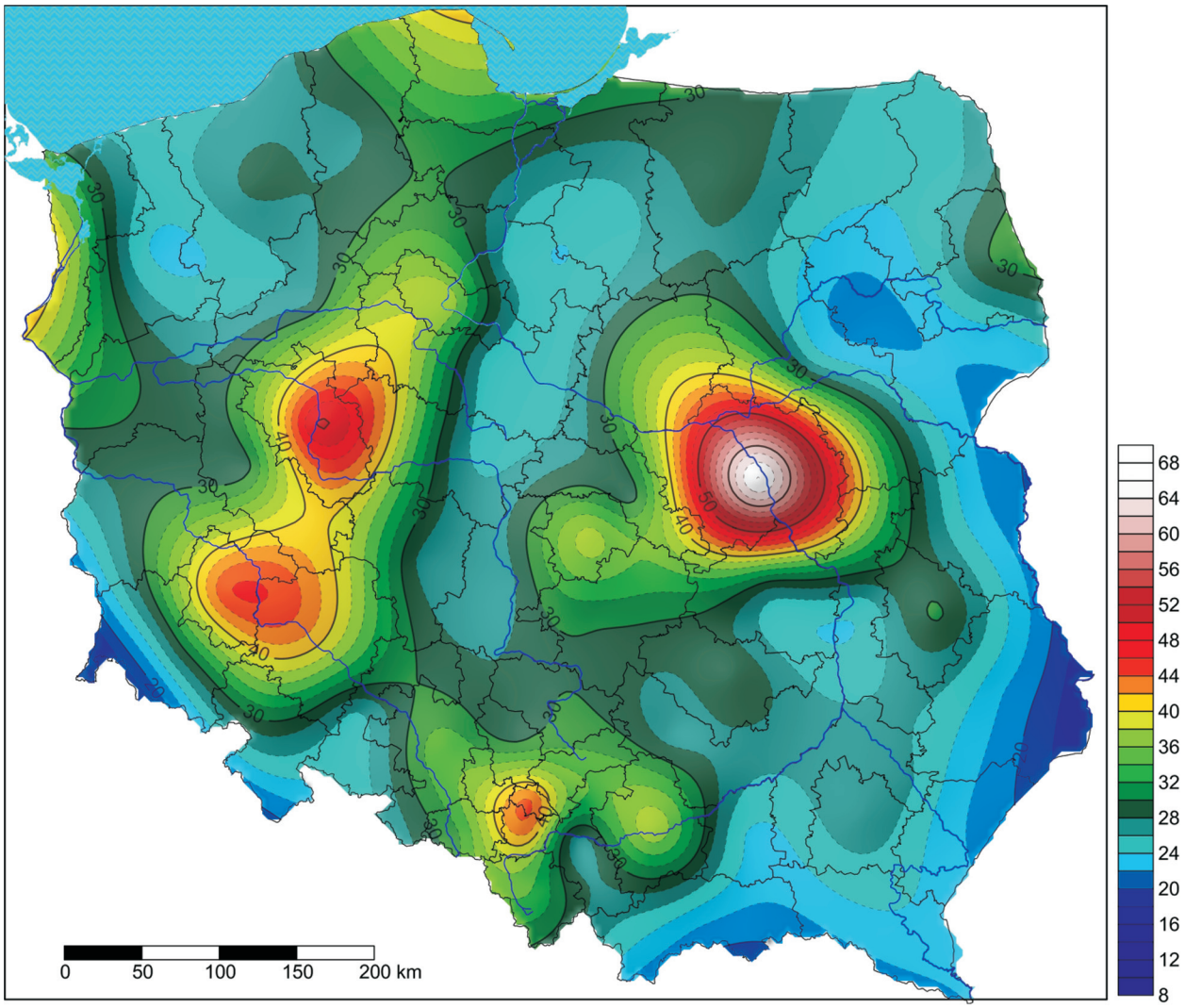

Fig. 1. Spatial-economic structure of Poland in 2008: the spatial distribution of the potential quotient (isoline value – thous. zlotys per head).
Source: content prepared by T. Czyż, cartographic work by A. Stach.

the pole. Areas peripheral to the core regions are in a marked contrast to them, with lower values of the development index.

In Poland there are three core regions distinct in their territorial shape: Mazovia, Wielkopolska-Lower Silesia, and Silesia.

The Mazovian core region is an extensive spatial system of a high level of socio-economic development. Its pole coincides with the Warsaw metropolitan area and has the highest development index in the country, at 66 thous. zlotys per head. The zone of influence of the Warsaw pole is a concentric system of isolines. The Mazovian region embraces a substantial part of Mazovian voivodeship, but without the Radom subregion and a large eastern fragment of the Ostrołęka-Siedlce subregion. Its boundaries exceed those of Mazovian voivodeship in two places. In the south-western part of the Mazovian region there is a marked deformation in the circular pattern of its border isoline denoting the development index of 30 thous. zlotys per head: it stretches out to include a fragment of the Skierniewice subregion in Łódź voivodeship (Rawa and Skierniewice poviats) as well as the urban agglomeration of Łódź (36 thous. zlotys per head), which remains under a strong influence of the Warsaw growth pole. In the south-eastern part, the Mazovian region embraces a small fragment of Lublin voivodeship in the Puławy subregion.

The shape of the Wielkopolska-Lower Silesia core region is elongated and extends from the

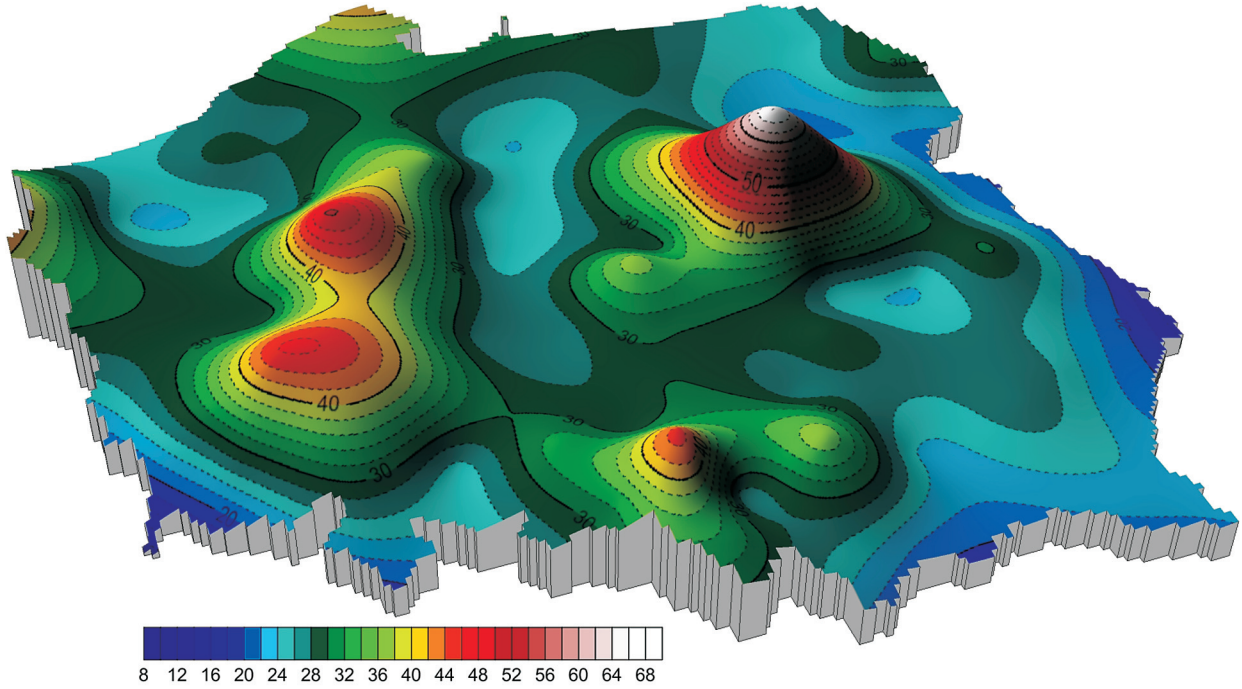

Fig. 2. Hypersurface of the level of socio-economic development in 2008.
Source: cartographic work by A. Stach.

south-west towards the north. It is a bipolar region. The poles, well marked and situated in the central and southern parts, are almost of equal rank in terms of development and form a spatially integrated system. The boundaries of the Wielkopolska pole, with the development index of 49 thous. zlotys per head, run slightly towards the east of the urban agglomeration of Poznań. The Lower Silesian pole embraces the urban agglomeration of Wrocław (with an index of 40 thous. zlotys per head) and the Legnica-Głogów subregion (with a high development index equal to 49 thous. zlotys per head as a result of the income-generating industries of copper mining and processing). The Wielkopolska-Lower Silesian region embraces mostly Wielkopolska voivodeship (without the eastern part of the Kalisz subregion and Złotów poviat from the Piła subregion) and Lower Silesian voivodeship (without the borderland poviats of the Jelenia Góra and Wałbrzych subregions). Apart from those voivodeships, the region also includes fragments of the neighbouring voivodeships: small in the case of the voivodeships of Opole (Namysłów poviat from the Nysa subregion) and Lubuska Land (the eastern part of the Zielona Góra subregion), and a more substantial one of Kujavia-Pomerania (Nakło and Żnin poviats from the Włocławek subregion and the Bydgoszcz-Toruń subregion including the Bydgoszcz-Toruń agglomeration with its relatively high development index of 36 thous. zlotys per head).

The Silesian core region, the smallest in spatial range, embraces Silesian voivodeship (without the north-western part of the Częstochowa subregion), a fragment of Opole voivodeship (the eastern poviats of the Opole subregion with the town of Opole) and the Cracow subregion of Małopolska voivodeship. The pole of this region (with a development index of 42–44 thous. zlotys per head) is a fragment of the polycentric Upper Silesian agglomeration within the boundaries of Katowice and Tychy subregions. Because of its eastward elongation, the Silesian region also includes the Cracow agglomeration (with an index of 37 thous. zlotys per head), which has a poorly marked zone of influence.

On the map of the development level there are also poles in the form of the Szczecin and Tri-City (Gdańsk–Sopot–Gdynia) agglomerations, poorly marked borderland territorial regions. What gives them a special character is the presence of a state border as part of their boundaries. The poles of those regions, located near the state border, have indistinct and deformed zones of

influence[5]. The reason of the poor spatial crystallisation of those frontier regions can also be the fact that while their poles, Szczecin and Tri-City, are well-developed agglomerations, they still struggle with growth disturbances owing to the fall of maritime economics and the crisis in the shipyard industry.

The areas located peripherally in relation to the core regions distinguished are in sharp contrast to them, showing a lower development level. They can be divided into semi-peripheries and peripheries proper. Semi-peripheries are external areas of the three core regions. Their boundary is the isoline of the development level reduced to 28 thous. zlotys per head. The farther this isoline departs from the pole of the core region, the more complicated and deformed it becomes, but it usually preserves its characteristic extension towards the pole region. Within a semi-periphery there are only a few departures from the main downward trend in the development level associated with major towns (especially readily visible is the Lublin anomaly).

The semi-peripheries surrounding individual core regions are clearly separated by areas of a low development level, which are peripheries proper. On the map of the development level, peripheries proper show as enclaves of underdevelopment, usually bounded by a closed isoline or forming low-development belts.

Peripheries in the form of enclaves can be found: (1) in north-western Poland – an enclave in West Pomerania embracing the Stargard subregion (a development index of 24 thous. zlotys per head) and part of the Koszalin subregion, (2) in central Poland – an enclave with a development index ranging from 27 to 25 thous. zlotys per head and extending from the Sieradz subregion in Łódź voivodeship across the Konin subregion (Turek and Koło poviats in Wielkopolska voivodeship), the eastern part of the Włocławek subregion with the town of Włocławek and the eastern part of the Grudziądz subregion in Kujavia-Pomerania voivodeship, to Iława and Nowe Miasto poviats of the Elbląg subregion in Warmia-Mazuria voivodeship, and (3) in south-eastern Poland (with an index of 24–27 thous. zlotys per head), on the borderland between Świętokrzyska Land voivodeship (Opatów poviat in the Sandomierz-Jędrzejów subregion), Mazovian voivodeship (Zwoleń and Lipsko poviats in the Radom subregion), and Lublin voivodeship (Kraśnik and Opole Lubelskie poviats in the Puławy subregion).

In the south-west of the country are the frontier-belt peripheries embracing the subregions of Jelenia Góra and Wałbrzych in Lower Silesia (27 thous. zlotys per head), Nysa in Opole voivodeship (25 thous. zlotys per head), and Oświęcim in Małopolska voivodeship (27 thous. zlotys per head).

However, the most extensive belt of peripheries with the lowest development level (22–25 thous. zlotys per head) stretches in south-eastern and eastern Poland. It embraces the subregions of Nowy Sącz and Tarnów in Małopolska voivodeship; Krosno, Tarnobrzeg and Przemyśl in Subcarpathia voivodeship; Chełm-Zamość, Puławy and Biała Podlaska in Lublin voivodeship; Łomża and Suwałki in Podlasie voivodeship; Ełk in Warmia-Mazuria voivodeship; and the eastern part of the Ostrołęka-Siedlce subregion in Mazovian voivodeship.

5. Changes in Poland's spatial-economic structure over the years 1998–2008

The main trends in the evolution of the spatial-economic structure of Poland can be determined by comparing its current state (as of 2008) with that at a stage of advanced systemic transformation (as of 1998) (Fig. 3).

Over the ten years, significant changes occurred in the country's spatial structure involving an increase in the importance of the core regions and their poles as chief development centres. In this period the Mazovian region secured its highest position on the scale of socio-economic development while its spatial crystallisation advanced. With the development of the Warsaw metropolitan area, or the pole of the region, the force and spatial range of its influence grew too, and as a result there was a modification in the course of the boundary of the Mazovian region. Especially

[5] Besides, the development index values expressed as the quotient of potentials tend to be underestimated in frontier areas owing to the so-called border effect that occurs when measuring potential.

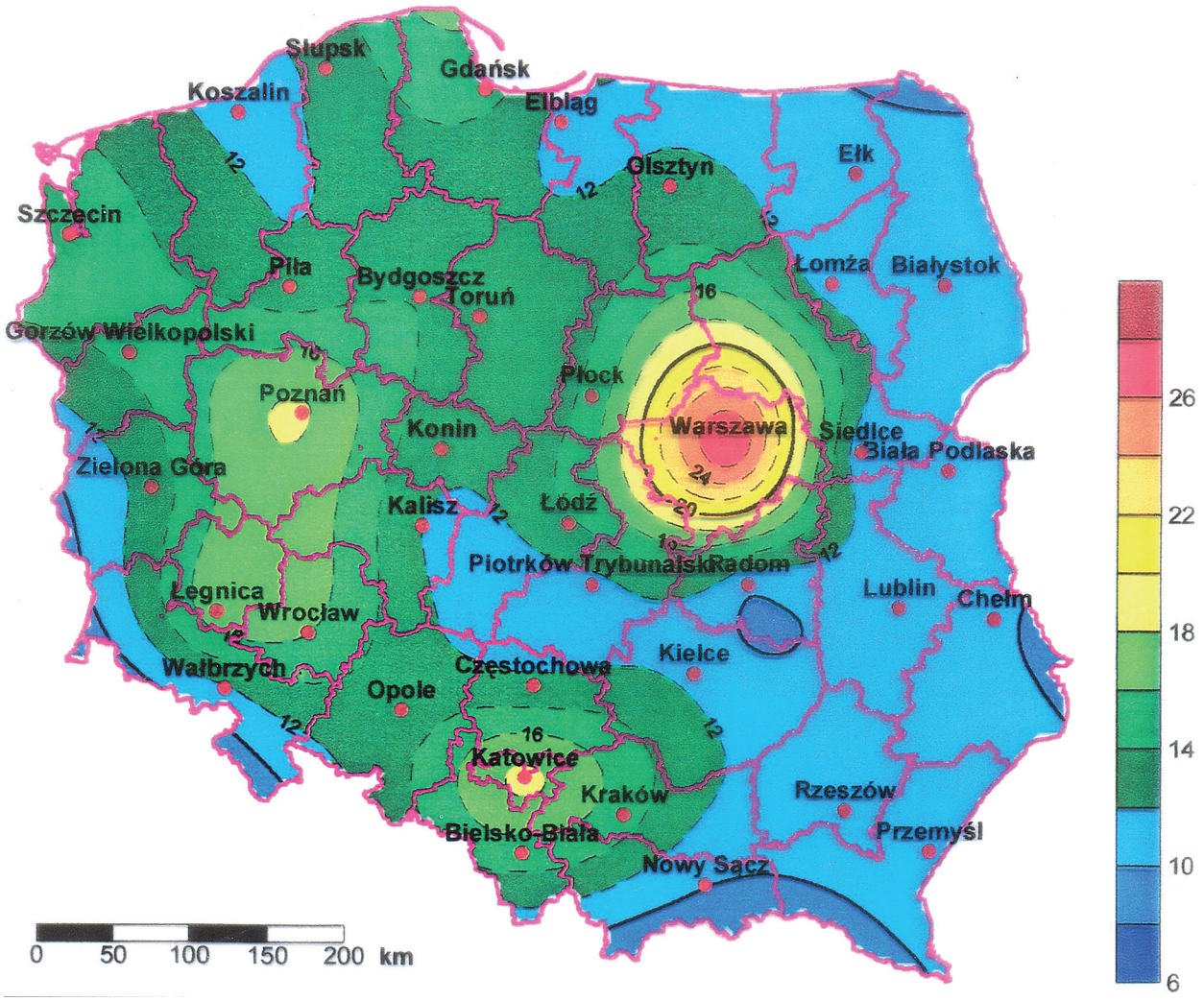

Fig. 3. Spatial-economic structure of Poland in 1998: the spatial distribution of the potential quotient.
Source: Czyż (2002).

readily visible is its protrusion towards the south-west, which means that the poorly delineated area of influence of Łódź found itself in the zone of influence of the powerful Warsaw. Also, the semi-periphery of the Mazovian region became more extensive, spreading towards the north and south-west.

The greatest changes, however, occurred in the spatial structure of the western part of Poland. The Wielkopolska region had transformed into a Wielkopolska-Lower Silesian region of substantial spatial reach. Its territorial shape stands out clearly. Its bipolar core became stronger and more prominent as a result of both, the growth of the urban agglomeration of Poznań and the dynamic development of that of Wrocław. Another indication of an increase in the economic strength of the Wielkopolska-Lower Silesian region and its role in shaping the country's spatial structure is also the extension of its semi-periphery towards the north-west.

In turn, there was no fundamental change in the spatial outline of the Silesian region. However, after a stage of stagnation, its pole – the Upper Silesian agglomeration – improved its position (not only at the scale of the region, but also the entire country), with a secondary position maintained by the Cracow agglomeration, weakened by development contrasts with its hinterland.

Over the years 1998–2008, there was a clear tendency in Poland's spatial structure towards a further domination of the three core regions on the scale of development, which was connected with an increase in the importance of the Warsaw metropolitan area and the urban agglomerations of Poznań, Wrocław and Upper Silesia. The zones

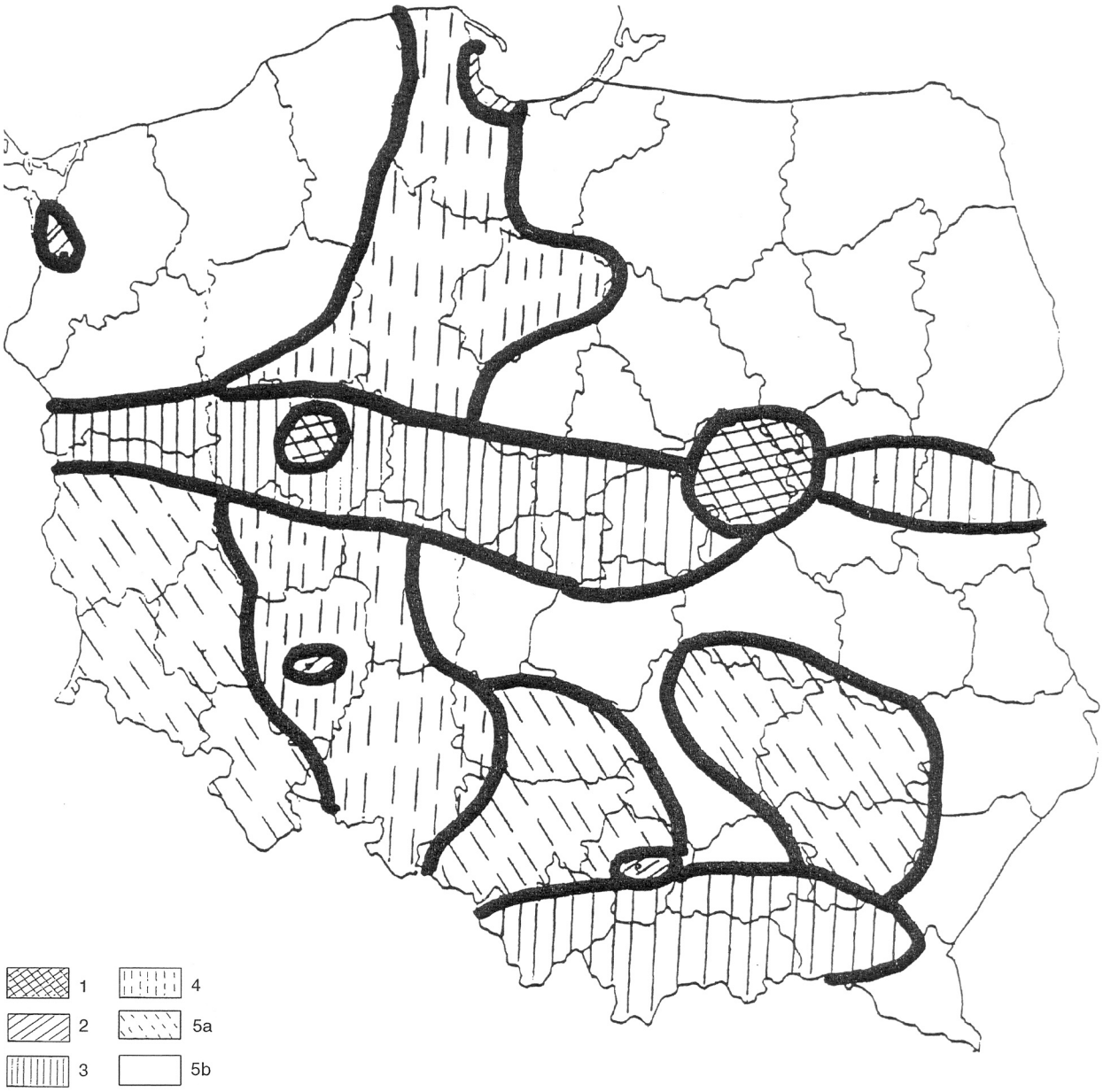

Fig. 4. Cores and peripheries in Poland in the 2010s.
1 – cores; 2 – sub-cores (growth poles); 3 – growth axes; 4 – semi-peripheries; peripheries: 5a – regions in decline; 5b – poorly developed regions.
Source: Rykiel (1997).

of influence of the urban agglomerations of Łódź, Cracow, Tri-City and Szczecin remained poorly delineated. Semi-peripheries, or the immediate surroundings of the core regions, became more extensive, while the peripheralisation of the rest of the country remained fixed, and in some enclaves it even deepened and expanded. In north-western Poland the spatial extent of the Stargard-Koszalin enclave of a low development level increased, there emerged and became prominent an enclave of underdevelopment in central Poland, while the Radom-Puławy enclave of poor development kept on, and this in a close vicinity of the Mazovian region. There was almost no change in the belt of frontier peripheries, also in south-western Poland, which proves that the effect of the border location rent on accelerating the rate of economic development is poor. Poland's chief peripheries are still its south-eastern and eastern areas, which do not show yet the deep

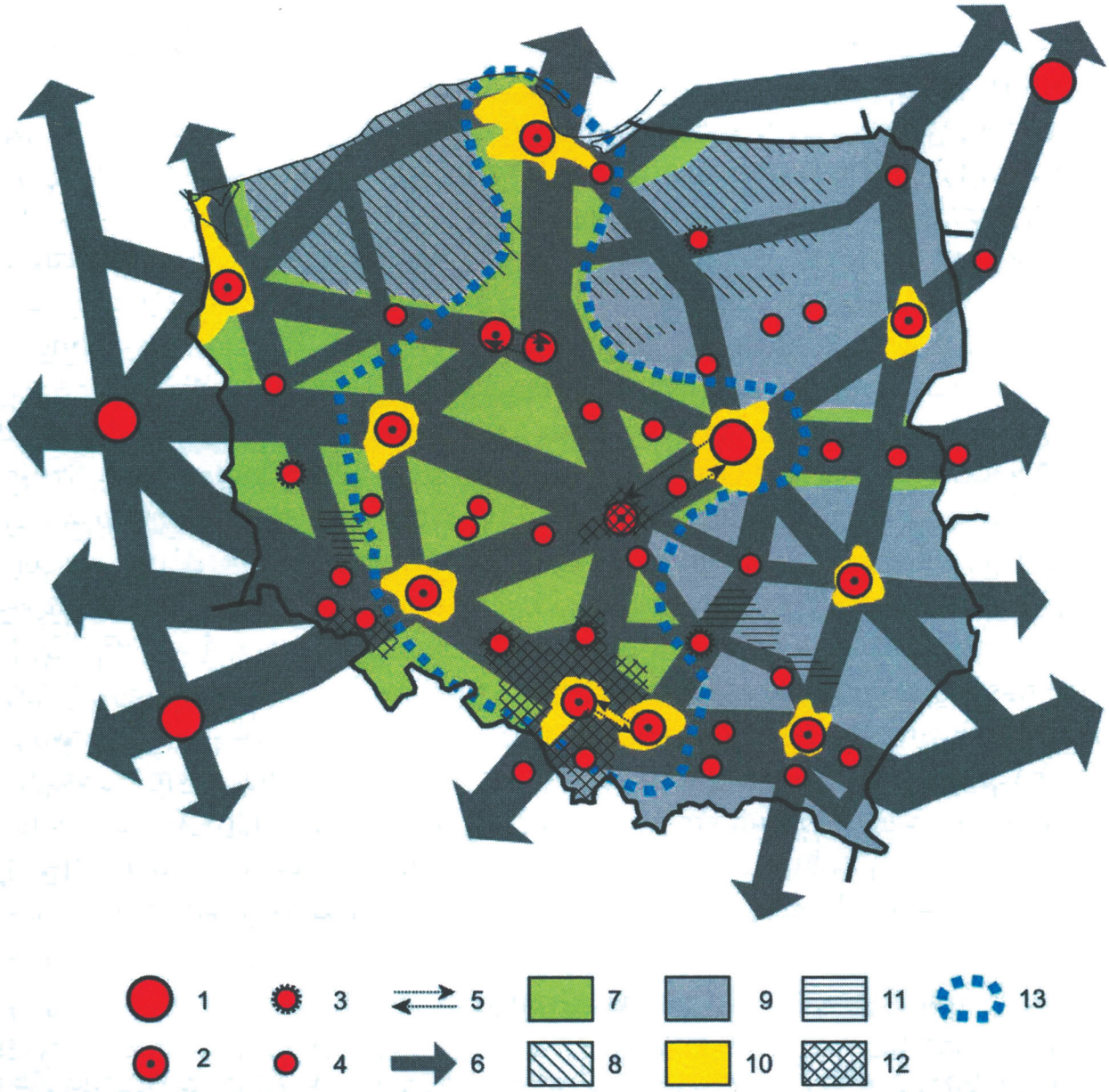

Fig. 5. Conception of Poland's spatial development policy: the development-balancing model.

1 – capital metropolis; 2 – European polarisation centres; 3 and 4 – development-balancing centres; 5 – bipolar links between centres; 6 – potential accelerated development routes; 7 – accelerated development zone; 8 – recession-reversing zone; 9 – activation zone; 10 – metropolitanisation-balancing zone; 11 – zone of breaking out of economic-base crisis; 12 – active restructuring zone; 13 – zone of growing concentration of civilisational and economic potential

Source: designed by Bański (2010) on the basis of *Koncepcja polityki*... (2001: 534).

socio-economic transformation necessary for dynamic development. The only germ of a 'development island' that emerged in the north-eastern part of Poland over the study period is the Białystok subregion.

The changes in the spatial-economic structure of Poland that took place over the years 1998–2008, i.e. at a stage of the country's advanced transformation and then after it had joined the European Union, which allowed it to use EU assistance funds, were not radical; rather, they were evolutionary in nature. During those ten years the spatial division of Poland into core regions and peripheries did not change fundamentally. Socio-economic development could mostly be observed in the core regions, which shows that

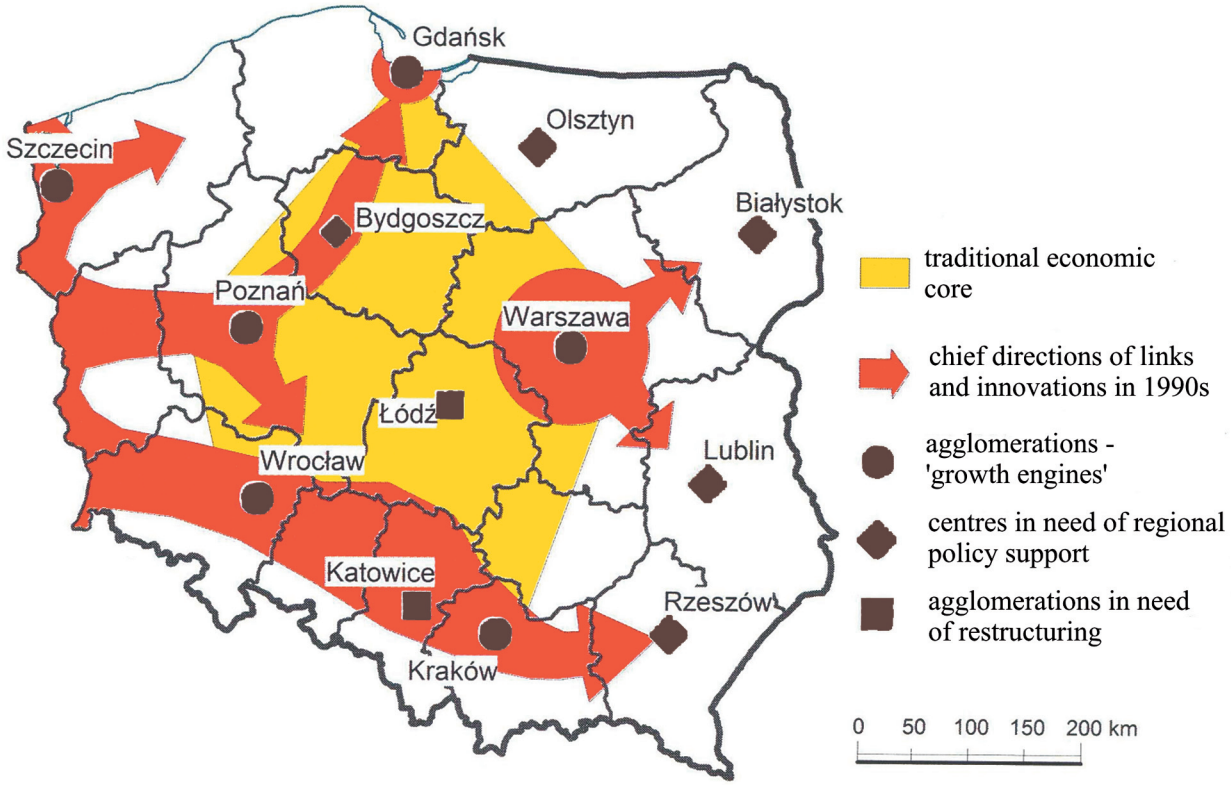

Fig. 6. Changes in Poland's spatial structure in the early 2000s.
Source: Węcławowicz et al. (2006: 19).

the process of divergence in the system of developed areas and those lagging behind still persists (cf. Czyż & Hauke 2010).

6. Poland's current spatial structure and spatial development scenarios

In order to examine how close Poland's current spatial structure comes to what has been envisioned as its correct shape, its 2008 spatial-economic structure was examined against selected scenarios of structural changes in its spatial development presented in the years 1997–2003.

The forecast of "The distribution of cores and peripheries in Poland at the beginning of the 21st century in case of its integration with the European Union" drawn up by Rykiel (1997: 245–246) stated that "by 2010 one can expect the shift of Poland's economic core from Warsaw to Wielkopolska to be well advanced. While the Warsaw agglomeration may still be the basic core, the Poznań agglomeration is likely to rise to the rank of an alternative core [...]. Tri-City, Cracow and Wrocław may keep their function of sub-cores, while Szczecin may have measured up to this role". The main latitudinal development axis would be an extension of the core regions of Warsaw and Poznań. "Another axis may develop in the Carpathians along the Cieszyn – Bielsko-Biała – Nowy Sącz – Krosno – Sanok line". There would also emerge a quasi-longitudinal development axis having the nature of a new semi-periphery and embracing a major part of the Gdańsk, Bydgoszcz, Wrocław and Opole region. "The remaining part of the country will form a periphery in which one will find poorly developed regions and those in decline" (Fig. 4). A verification of this forecast against Poland's current spatial structure shows that latitudinal axes have not developed, in particular the one running from the western border through Poznań to Warsaw. The forecast failed in its prediction of the degradation of the Silesian region to the class of "regions in decline". After the transformation shock, economic adjustment has allowed Upper Silesia to keep its position of a core region. Another point the forecast did not anticipate was that Poland's

accession to the European Union would give the Wrocław agglomeration an opportunity for very dynamic development. The point where it was right was an increase in the importance of the Warsaw metropolitan area and the Poznań agglomeration as the chief development centres in Poland.

The 2001 planning document *Conception of Poland's Spatial Development* (Monitor Polski no. 26/2001) emphasised the significance of the Warsaw metropolis and europoles (or urban agglomerations) as leaders of development and socio-economic changes as well as integration with the European economy. In the formation of Poland's new spatial structure, the chief role was supposed to be played by a central system of economic revival, a so-called zone of a growing concentration of civilisational and economic potential, situated in the polygon between Gdańsk, Bydgoszcz, Poznań, Wrocław, Cracow, Łódź and Warsaw, and accelerated development belts connecting them[6] (Fig. 5). This system was termed a potential Polish pole of European significance in Central Europe.

Also the model of changes in Poland's spatial structure in the early 2000s presented in the experts' report published by Węcławowicz et al. (2003) foresaw a similar spatial development pattern, with "a core of faster development in the central part of the country, based on the largest urban agglomerations in the role of growth engines, and development belts connecting them" (Węcławowicz et al. 2006: 18) (Fig. 6).

Thus, from the confrontation of the current (2008) spatial-economic structure of Poland against planning visions, one can state the following:

1) The polarised spatial system of a high development level connected with the distribution of its poles: the Warsaw metropolitan area and the biggest urban agglomerations, has solidified and strengthened. The areas surrounding core regions, i.e. the zone of semi-peripheries, show some symptoms of economic revival.
2) The asymmetry of development between western Poland and central and eastern Poland still persists. In the structure of western Poland, a belt of high development has emerged along the Poznań-Wrocław axis.
3) No anticipated development belts have appeared in central, southern and eastern Poland, whether latitudinal or longitudinal, as infrastructural and functional links of peripheral areas with urban agglomerations.
4) The widening spatial differences (polarisation, peripherality) and lack of territorial cohesion demonstrate that the spatial policy pursued in Poland so far has not produced the expected results ensuring the country a correct spatial structure, and should therefore be revised. Hence, it is necessary to continue the discussion about the rules and new ways of implementing spatial policy in Poland.

6 According to Bański (2010: 625), this conception of a central core development system can also often be found in more recent planning documents, where it is termed a Central Hexagon.

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