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ACCESSIBILITY, SETTLEMENT DISPERSION, AND UNEMPLOYMENT IN SLOVAKIA

A Thesis

Presented to the

Department of Geography-Geology

and the

Faculty of the Graduate College

University of Nebraska

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

University of Nebraska at Omaha

by

Pavol Hurbánek

April 2003

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THESIS ACCEPTANCE

Acceptance for the faculty of the Graduate College,

University of Nebraska, in partial fulfillment of the

requirements for the degree Master of Arts,

University of Nebraska at Omaha

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Date April 18, 2003

ACCESSIBILITY, SETTLEMENT DISPERSION, AND UNEMPLOYMENT IN SLOVAKIA

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University of Nebraska, 2003

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Abstract

The thesis examines the relationship between accessibility and unemployment and the relationship between settlement dispersion and unemployment in Slovakia. The two main hypotheses are as follows: First, the settlements with lower accessibility have higher rates of unemployment. Second, because the areas of dispersed settlement most likely experience poor accessibility, these areas have also higher rates of unemployment. While Slovakia is the main study area, additional analysis is conducted in the case-study region of the Myjava and Skalica Counties in the western part of Slovakia. Several methods are used to evaluate accessibility and settlement dispersion. Container approach and distance approach are the two approaches used to assess accessibility. Traditional method and kernel method of settlement density measurement are the two methods used to assess settlement dispersion. Correlation analyses and testing of their results for significance are the last two steps in the methodological design. Major findings and suggestions for further research of accessibility, settlement dispersion and unemployment are summarized at the end of the study.

Acknowledgement

I would like to thank Dr. Pavlínek for all he has ever done for me as my professor, main thesis advisor and my friend. I would also like to thank my other thesis advisors Dr. Gildersleeve and Dr. From for their guidance and help. I would like to acknowledge the professors at the Department of Geography and Geology at University of Nebraska at Omaha for the trust they put in me when I was accepted to the position of teaching assistant. I would also like to acknowledge the help of the institutions that financially contributed to my studies – American Fund for Czechoslovak Relief and Office of the Dean at University of Nebraska at Omaha,.

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1 Introduction

1.1 Nature of the Problem

A series of complex political, economic and social changes have taken place in Slovakia since the fall of state socialism in 1989. Political changes include democratization and the 1993 break-up of Czechoslovakia. Economic changes encompass the transformation from the centrally planned to a market-based economy through privatization and economic restructuring, and the changes related to Slovakia's efforts to achieve the admission to the European Union and NATO. Unemployment, a phenomenon officially unknown in any state socialist country before 1989, is one of the problems introduced and considerably amplified by the post-communist transformation. According to the National Labor Office (NLO), the unemployment in Slovakia was 17.7% in February 2003 (NLO 2003). However, the share of unemployed is much higher in rural areas than in cities. This poses a problem of inequity of job opportunities. This thesis will address this problem.

1.2 Terms and Concepts

Because many concepts employed in this thesis have multiple meanings and are often used in different contexts, it is crucial to define and explain them.

The first such concept is *accessibility*. One of the simplest of numerous definitions describes accessibility as "the ease with which one place can be reached from another" (Johnston 2000, 2). This definition implies the spatial (physical) dimension of the term,

and omits other dimensions, such as legal, economic, social, psychological, or temporal. The spatial dimension of accessibility will be of a paramount interest in this study *(Figure 1)*. According to Tolmáči (1998), Bruinsma and Rietveld define accessibility as "a potential of interactions with activities or sources." Like the definition by Johnston (Johnston 2000, 2), this one also implies that accessibility should be conceived as a *potential for commuting*. With regards to commuting to the place of work, employment accessibility could be seen as a potential for interacting with a job, i.e. a potential for commuting to work.

The spatial dimension of accessibility is based on the concept of friction of distance or friction of space. It may be measured in units of separation represented by geodetic distance (also called straight line or air distance), topological distance (number of nodes or edges), journey distance (e.g. by road or railway), time, or costs. The discrete notion of accessibility measurement is usually examined through the concept of direct (e.g. neighborhood approach) and/or indirect topological accessibility. This notion of accessibility measurement includes also the container approach, which is based on the presence or absence of an object within a specified area (Lindsey et al. 2001, 334).

Moseley (1979) argues that the distinction between the concepts of *spatial and social dimensions* of accessibility is not to deny the existence of important interrelationships between these two. "For example," he writes, "an improvement in a person's physical access to alternative places of work may bring social and economic benefits, which could increase the 'social accessibility' he or she enjoys" (Moseley 1979, 57). He continues with Ingram's definition of accessibility as "the inherent characteristic, or advantage, of a

place with respect to overcoming some form of spatially operating source of friction, for example time and/or distance." Moseley objects that this definition divorces accessibility from the nature of the desired *destination*, and thus it is concerned with mobility, i.e. ability to move, rather than accessibility. Since travel is rarely an end in itself, he thinks that accessibility should incorporate destinations as opportunities, which may or may not be present as a result of person's moving. Moseley also argues that, while Ingram's definition of accessibility refers to 'places,' geographers should be concerned with accessibility of 'people,' as the circumstances of different people in any given place may be vastly different. Pacione (1984, 286) discerns between these two as the *locational* accessibility and the *personal* accessibility. Moseley concludes that "it is the spatial dimension of accessibility, with which we are concerned, but the 'score-sheet' that we use should have social dimensions" (Moseley 1979, 58). Knox and Pinch (2000, 358) suggest that these social dimensions could be conceived of as *externalities*, i.e. by-products of relative location. Referring to the distinction made by Harvey (cited in Knox and Pinch 2000, 358) between the *price of accessibility* to desirable amenities and the *costs of proximity* to undesirable nuisances, they distinguish positive and negative externalities. This also shows that spatial and social dimensions of accessibility are complexly interwoven and cannot be separated.

Another term closely related to accessibility is *daily commuting region*. It is based on intraregional interactions resulting from daily life cycle of inhabitants of a region. A similar concept called *urban region* was developed at the end of the 1960s. In 1967, the Greek urban planner Doxiadis named it *daily urban system* (Bezák 1990, 58). *Urban*

region or *functional urban region* is defined as a spatially contiguous area, which is relatively closed with respect to its inhabitants' daily commuting to places of work, education, services, recreation, and social contacts (ibid. 57). Berry and Hall suggested that boundaries of urban regions should be delineated on the basis of intensive daily fluxes between the places of living and working (ibid. 58). This should facilitate the empirical application of the concept of urban region. The selection of commuting to places of work as the only form of daily contacts can be also advocated by the lack of data on other intraregional interactions, and by the theoretical and empirical reasons for the assumption that the daily commuting to work reflects spatial pattern of the broad spectrum of intraregional fluxes, especially commuting to service facilities.

Daily commuting region could be defined in terms of a certain *maximum daily commuting distance* between a *place of living* and a *place of work*. When an individual thinks about taking a new job, the maximum the distance he/she will be willing to commute depends on *(Figure 1)*:

- Compatibility / coincidence between his/her spatial constraints (such as, for example, the place of living and places of other vital activities) on one hand, and the commuting distance and routing of the means of transport on the other hand.
- Compatibility / coincidence between his/her temporal constraints (such as, for example, the time for sleeping and other vital activities) on one hand, and the commuting time, working time, and timing of the means of transport on the other hand.
- Compatibility / coincidence between his/her personal constraints (such as, for example, the physical and mental constraints, skills and personal preferences) on one hand, and

the personal satisfaction from the job, income, and costs of means of transport on the other hand.

In this study, the terms place of living and place of work will be substituted with the term *settlement*. In geography, settlement is understood as an elementary area unit of the settlement system. It is best defined as one or a group of permanently or seasonally occupied residential dwellings with adjacent nonresidential objects, separated from other settlements by a relatively wide unsettled area. However, there are usually no data available for settlements delineated on these principles.

The majority of all Slovak statistical data are available for *communities*, which are the elementary area units of Slovakia's administrative system. Communities are either *towns* or *villages*.[1] Towns in Slovakia are communities with a city status, which may or may not be assigned to a community by the parliament after a referendum in that community. Since the Census of 1970, *elementary settlement units* (ESU) are the smallest area census units distinguished by the official statistics in Slovakia. ESUs include *urban wards* (UW) and *settlement localities* (SL). UWs are delimited in cities with more than 10,000 inhabitants and in all county capitals, i.e. in 101 out of all 138 cities in the country (SEA 1999, 5). SLs are delimited in the remaining cities and in all villages. The main criterion for UW delineation is its internal functional homogeneity, and, in general, the UWs forming a particular city could be interpreted as functional zones of that city. SL is defined as an independent integrated grouping (clump) of residential buildings that

[1] In this study, the terms *town* and *city* are used interchangeably.

include at least 10 occupied residential units or 30 permanent residents.[2] The grouping is considered independent, if there is at least 200 meters of continuously non-built-up area or an impassable natural or artificial barrier of mutual accessibility between borders of each two groupings (SEA 1999, 3-4). From this definition, it may seem that SL is a synonym for settlement, because the delineation criteria for SL closely remind those from the geographic definition of settlement. However, that is not the case due to additional criteria used for the delineation of SLs, and due to the complexity of settlement system in reality. This mismatch can be illustrated by the number of 10,800 settlements delimited by the Slovak geographer M. Lukniš (1987, 5), as opposed to only 7,261 ESUs in the 1980 Census and 7,413 ESUs in the 1991 Census.[3] The conceptual mistake would be even bigger, if the communities were confused with settlements. The number of communities was only 2,725 in 1980 and 2,834 in 1991, as opposed to 10,800 settlements in the 1980s.

Thus, it is clear that some of the small, usually dispersed settlements are grouped together for the purposes of census and other statistical surveys. At the same time, other settlements are split into several statistical units. Moreover, while a settlement consists only of 'one or a group of settled residential dwellings with adjacent nonresidential objects,' communities and ESUs consist of both settled and unsettled (non-built-up) areas, covering thus the whole area of the country. These facts put crucial limitations on

[2] An occupied residential unit is defined as a residential unit with at least one permanent resident. A residential unit can be a single-family dwelling or a single apartment in an apartment complex.
[3] ESUs include both UWs and SLs. While SLs usually comprise one or more settlements. UWs are usually parts of settlements and not settlements themselves. The number of UWs in 1991 was 2442 (Slavík 1997).

the use of official statistical and census data, and on the research, in which the dispersion of settlements and accessibility play key roles.

1.3 Objectives, Hypotheses and Rationale

This thesis has two main objectives: *First*, to determine the nature of the relationship between accessibility and unemployment in Slovakia. *Second*, to determine the nature of the relationship between settlement dispersion and unemployment in Slovakia. The hypotheses for these objectives are as follows: *First,* the settlements with lower accessibility have higher rates of unemployment. *Second*, because the areas of dispersed settlement most likely experience poor accessibility, the settlements in these areas have higher rates of unemployment.

The first reasonable and most common rationale behind the first hypothesis is that if a person cannot get to work on time and return home after working hours, he/she cannot work. Obviously, some jobs can be carried out at home, but most of them cannot.

The principle of the relationship between accessibility and unemployment can be explained using several theoretical models. The first model is based on the notion of settlement system development. A system of settlement in a particular area is the result of its historical development. This system reflects the natural and socioeconomic conditions that affected its evolution in the past and that are still in effect today. As the society develops, its settlement system created in the past might not be suitable for its present needs. If once there was an equilibrium between peoples' places of living and places of work, this might not be true after the society has changed. Therefore, the mechanism of

re-reaching of the lost equilibrium starts through migration and/or commuting. If neither migration nor commuting take place it leads to an unequal spatial distribution of unemployment. Moreover, the disparities in the spatial distribution of unemployment rate are positively related to the intensity of the shift from the equilibrium that once existed between peoples' places of living and places of work. Thus, more radical political and/or economic changes in a society lead to a more unequal spatial distribution of job opportunities in that society.

The principle of the process of spatial differentiation of unemployment rate is explained in *Figure 2*. It shows the model of economic transition in hypothetical cities X and Y based upon two general assumptions: (1) X and Y form an isolated system, i.e. no employees from inside commute outside the system, and no employees from outside commute inside the system. (2) Population sizes of X and Y are equal and constant throughout the whole period of transition.

In *Figure 2A* there are the following additional assumptions: (3) The employment rate in the whole system is 100% and it is constant throughout the whole period of transition. (4) There are no physical and/or institutional (political, economic, social) barriers for migration (i.e. moving) between X and Y. (5) The concept of friction of distance between X and Y does not apply, i.e. the time and costs of commuting are minimal, converging to zero. Applying all the five assumptions, it holds that when a change occurs (for example, a company employing 20% of the residents of the city Y moves for some reasons to the city X) the newly unemployed residents of the city Y will either move or begin to commute to X.

Figure 2B shows what would happen, if the assumption about 100% employment did not apply.[4] The assumptions (4) and (5) still apply. It means that if there were neither barriers for migration nor negative externalities of commuting (e.g. travel time, costs) between the cities X and Y, the residents of Y, which have experienced relatively more intensive decline in number of job opportunities, would either move or commute to the city X.

A more realistic approximation of the situation that evolved in the two model cities in Slovakia during the transition is based only on the assumptions (1) and (2) (*Figure 2C*). This model incorporates the fact that there are political, economic, and social barriers to migration (which is the case in Slovakia.) It also incorporates the concept of friction of distance, based on which the residents of the city Y commuting to the city X experience the negative externalities of accessibility. Because the commuting to work to the other city requires time and costs money, some of the people who have lost their jobs in the city Y will decide not to commute to the city X which has a lower unemployment rate. Finally, as neither migration nor commuting occurs, or both of them are relatively limited, the rates between demand and supply on the labor markets of the two cities are different, leading to the unequal spatial distribution of the unemployment rate.

An alternative model of relationship between accessibility and unemployment is based on an individual's decision-making. Like the previous model, this one also presupposes institutional barriers of migration to the place of work. The decision-making model suggests that when an individual considers whether to take a new job or not,

[4] This situation is the case of Slovakia in its transition from the centrally planned to market economy.

he/she weights the advantages and disadvantages of being employed or unemployed against each other:

$$I + SJ > UB + AS + C$$

In this expression I stays for income, SJ for personal satisfaction from the job, UB for unemployment benefits, AS for alternative satisfaction, and C for commuting.

According to this model, the benefits coming from the job are greater than the benefits of being unemployed, and therefore the employment occurs. If the sign "is greater" in the expression was replaced with "is smaller," then the individual would not take the job and he/she would become or remain unemployed. On one hand, this model incorporates the advantages of employment, i.e. the income from the offered job and the potential personal satisfaction from the job. On the other hand, the model also includes the disadvantages of employment and the advantages of unemployment. The unemployment advantages include the payments of unemployment benefits from the government and the satisfaction from an alternative use of time, which involve leisure and/or personal satisfaction and income from the informal economy. The employment disadvantages are introduced into the model by commuting, mainly perceived in terms of time and costs. Because accessibility is conceived as a potential for commuting, it can substitute the commuting in the model:

$$I + SJ > UB + AS + A$$

In this expression, the value of accessibility (A) co-determines the fact, whether the sign "is greater" stays or is replaced by its counterpart "is smaller." Because the signs "is greater" and "is smaller" in this expression stay for "employment" and "unemployment"

respectively, the relationship between accessibility and unemployment is thus established.

The second hypothesis in this thesis inherently presupposes that dispersed settlements most likely experience poor accessibility. We use the theory to back up this presumption. In accordance with the central place theory (Christaller 1966), smaller and numerous lower order central places stock less goods and services than larger and less numerous higher order central places. Therefore, transportation services are typically scarcer in smaller settlements than in their larger counterparts. As the majority of Slovak population depends on public transportation, it is obvious that people living in small, dispersed hamlets and villages experience greater inaccessibility problems than those in more concentrated and populated villages, although both of them may be in the same distance from a particular service and/or employment center. In addition to public transportation, activities such as road maintenance should also be included in transportation services. The car-owners living in dispersed settlements are then also affected, as the probability that they can get to work (on time) during winter is reduced.

An alternative explanation can be given using the concept of daily commuting region. As explained above, such a region is determined on the basis of a certain maximum commuting distance from every place of living (every settlement) to all the places of work (all the settlements with employment opportunities) within this distance. If the maximum commuting distance is constant for all settlements and the density of opportunities (per area unit) spatially varies, then it is obvious that the lower density of job opportunities in a particular area results in the smaller number of job opportunities in

the daily commuting region in that area. Also, a lower ratio of job opportunities per capita in productive age leads to a smaller chance to get a job. The question remains what areas have the low density of job opportunities and also the low ratio of job opportunities per capita in productive age. In most cases, rural areas are the areas of scarce job opportunities, limited mobility, and consequently of scant employment accessibility and rural depopulation (*Figure 3*) (e.g. Moseley 1979, Gilg 1985, Pacione 1984, Robinson 1990, Zubrický 2000). The small size of settlements and low population density (which implies mutual remoteness of people, their activities and settlements) are generally accepted as the main characteristics of rural areas, therefore "it should come as no surprise to learn that problems of inaccessibility are particularly serious there" (Moseley 1979, 1). Because it can also be suggested that the more intensive these characteristics are, the more striking are the problems, it is reasonable to assume that people in smaller, dispersed villages experience worse accessibility than those in "regular" rural areas with larger, concentrated villages.

Figure 4 depicts a model situation when two different communities have the same distance to the regional employment center, i.e. a city, in whose hinterland they are located. Because people living in the small dispersed built-up areas of Village B – which are basically settlements of their own – face a problem of "additional distance," they hardly enjoy as good accessibility as those living in the concentrated built-up areas of Village A. In the case when there are *no* direct connections (in terms of roads or public transportation lines) between the small dispersed built-up areas and the city, the "additional distance" is a physical distance between the periphery of Village B and its

core. In the case when there *are* direct connections between the small dispersed built-up areas and the city, the term "additional distance" represents the fact, that these connections are of lower order than the one between the concentrated built-up areas of Village A and the city. This lower order could be expressed in terms of the quality of road or of its maintenance, or in terms of frequency and speed of public transportation connections.

Another possible scenario of the relationship between accessibility and settlement dispersion may develop especially in certain types of mountainous areas in conjunction with particular types of historical settlement development. In such a landscape, the regional center is often located in a bigger valley with the surrounding smaller valleys and upland areas forming its hinterland. Under these circumstances, a community, which is located further from the regional center, is also further / higher in the uplands and it has a more dispersed settlement pattern. If this is the case, then it can be said that dispersion and distance to the regional center covariate and, therefore, they cannot be used as two independent variables for explaining any dependent variable such as unemployment. However, this problem is beyond the scope of this study.

1.4 Significance of the Research

This thesis contributes to the mitigation of the problem of unequal distribution of job opportunities in Slovakia. As mentioned above, the unemployment rate in Slovakia is high, and it is unequally distributed. Rural areas generally suffer from higher unemployment than urban areas and they also face substantial inaccessibility problems.

Therefore, several questions arise: What is the relationship between accessibility (conceived as a potential for commuting) and unemployment? What is the coincidence of their patterns of spatial distribution? Does limited accessibility contribute to unemployment? If so, to what degree does limited accessibility contribute to unemployment?

This thesis examines the nature of the relationship between accessibility and unemployment in Slovakia. If it is found that these two phenomena are tightly related, then further research will be needed to determine whether this relationship is causal or spurious, and to what degree limited accessibility contributes to unemployment. The answers to these questions represent important information for the decision-makers in Slovakia responsible for the alleviation of spatial inequity of job opportunities. Knowing that limited accessibility has a strong negative influence on unemployment, they could redirect their resources towards the problem of inaccessibility. If it is found that there is no relationship between accessibility and unemployment rate, or that this relationship is not causal, the responsible decision-makers will need to examine other factors that cause unemployment and use their resources to mitigate them.

2 Literature Review

The body of literature that relates to the objectives of this study can be divided into several topical groups: rural geography, settlement geography, dispersed settlements in Slovakia, unemployment in Slovakia, accessibility and spatial analysis.

A part of the rationale for the hypotheses discussed in the previous chapter is based on the works by the British authors (e.g. Pacione 1984, Gilg 1985, Robinson 1990) published within rural geography in the 1980s and early 1990s. Addressing such themes as rural population, housing, settlement patterns, agriculture (agricultural geography), forestry, transportation, service provision, tourism, recreation, land use, conservation and planning, they provide a comprehensive summary of the body of knowledge in this field. Subjects most pertaining to this study include rural employment and accessibility. Importance of the latter is demonstrated by the existence of a separate monograph "Accessibility: The Rural Challenge" authored by Moseley (1979). This book presents the results of an extensive transport and accessibility research project, synthesizes previous works on the subject, and appraises policy developments in the sector. The significance of the problem of rural accessibility can be also demonstrated by the interest of the Committee of the Regions, which addressed this issue in regions of the European Union (CR 2000). In Slovakia, as in the most of other post-socialist countries, rural geography as an individual branch of geographic research is only of a very recent origin. Its studies (e.g. Lobotka 1987, Zubrický 1994, 1998, 1999a, 1999b, 2000, Spišiak 1996, 1997a,b, 1998a,b) deal mostly with the transition of rural areas within the context of Slovak economic transformation and also with particular theoretical and methodological problems.

Before rural geography evolved as a relatively freestanding subdiscipline of geography, the issues of rural areas, especially those of spatial nature, were traditionally dealt with in geography of settlements. Hudson's (1970) "A Geography of Settlements"

represents an example of the comprehensive work on geography of settlements, still comprising rural, as well as urban components. The spatial aspects of settlements, such as settlement morphology and settlement patterns, are thoroughly discussed in Roberts' (1996) "Landscapes of Settlement: Prehistory to the present." He focused especially on the rural part of settlement systems. Some of the older and more analytically oriented works in this area include studies by, for example, Barnes and Robinson (1940), Robinson and Bryson (1957), Dacey (1960), R. P. B. Singh (1974), and studies 11 through 15 in R. L. Singh et al. (1976). The traditional Slovak geographers that contributed to the research on settlements include Veršík (1974, 1980), Lukniš (1987), Baran and Bašovský (1998). The new generation of authors such as Slavík (1985, 1997, 1998, 1999) and Buček (1997), addresses transformation of the settlement system in Slovakia, conceptions of planning, and issues of public administration. A special topical subset of geography of settlements is formed around the body of literature dealing with the settlement structure conceived as a spatial aspect of societal organization (e.g. Hamerská 1983, 1989, Andrle 1983, Šteis 1985, SEA 1999, and Hájek et al. 2000). This subset of literature defines the elementary concepts of settlement system classification, and thus sets the stage for further applied research.

In addition to the works with emphasis on the spatial aspect of settlements, it is also important to consider the studies on the dispersed settlements in Slovakia. This issue was addressed already in 1905 by Medvedecký, and since that time by many other authors throughout the century including, for example, Janšák, Hromádka, Fekete, Mesároš, Verešík, Pozdišovský, Horváth, Huba, and others (Petrovič 2002). Some of the recent

studies on dispersed settlements in the Myjava region were written by Lauko (1985, 1990, 1996), Lauko and Nemček (1998), and Varsík (1985). Almost all of the authors named above come from the fields of geography, history and etnography. The topics that appear most frequently in their works include the definitions of dispersed settlements, the classifications of dispersed settlements according to their origin, size, and morphology, and the changes of dispersed settlements throughout the history up to the present, including the population development, and social and economic transformations. Most of the authors also attempted to delineate the areas of dispersed settlements in Slovakia usually followed by their individual and/or typological regionalization. The majority of the research on spatial aspect of dispersed settlements in Slovakia is mostly qualitative, i.e. based on the human ability to visually interpret, impose order and recognize pattern, or on the official statistics, whose drawbacks were discussed above. It can be suggested that in the spatial analysis of these areas there is a potential for the use of quantitative methods that have not been applied yet.

Another body of literature significant to this study relates to unemployment. In Slovak geography, the issue of unemployment is mostly discussed by authors in regional geography and regional development (e.g. Rajčáková 1994, 1996, 1998, Bezák 1996, Hurbánek 2002). Their studies attempt to account for the spatio-temporal variations in unemployment rate generally as well as specifically in selected ethnic and social groups, reflecting the political, economic and social transformations in Slovakia. For example, Fáziková and Harceková (1996) devote special attention to agricultural unemployment and its relation to land use changes. Other regional-geographic / demographic studies

significant to this thesis include works by Švecová (1998) – on urban and rural population development, and by Jurčová (1996) – on internal migration.

Before the second half of the 20th century, there was no major interest in exploring accessibility in the literature. Although some of the earlier works in theoretical geography do not specifically address the issue of accessibility, they provide an important theoretical background (e.g. Christaller 1966; originally published in 1933). The more significant from the earliest studies dealing with accessibility include those by Haggett (1965), and Haggett and Chorley-(1969). These authors greatly contributed to the development of graph theory, from which most of the accessibility measures evolved. Hoggart (1973) conducted a comprehensive review of the literature on transportation accessibility. Since then, the notion of accessibility as a potential for spatial interaction has been further developed by e.g. Vickerman (1974), Pirie (1979), Weibull (1980), Bröcker (1989), Geertman and Ritsema Van Eck (1995). The concept of accessibility is employed in numerous studies dealing, for example, with countryside recreational access in the United States (Millward 1996), employment probability in metropolitan Detroit (Perle et al. 2002), equity in transport planning in the United Kingdom (Vigar 1999), and equity of access to urban greenways in Indianapolis (Lindsey et al. 2001) and elementary schools in West Virginia (Talen 2001). Slovak geographers address accessibility mainly in connection with the issues of transportation networks (Korec 1993), population potential (Kusendová 1993, 1996a,b), and regionalization (Tolmáči 1996, 1998). Commuting, a subject related to the topic of accessibility, was studied by Bezák (1990), who delineated the functional urban regions in Slovakia.

In addition to the studies dealing specifically with measures of accessibility, there are also other more or less general works on quantitative analysis in geography (e.g. Yeates 1974, Griffith and Amrhein 1991, Cressie 1991, Burt and Barber 1996, Clark and Evans 1954, Thompson 1956, Getis 1964, Boots and Getis 1988). They provide background on the methods that will be employed in this thesis. Besides the potential models that are used in accessibility measures, these works also explain the principle of the kernel method for estimating probability density.

3 Study Area

Independent Slovakia was established after the break up of Czechoslovakia on January 1, 1993. The area of Slovakia is 49,034 sq. km (19,933 sq. mi), its population is 5,379,455, and population density is almost 110 inhabitants per sq. km (270 inhabitants per sq. mi). The ethnic structure is dominated by Slovaks (85.8%), Hungarians (9.7%), Romas (1.7%), Czechs (0.8%), Rusins (0.4%) and Ukrainians (0.2%). The religious structure is composed of Roman Catholics (68.9%), Evangelics (6.9%) and Greek Catholics (4.1%). Atheists account for 13.0% (SRSO 2003).

Slovakia is divided into eight districts that are subdivided into 79 counties. For the purposes of this study, the five counties forming the area of the capital and the largest city of Slovakia – Bratislava (called Bratislava 1 through Bratislava 5) are merged into a single region (called Bratislava in this study). The five counties forming the area of the second largest city of Košice and its surrounding (called Košice 1 through Košice 4 and

Košice – okolie) are merged into a single region (called Košice in this study). Thus, 71 "customized counties" are established, that will be called counties in this study (*Figure 5*). The local level of self-government administration is represented by 2,883 communities (*Figure 6*), out of which 138 have a city status. As argued above, it would be misleading to equate communities with settlements, and therefore the polygons of built-up areas are employed as a more accurate representation of settlements (*Figure 7*).

Two counties – the Myjava County (17 communities) and Skalica County (21 communities) – form the case-study area where additional analysis is conducted. Their selection is mainly based on data availability. The population of the Myjava County is 29,243, with 13,142 inhabitants living in the town of Myjava, and the population of the Skalica County is 46,791, with 15,013 inhabitants living in the town of Skalica (SRSO 2001b). What these two counties have in common is their location at the Slovak-Czech boundary. However, several significant differences between these two counties can be identified. While the Skalica County is more of a gateway-type area with seven border crossings from Slovakia to the Czech Republic (two of them being of national importance), the Myjava County has only two border crossings (both of them of just local / regional importance). This situation is, to a significant degree, determined by the nature of topography in these two areas (a greater vertical dissection in the Myjava County) and by the historical development. Topography and history also influenced the morphology of the settlement system in these two areas, which is dispersed in the Myjava region and clustered or concentrated in the Skalica region (*Figure 8*).

As mentioned above, many authors (e.g. Moseley 1979, Gilg 1985, Pacione 1984, Robinson 1990, Zubrický 2000) recognize the problems of scarce job opportunities, limited mobility, and consequently scant employment accessibility as some of the major reasons for rural depopulation. Though the period of rural depopulation (urbanization) was followed by the period of rural repopulation (counterurbanization) in most of the Western developed countries during the later half of the 20th century (Gilg 1985, 72), this situation does not apply to Slovakia. While the migration balance in Slovakia between 1980 and 1991 in the size category of communities with population of 5,000 or more was positive, it was negative in the categories of communities with less then 5,000 inhabitants. Nevertheless, the net emigration from small communities declined significantly from about 28,000 to 10,000 migrants in communities with less than 2,000 inhabitants, and from about 8,000 to 2,000 migrants in communities with 2,000 to 4,999 inhabitants between 1980 and 1991 (Jurčová 1996). This decline also relates to the decrease in the net immigration to cities. According to Bezák (cited in Zubrický 2000, 320), the relative growth of Slovak urban population after 1990 was only about a quarter of the growth between 1970 and 1980, and about a third of the growth between 1980 and 1990. Although this may imply that Slovakia is entering a new era of population deconcentration, Bezák suggests that it is the outcome of the reduction in apartment buildings construction in cities, which considerably weakened population mobility. However, he argues that it is only a temporary change, caused by the post-1989 socioeconomic transformation, and therefore it should not be misinterpreted for the beginning of counterurbanization process (ibid. 320). Gilg (1985, 69, 78-79) and Pacione

(1985, 162) contend that rural repopulation is usually experienced first and to a greater extent by larger villages close to cities, while the smaller and more remote villages may experience only slow growth or be still in the phase of depopulation. This suggests that even if there were signs of counterurbanization in certain areas of Slovakia, these areas would be most likely located in the immediate hinterlands of the largest urban aglomerations in Slovakia (suburbanization of metropolitan areas), rather than in the surrounding countryside of smaller cities and towns.

As mentioned in the rationale, the societal transition disrupts the equilibrium between peoples' places of living and places of work. Consequently, this disruption leads to unequal spatial distribution of unemployment rate. More radical economic and/or political changes lead to more unequal spatial distribution of job opportunities. We suggest that the transformation in Slovakia has had the nature of a radical change and considerably contributed to the spatial inequity in job opportunities. This can be compared to the gradual evolution in the developed Western countries, where workers leaving the cities are ready to commute. The differences between Slovakia and the West relate mainly to the hinterlands of smaller urban centers (centers of about 10 to 50 thousand inhabitants), where the contrast between the counterurbanization in the West and the continuing rural depopulation in Slovakia is the greatest. The two important differences that can be identified relate to the changes in agricultural employment and in the public transportation and car ownership.

Agricultural employment is traditionally the main sector of economic activity in rural areas. As shown in *Figure 3*, the decline in agricultural employment is the initial stimulus

of rural depopulation. In 1991, 21.3% of the economically active rural population in Slovakia worked in agriculture (Zubrický 2000, 319). However, with the onset of economic transformation the phenomenon of the "artificial full employment" inherited from state socialism disappeared. Many workers in agriculture lost their jobs. During the first few years of transformation (1990-1994), the number of employees in the Slovak agriculture dropped by 51% (Fáziková and Harceková 1996). The agricultural employment in upland regions, which have the worst farming conditions in the country, experienced even worse decline by about 60%. Based on the theory of rural depopulation (*Figure 3*), an increased level of countryside out-migration should be observed. However, as explained above, the actual rural depopulation declined, and the urban in-migration in the 1990s reached only one third of its 1980s level.

So, if the people who lost jobs in villages do not move to cities, do they commute to new jobs in cities, where the unemployment rate is lower? No data on commuting are available and therefore the question cannot be answered with certainty. However, the matter of fact is that since 1990 the public transportation services have been steadily and considerably reduced in frequency and their real prices have risen. This situation led to the decline in the number of accessible destinations (at least during particular times) and most likely also in the number of people using these services. If less people use public transportation, do then more people commute by private cars? The data on commuting by cars are not available. However, the Census data show that the percentage of the occupied residential units (households) with a car out of all occupied residential units was 39.2% in

1991 and 39.1% in 2001 (SRSO 2003). This suggests that the private car commuting did not offset the decline in public transport services.

With respect to the evolution of the "living-working places inequilibrium" in Slovakia, when compared to the evolution in the more developed western countries, the following conclusions can be made: (1) Slovakia experienced a more radical decline in agricultural employment, and therefore a more radical growth in the rural unemployment rate than the West. (2) Because the governmental apartment buildings' construction in Slovak cities dramatically slowed down, the prices of housing in cities rose much faster than in the West, thus slowing the migration to the Slovak cities. (3) The public transportation services were reduced at a faster rate in Slovakia than those in the West. (4) The reduction of public transportation services in Slovakia was neither preceded nor followed by an increase in private car ownership rate, which occurred in the West.

4 Methodology

4.1 Data

The unemployment data used in this thesis were provided by the Slovak National Labor Office (NLO 2002). They represent counts of unemployed in all 2,883 communities as of 31 December 2001 (*Figures 9 and 10*). As shown in Hurbánek (2002), unemployment is a phenomenon of a great spatio-temporal complexity. Therefore, a dataset that represents only a cross-section in time may not completely capture the nature

of this dynamic phenomenon (*Figure 11*). Unfortunately, this is the only available moment, for which the unemployment data are available at the level of communities.

The data on the number of job opportunities, that are staffed (existing jobs) as well as those that are vacant (openings for applicants), are very important to consider in this type of research. Unfortunately, they are not commonly available in official statistics. After consulting several County Labor Offices (CLOs) in the western part of Slovakia, these data were acquired only from two of them – the NLO-CLO in Myjava (2002) and the NLO-CLO in Skalica (2002). They represent the number of job opportunities as of 31 December 2001 and are spatially aggregated at the level of communities (*Figure 12*). The most important drawback of these data is that they are based on the addresses of the firms' headquarters and not on the actual location of jobs.

The data on the number of permanent residents and the number of economically active, i.e. those who either have a job or are unemployed (labor force), in each community were obtained from the 2001 Census carried out by the Slovak Republic Statistical Office on 26 May 2001 (SRSO 2001b). There is an obvious temporal mismatch between the unemployment and census data. Because unemployment rate is computed as a ratio of the number of unemployed and the number of economically active, this mismatch causes an error in the values of unemployment rate. As a result of this error, four communities have values of unemployment rate exceeding 100%. For the purposes of this study, these values are put equal 100%, as no other information for their refining is available. It should be also acknowledged that there are probably more errors in these data in addition to the temporal mismatch error, because, for example, in the case

of community of Radnovce, the number of unemployed (247) exceeds the number of economically active (184) by 63 (34%). It is unlikely that such a significant difference is caused only by the temporal mismatch.

The spatial data used in this study come from the vector version of the Base Map of Slovak Republic 1 : 50,000 (CGI 1998). They include the data on built-up areas, roads, and the boundaries of the communities' administrative areas. The layer of built-up areas consists of 95,075 polygons of three different types: individual buildings (47,401), blocks of built-up area (47,075), and blocks of built-up area with recreation housing (599). Because built-up areas serve the purpose of a proxy for settlements in this study, i.e. the places where people live (not where they recreate), only the first two types of polygons are used in the analysis further on. Although, it cannot be stated with certainty that people live in all of the areas of these two types, it is evident that the areas of the third type have no permanent residents. From the layer of road network, only the roads of the first, second and third class are used for the analysis of road accessibility. Because this data have too many topological errors, it was only possible to conduct the analysis of road accessibility in the case-study area of the Myjava and Skalica Counties, where the errors have been manually eliminated (*Figure 8*).

Finally, the data on bus station locations and main bus stops in the Myjava County were acquired by global positioning system (GPS) during the fieldwork in the summer of 2002.

4.2 Measuring Accessibility – Distance Approach

4.2.1 Distance

In this study, accessibility is measured in terms of physical distance. Due to the shortcomings of the road network data described above, air distances are used at the country level and road distances are used only at the case-study-area level.

As mentioned above, built-up areas better represent settlements than communities do. However, there are no data available for the polygons of built-up areas with the exception of their location, shape and size. All other data (i.e. total population, economically active population and the counts of unemployed) are not available beyond the level of communities. Therefore, the distances are measured between communities and the data on built-up areas are only used to "locate" communities.

4.2.2 Point Representations of Communities

Because communities are physically represented as polygons of their administrative areas, the methodological problem that arises is how to measure distance between two polygons. One of the solutions is to find the points that represent the locations of these polygons and then to measure the distance between the points. Ideally, such points would be located in approximate centers of the polygons, and therefore they are called centroids. A search for a method that would produce the "best centroids" for all possible polygons has been a long debated topic. One of the solutions for this problem is ArcView's function called ReturnCenter (ESRI 2002). However, the exact algorithm of this procedure has not been published, and therefore some of its nuances had to be revealed

by testing for the purposes of this study. According to ESRI (2002), this function first constructs a bounding box, i.e. the smallest possible rectangle (with two of its 4 sides horizontally oriented) that completely contains the polygon. Then, the function returns the center of that bounding box with coordinates X_bY_b. If this point falls inside the polygon, then it becomes the centroid of that polygon. If it does not fall inside the polygon, then it is moved in the horizontal direction (X-direction) until it falls inside the polygon. The question remains how far the point is moved. The testing revealed that if the intersection of the polygon and a line defined as $Y = Y_b$ and $X = \{ -\infty , \infty \}$ produces only one segment, then the point is placed in the middle of that segment. If the intersection of the polygon and that line produces two or more segments, then the point is placed in the middle of the longest segment. However, more testing was needed that would explain how the ReturnCenter function works on polygons consisting of multiple parts. Huber (2003) revealed that if the center of the bounding box of the multipart polygon *falls* inside one of the parts of the polygon, then it becomes the centroid of that polygon. If the center of the bounding box of the multipart polygon does *not fall* inside one of the parts of the polygon, then the procedure is applied to the largest part of the polygon, and its result becomes not just the centroid of that particular part, but also the centroid of the whole multipart polygon.

To receive the best results, i.e. to find the "most representative" centroids for the locations of communities, several methods have been developed for the purposes of this study resulting in the following five types of centroids (*Figure 13*):

Type A Centroid. This centroid is created by applying the ReturnCenter function to the polygon of community's administrative area.

Type B Centroid. In this case, each community is represented by a multipart polygon, i.e. an object consisting of multiple polygons. This multipart polygon represents all the built-up areas within administrative boundaries of a community. By applying the ReturnCenter function to this multipart polygon, Type B Cenroid is generated for that community.

Type C Centroid. ReturnCenter-type centroid is created for each part of the multipart polygon that represents all the built-up areas within administrative boundaries of a community. Using the coordinates of the centroids of these parts (X_iY_i), mean X and mean Y are computed, and these are accepted as the coordinates of the Type C Centroid.

Type D Centroid. This type of centroid is computed similarly as the previous one. In this case, however, weighted arithmetic mean is employed instead of regular arithmetic mean. The sizes of the built-up areas are used as the weights for the respective X_i and Y_i.

Type E Centroid. As mentioned before, built-up areas in the source data are either (1) *individual buildings* or (2) *blocks of built-up area* (*Figure 14a*). Because these source data have originally been produced by digitizing paper maps, they still preserve some of the characteristics inherent to paper maps. Exaggeration of some of the objects on a map and generalization of others are examples of such characteristics. In this case, a problem arises due to the exaggeration of the width of the roads in built-up areas, which divides almost a continuous built-up area into numerous blocks of built-up area. For the purposes of this study, it was decided to eliminate this "unwanted heritage" by applying the

following "blending procedure" to the second type of built-up areas, i.e. to blocks of built-up area (*Figure 14*). First, a buffer is made around each of the polygons representing blocks of built-up area. The size of the buffer is determined on the basis of the "maximum width" of the roads on the original 1 : 50,000 source paper maps. Because this "maximum width" is estimated to be about 3 millimeters on the paper map, which correspond to about 150 meters in reality, the size of the buffer is determined as one half of this value – 75 meters. This ensures an overlap of the buffers of the blocks of built-up area, which were originally separated by a symbol of a road less than 3 millimeters wide (*Figure 14b*). The overlapping buffered objects are transformed into a single object (*Figure 14c*). An "inside buffer" of 75 meters is then "subtracted" from all the objects, to which an outside buffer of 75 meters was previously added (*Figure 14d*). As a result, all the blocks of built-up area, which were seemingly clustered at the beginning (*Figure 14a*), are now part of one continuous built-up area polygon (*Figure 14e*). Finally, all the built-up area polygons – both the blended blocks and the individual buildings – within administrative boundaries of a community are transformed into a single multipart polygon (similarly as it is done in the case of Type B Centroids). By applying the ReturnCenter function to this multipart polygon, Type E Cenroid is generated for that particular community.

The centroids of all of the types were then visually examined. It is concluded, that certain types of centroids perform better in certain types of communities characterized by the shape of their administrative area, and by the shapes, sizes and spatial arrangement of the polygons of their built-up area. Generally, it is the most difficult to construct a

representative centroid for the communities whose built-up areas are most dispersed. In other words, the different types of centroids created for such a community are more spread out than the centroids created for a "normal" concentrated community (*Figure 8*). According to the rationale behind the procedures of the construction of different centroids, Type E Centroids should perform the best. This also seems to be the case when the different types of centroids are visually examined. To support this claim, a quantitative test is designed for the purposes of this study and applied to the western part of the case-study area (the Myjava County), which has dispersed settlements that are more difficult to represent by centroids (*Figure13*).

As it was discovered during the field work, one of the multiple bus stops in a community – usually the one located at the community's main square, main retail business, and/or council building – is commonly considered to be its main bus stop, and therefore its location can be deemed as "central." Using GPS, the locations of these bus stops were measured in 17 communities of the Myjava County, and they were compared to the locations of all of the types of the constructed centroids. This was achieved by computing air distances between the bus stops and the respective Centroids of Type A through E for all 17 communities, and calculating their arithmetic means. The resulting averages of distances between bus tops and each of the types of centroids are as follows: 1074 meters to Type A Centroids, 768 meters to Type B, 828 meters to Type C, 586 meters to Type D, and 468 meters to Type E Centroids. Although this test is not exclusively objective – due to the potential introduction of subjectivity through the procedure for the selection of the "central" bus stops – it supports (at least in the case of

the Myjava County) the results of the visual interpretation. Type E Cenroids are therefore applied as the "most representative" points of communities' locations and are used in the further analysis in this study.

4.2.3 Destinations

In reality, almost every community is a source as well as a destination of accessibility at the same time. However, this study uses a simplified model, in which each community is a source of potential commuting, but only some of them are also destinations. In the case when a source is identical with a destination, the distance is put equal to zero.

The selection of the destinations of potential commuting, i.e. the destinations of accessibility is one of the critical points in the methodology. In theory, these destinations are called *regional employment centers. An average of maximum commuting distances* could be used as one of the criteria for the selection of these regional employment centers. However, no such an average is available. Moreover, this method would not incorporate the scale-dependency of commuting, which is based on the fact that this average as well as the size of a daily commuting region varies significantly according to different types of jobs.

Another solution would be to use the centers of functional urban regions delineated by Bezák (1990). However, his study provides only the list of the regions, not the list of their centers. Therefore, a different approach has to be followed in this study. A feasible solution is to use district seats, county seats and towns (*Figure 15*) as crude proxies for regional employment centers, which represent three different scales of daily commuting

regions. This idea is based on a potential similarity existing between the functional hierarchy of public administration and the hierarchy of daily commuting regions. Another alternative, partially based on the central place theory (Christaller 1966), suggests that towns of certain sizes could serve as crude proxies for regional employment centers. Again, a three-level system is applied: the towns with more than 30,000; more than 20,000; and more than 10,000 inhabitants (*Figure 16*). Together these two alternatives yield six types of commuting centers: district seats (8 in count), county seats (71), all towns (138), towns with over 30,000 inhabitants (23), towns with over 20,000 inhabitants (40), and towns with over 10,000 inhabitants (72). In all six cases, the air distance to the nearest potential employment regional center is recorded, and thus each community is assigned six values of accessibility (*Figures 17-22*).

At the national scale, Bratislava – the capital and the largest city in Slovakia – may be theoretically considered the center of the daily commuting region of the highest possible rank. While one might argue that daily commuting to Bratislava applies only to a few types of jobs, the underlying nature of the input data reveals why it is appropriate to consider Bratislava as the highest rank daily commuting center. Undoubtedly, the capital of Slovakia offers the greatest number of job opportunities in the country and the average salary in Slovakia is by far highest in Bratislava and its immediate hinterland. These two facts motivate people to commute to Bratislava from large distances. In many cases, however, instead of daily commuting, commuters choose to stay in temporary residencies in Bratislava, while returning home only weekly, biweekly or less often. These commuters thus keep their permanent home addresses outside Bratislava. As a result, in

official governmental statistics they are included in the number of residents, economically active and employed in their home communities, thus effectively contributing to their lower unemployment rates. As such, they become what can be called "seeming daily commuters." This *seeming daily commuting* is the primary justification for measuring the distance between a community and Bratislava and for considering the potential influence of this distance on the level of unemployment rate in that particular community. Thus, each community is assigned the seventh value of accessibility (*Figure 23*).

Above described methodology based on air distances is applied to all 2,883 communities in Slovakia. Similar methodology, based on road distances, is applied to 17 communities of the Myjava County and 21 communities of the Skalica County. In this case-study area, only the accessibility of the nearest county seat and of the nearest town is measured. These centers may not necessarily be located within the case-study area. Finally, each community is assigned two values of road accessibility – one to the nearest county seat and the other one to the nearest town (*Figures 24 and 25*).

4.3 Measuring Accessibility – Container Approach

In addition to the distance approach to measuring accessibility, a container approach is also employed. Because it requires the data on the number of job opportunities, which are commonly not available, it is used only in the analysis in the case study area of the Myjava and Skalica Counties. According to this approach, the employment accessibility in a community is defined as the ratio of the number of existing job opportunities and the

number of economically active living in that particular community. If this ratio is multiplied by 100, then the accessibility is expressed as the number of job opportunities per 100 economically active (*Figure 12*).

4.4 Measuring Settlement Dispersion

As mentioned above, the delineation of dispersed settlements in Slovakia in the existing research is usually based on visual interpretation and/or on the official statistics, whose drawbacks were discussed in section 1.2. The method employed in this study is based on the evaluation of settlement density. For the purpose of this assessment, settlements are represented by built-up areas, which include individual buildings as well as the preprocessed blended blocks of built-up area (*Figure 14*). The objective of this evaluation is to find a value of settlement dispersion for each of the 2,883 communities.

Two different methods of density measurement are used: "regular" (traditional) method and kernel method. The regular method of density measurement employs the ratio of the number of settlements in a community and the area of that community. It is expressed as the number of settlements per one square kilometer (*Figures 26 and 29*).

Kernel method of density measurement is based on probability estimates for point data. It spreads the mass of each observation around the observed point (Burt and Barber 1996). The amount of spread or smearing is determined by the function called kernel and by the value of bandwidth, also called a search radius. In this study, normal bivariate probability density function is used. The search radius is assigned the value of 2,326 meters, i.e. the radius of the circle with the size of an average community administrative

area. This procedure creates a raster with pixels 100x100 meters (*Figure 27*). The raster is then overlaid with the vector map of community administrative boundaries. Finally, each community is assigned the value of the mean of all the pixels within its boundaries (*Figures 28 and 29*).

Both regular and kernel method of density measurement have their advantages and disadvantages. On the one hand, the advantage of the kernel method is that it measures density at a constant scale throughout the whole country, while the scale of the regular method changes with the size of the administrative area of the community being considered. On the other hand, the disadvantage of the kernel method is its spreading effect that smears the values of density across community boundaries. This shortcoming disqualifies the kernel method from further use in this study and, therefore, the regular method results are used.

4.5 Correlation Analysis

Correlation analyses and testing of their results for significance are the last two steps in methodological design (*Figure 30*). The relationships between unemployment and accessibility and between unemployment and settlement dispersion are evaluated by the two commonly used rank correlation coefficients – Spearman's ρ and Kendall's τ. Pearson's product-moment correlation coefficient (r) is also computed, but its values serve only an informative purpose, because the assumptions of normality are not met.

Javorina and Valaškovce, two out of 2,883 evaluated communities, are actually not communities, but military zones. As such they have no permanent residents. Therefore,

these two units are omitted from the analysis. The correlation analyses of unemployment and the distances to regional employment centers include only those communities, whose commuting distance is greater than zero, i.e. the commuting centers themselves are not considered.

5 Results

5.1 Accessibility – Distance Approach

The results of the correlation analyses (*Figures 31-45*) at the national level show that the unemployment rate and accessibility in Slovakia are positively correlated (the top seven lines in the table in *Figure 31*). They are significant at $\alpha = 0.01$ and this suggests that the first hypothesis should be accepted. However, there are several other facts that have to be considered before stating the final verdict.

First of all, the errors in the input data have to considered when the outputs of the correlation analyses are interpreted. As mentioned in section 4.1, there is a temporal mismatch error, the error of "un-captured complexity," as well as other unspecified errors in the source of unemployment rate data. Errors probably also exist in the distance data, since they are based on a simplified model. An additional error is introduced through the source data and methodology for the construction of centroids. The greatest amount of error comes most likely from the fact that only crude proxies are used for the destinations of potential commuting.

When the acceptance or rejection of a research hypothesis is being considered, not only the statistical significance, but also the practical significance has to be taken into account. While an exact value of percentage of explained variance can be determined in the case of Pearson's product-moment correlation analysis, the ordinal measures of association used in this study do not offer this capability. However, because the population sizes of the national level datasets are approximately the same (2,743 to 2,880), and because all of the values of the nonparametric correlation coefficients are statistically significant, these values can be compared with each other. An interesting fact revealed by this comparison is that five of these seven values of Spearman's ρ and Kendall's τ (with the exceptions of Bratislava and county seats) decline with the growing number of employment centers (the top seven lines in the table in *Figure 31*). This suggests that the relationship between unemployment and accessibility is stronger at the higher-order employment centers and weaker at the lower order employment centers. However, based on the rationale behind the first hypothesis, the opposite was expected. According to this original rationale, the majority of the economically active population commutes short distances and minority commutes longer distances (e.g., 50 kilometers or more). Even though the number of the long-distance daily commuters is additionally enlarged by the "seeming daily commuters," they are probably still outnumbered by the short-distance commuters.

To explain the finding that the distances to the higher-order employment centers experience stronger correlation with unemployment rates than the distances to the lower order employment centers, the issue of spatial autocorrelation needs to be addressed.

While the autocorrelation in the unemployment dataset relates to the autocorrelation of factors that cause unemployment, the autocorrelation in the distance dataset is inherent to the nature of the distance data. As a general rule, autocorrelation inflates values of correlation coefficients. However, the issue of autocorrelation is more complex. The reason of this complexity stems from the scale-dependent spatial variance structure, which refers to different amounts of autocorrelation in a dataset at different scales / lag distances. Although the scale-dependent spatial variance structure of the input data has not been evaluated (e.g., by the semivariogram analysis), the visual interpretation suggests that the lag distances with significant values of spatial variance are much greater in the unemployment dataset (*Figure 9*) than they are in the distance datasets (*Figures 17-22*). It is also suggested that these distances decline with the growing number of employment centers (*Figures 17-22*) just like the values of Spearman's ρ and Kendall's τ do (*Figure 31*). Therefore, the explanation of the stronger correlation in the case of higher-order centers is that the smaller the difference between the lag distances with significant values of spatial variance of the two datasets, the stronger their correlation. However, a semivariogram analysis would be needed to prove this claim.

Bratislava and county seats are the two exceptions from this general tendency. The explanation for county seats is based on the insignificant difference between the number of county seats (71) and the number of 10,000+ towns (72) (that also suggests an insignificant rank difference between these two kinds of employment centers). This insignificant difference may not show up in the general tendency of the stronger correlation between higher-order centers and unemployment described above. The

exception of Bratislava can be also explained on the basis of the scale-dependent spatial variance structure of the datasets entering the correlation analysis. Based on visual interpretation, it can be suggested that the lag distances with significant values of spatial variance in the distance-to-Bratislava dataset (*Figure 23*) are greater (almost the greatest possible) than they are in the unemployment dataset (*Figure 9*). At such a great magnitude of these lag distances, the lag distance difference between the two datasets is not as important (as it was explained in the previous paragraph) as the general direction of the increase of the values of the two datasets. While the distance to Bratislava increases in the general direction from west-southwest to east-northeast, unemployment increases in the general direction from northwest to southeast. If these two general directions were the same, the correlation coefficient values for the relationship of these two datasets would be greater than for any other of the six analyzed relationships at the national level (the top seven lines in the table in *Figure 31*).

However, there are also other possible explanations of the fact that the distances to the higher-order employment centers experience a stronger correlation with unemployment rates than the distances to the lower order employment centers. One possible explanation is that the proxies of higher order administrative / population centers better represent the higher-order employment centers, than the proxies of lower order administrative / population centers represent the lower-order employment centers. Perhaps, the relatively high concentration of Roma population[5] in the areas farthest from the district seats (e.g., the Counties of Kežmarok, Spišská Nová Ves, Revúca, Rimavská

[5] Roma population in Slovakia generally experiences higher unemployment rates.

Sobota, and Rožňava; *Figures 5, 9 and 17*) and from the 30,000+ towns (e.g., the Counties of Revúca, Rimavská Sobota, and Rožňava; *Figures 5, 9 and 20*) also contributes to this phenomenon. Another explanation is based on the fact that the areas of greatest unemployment rate, i.e. southern-southeastern and eastern parts of Slovakia, are also the areas of low population densities and low levels of urbanization where the higher order urban centers have not developed as fully as in the rest of Slovakia. Thus, the location of these areas is peripheral with respect to the largest population / administrative / employment centers.

Most of the correlation analysis results at the case-study level show that the unemployment rate and accessibility in Slovakia are not correlated (the bottom twelve lines in the Accessibility – Distance Approach section of the table in *Figure 31*). The only exception is the correlation between unemployment rate and the road distance to the nearest town in the Myjava County, which is statistically significant at $\alpha = 0.05$. Overall, however, the results suggest that the first hypothesis should be rejected at the case-study level.

Although, no significant differences seem to exist between the road and air distances measured in the case-study area (*Figures 24 and 25*), it is interesting to note that in all six pairs of Spearman's ρ coefficients the values derived from road distances are greater than the ones derived from air distances. The same holds true with respect to the two pairs of Kendall's τ coefficients in the Myjava County. However, two other pairs of Kendall's τ coefficients tie and the other two pairs are inversed. Based on the rationale behind the first hypothesis, this may suggest that (in most cases) road distances better represent real

accessibility than air distances. Because this is an obvious fact, the claim can be reversed: Based on the fact that road distances better represent real accessibility than air distances, the greater values of correlation coefficients derived from road distances than the ones derived from air distances support the first hypothesis as well as the rationale behind it. However, it has to be stressed that – as mentioned in the preceding paragraph – only one out of the 24 correlation analysis results in the case-study area is statistically significant.

5.2 Accessibility – Container Approach

The container approach to the accessibility measurement leads to the highest correlation coefficient values in this study (*Figures 31 and 43*). While only the Spearman's ρ value is statistically significant at the whole case-study level, both Spearman's ρ and Kendall's τ values are significant in the Myjava County and none of them is significant in the Skalica County.

As mentioned in the section 4.1, a significant amount of error is introduced into this data by the methodology of their acquisition. The burden this error imposes on the results of the correlation analysis can be illustrated on the example of the firm producing sofas and armchairs in the Myjava County. The company employs 233 workers and, according to the data used in the correlation analysis (NLO-CLO in Myjava 2002), all of them work in the community of Bukovec. In reality, however, only the headquarters and one of the two operations are located in Bukovec while the other one is located in the community of Košariská (*Figures 10 and 12*). It is obvious, that if accurate data were available, the position of these two communities in *Figure 43* would be quite different. The extremely

high value of the number of job opportunities per 100 economically active in Bukovec would decline while its value in Košariská would increase. As a result, both communities would most likely better fit the imaginary trend line in the scatter plot, and the values of the correlation coefficients would further increase.

5.3 Settlement Dispersion

At the national level, the results of the correlation analyses indicate the exact opposite of what was hypothesized, i.e. that the areas with more dispersed settlement have lower unemployment rates (*Figures 31 and 44*). This is mainly caused by the fact that the settlement dispersion in this study was evaluated on the basis of settlement density. It is evident from *Figures 26 and 46* that, in general, the largest areas of settlement dispersion are well represented by the areas of high settlement density. In addition to the areas of dispersed settlement, however, there are many cities that also have relatively high values of settlement density. Because these cities often represent regional employment centers, their unemployment rates are low. This greatly affects the correlation analyses and causes negative values in their results.

While the situation in the Skalica County is analogous to the situation at the national level, the situation in the Myjava County is opposite to the situation at the national level (*Figures 31 and 45*). The explanation for the situation in the Skalica County is the same as it is for the national level (see above). The explanation for the situation in the Myjava County stems from the rationale behind the second main hypothesis in this study. While the absolute values of the correlation coefficients in the Skalica County are low and

statistically insignificant, the absolute values of the correlation coefficients in the Myjava County are relatively high and statistically significant.

The comparison between the national level and the Myjava County level suggests that settlement dispersion explains the variation in the unemployment rate mostly at the local to regional levels. It may be hypothesized that the percentage of the explained variance abruptly decreases as the scale changes from local, through micro-regional, mezzo-regional, macro-regional, to national.

As explained in the rationale of this thesis, sometimes, a community located farther from the regional center is also farther / higher in the uplands and it has a more dispersed settlement pattern. This suggests that the settlement dispersion and the distance to the regional employment center sometimes covariate, and that they both probably also correlate with unemployment. This seems to be the case in the Myjava County, where significant values of correlation coefficients characterize the relationship between settlement dispersion and unemployment ($\rho = 0.485$, $\tau = 0.353$), between road distance to the nearest town and unemployment ($\rho = 0.514$, $\tau = 0.352$), and between the container-approach-measures of accessibility and unemployment ($\rho = -0.586$, $\tau = -0.426$).

6 Discussion

This chapter briefly summarizes the reasons for incapability of definite conclusions and suggests several solutions for the future research.

For the purposes of measuring accessibility, the selection of destinations of potential commuting is the crucial step in methodology. The data on job opportunities, perhaps salary levels, and other factors increasing / decreasing motivation to commute, and/or the data on actual commuting should be employed in this task. The daily commuting regions, within which the distances are measured, should be natural socioeconomic regions rather than administrative or statistical units. An additional potential for improvements is in the methodology of the point representation of the commuting sources and destinations, as well as in the level of-elementary units epitomizing these sources and destinations.

A possible alternative, which bypasses the problem of destination selections and also better represents reality, combines the distance approach with the container approach. The example would be the evaluation of employment accessibility (A_i) within a certain job-type-specific average maximum commuting distance:

$$A_i = \sum_{j=1}^{n} \frac{O_{ij} / P_{ij}}{d_{ij}^{b}}$$

n - number of communities in the daily commuting region defined by the job-type-specific average maximum commuting distance from the i-th community

O_j - number of job opportunities in the j-th community in the daily commuting region of the i-th community

P_j - economically active population in the j-th community in the daily commuting region of the i-th community

d_{ij}^{b} - distance between the i-th community and the j-th community (calibration would be need for d_{ii} values, possibly the value of the radius of the circle with area of S_i could be used, where S_i is the area of the i-th community)

b - coefficient of friction of distance

Measuring of distance should be mainly based on road distance. It should also account for transportation network deviation (i.e. "curviness" computed as the ratio of the road distance and air distance, preferably in a multi-scale fashion), "vertical demandingness" (sum of the road's rises and falls, also preferably in a multi-scale fashion), public transportation quality components such as connection frequency, speed, timing, routing, and price (including all transportation means), and car ownership rates (with respect to different social groups).

The issue of multi-scale evaluation of accessibility has to be addressed. The suggestion is to measure distances at multiple scales, i.e. to employment centers of several orders, and then to use cluster analysis to determine the location of all the communities in an n-dimensional space, in which each dimension represents distance to one of the order-types of employment centers. In other words, it has to be determined which communities are near to the centers of all orders, which are near to the low-order centers but far from the high-order centers, which are far from the low-order centers but near to the high-order centers, and which are far from the centers of all orders.

Regarding the evaluation of the settlement dispersion based on settlement density, a method needs to be developed that would filter out the "noise" of the high values of the settlement density in cities. Whether this will be within the scope of pure spatial analysis or additional attribute data will be needed remains unknown. However, an approach incorporating a multi-scale evaluation of settlement dispersion will probably need to be applied.

7 Conclusion

Although the correlation analysis results related to the two main hypotheses of this study are statistically significant at the national level, the relatively low absolute values of the correlation coefficients suggest that their practical significance is secondary. The results of the correlation analyses at the case-study level are equivocal and further analyses are needed in natural socioeconomic regions rather than in administrative or statistical regions such as counties.

It is evident that spatial autocorrelation in the data used in the correlation analyses inflates the correlation coefficient values. The more similar the scales of autocorrelations in the two datasets whose relationship is being evaluated, the stronger their correlation. The fact that the distances to the higher-order employment centers experience stronger correlation with unemployment rates than the distances to the lower order employment centers suggests that the factors operating at mezzo- to macro-regional scales influence unemployment rates more than the factors operating at micro- to mezzo-regional scales. Because most of the commuting occurs at micro- to mezzo-regional scales, and because these scales (represented by accessibility to lower-order centers) demonstrate relatively weak relationships (compared to the accessibility to higher-order centers), it is concluded that the contribution of inaccessibility to unemployment is subordinate to other more important mezzo- to macro-regional factors influencing unemployment.

However, the correlation analysis results at both national and case-study levels also reveal that although the relationship is subordinate, it does exist and the exact magnitude

of its contribution to unemployment needs to be investigated. To assess the degree, to which limited accessibility contributes to unemployment, a method is needed that would filter out the effects of macro-regional factors. At best, this could be accomplished by a multiple regression analysis that would attempt to account for all the possible factors causing unemployment. The simpler alternative is to conduct separate correlation analysis in each natural socioeconomic micro-region / mezzo-region. This alternative would be especially appropriate when examining the relationship between settlement dispersion and unemployment that showed to be particularly strong at the local to micro- to mezzo-regional scales.

It is interesting to note, that out of all four study areas (Slovakia, joint area of the Myjava and Skalica Counties, the Myjava County, the Skalica County), the Myjava County stands out "best" with the highest absolute values of Spearman's ρ (and in most cases also Kendall's τ) in the distance approach to accessibility measurement (0.514), in the container approach to accessibility measurement (-0.586), and also in the settlement dispersion measurement (0.485; *Figure 31*). While this may be partially related to the sample size, an additional explanation is possible. When the hypotheses of this study were first stated, they were not as much based on the rationale from the literature as they were based on the rationale derived from pure logic (distance decay effect) and observation. Because the author of this study has spent most of his life in Myjava and its surrounding area, this is where most of the observation was accomplished. By stating a hypothesis based on the observation of one area, and testing this hypothesis also in

several additional areas, it may come as no surprise that this hypothesis "most successfully" interprets the situation in the region on which it was originally based.

APPENDICES

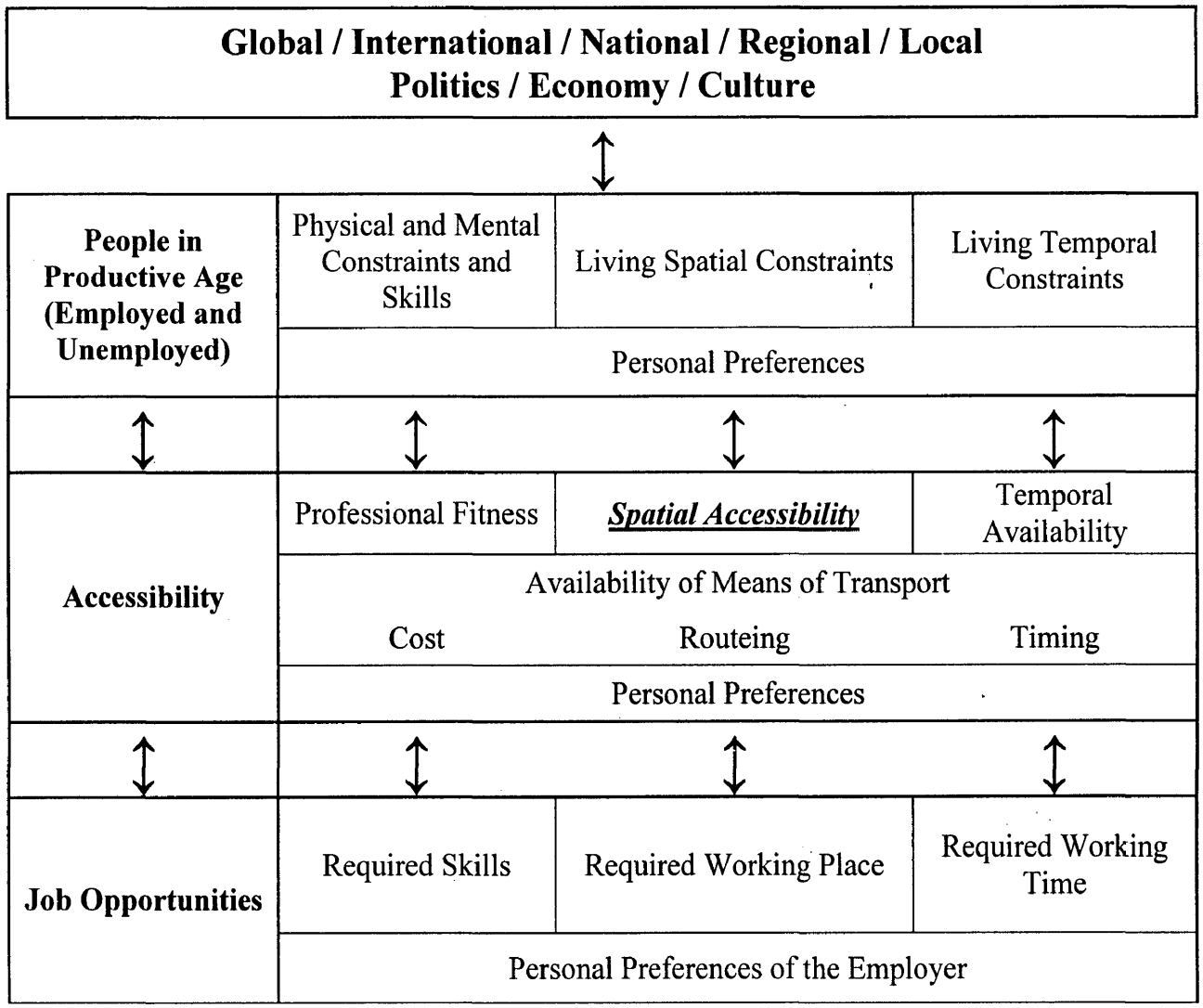
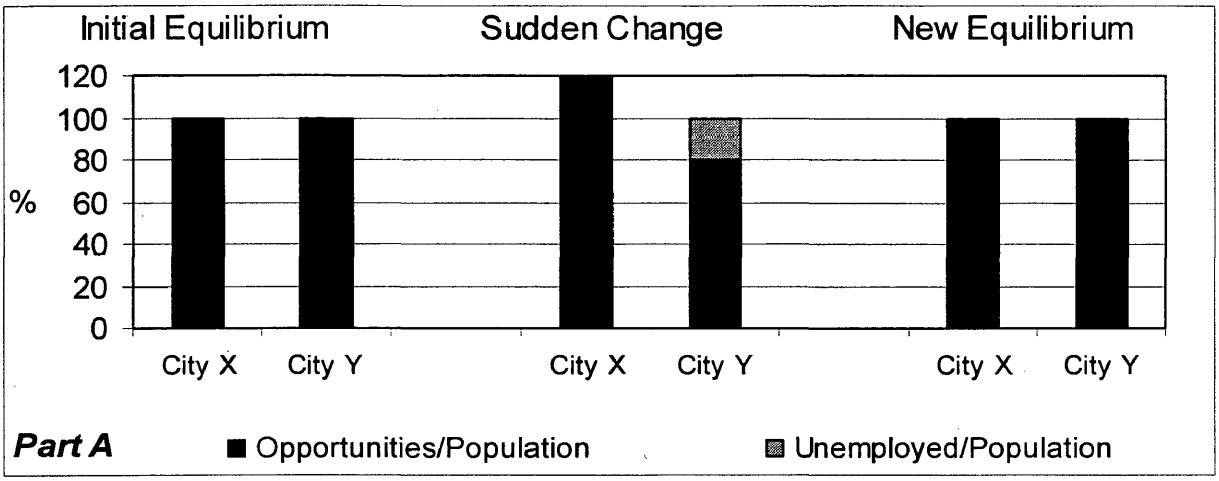
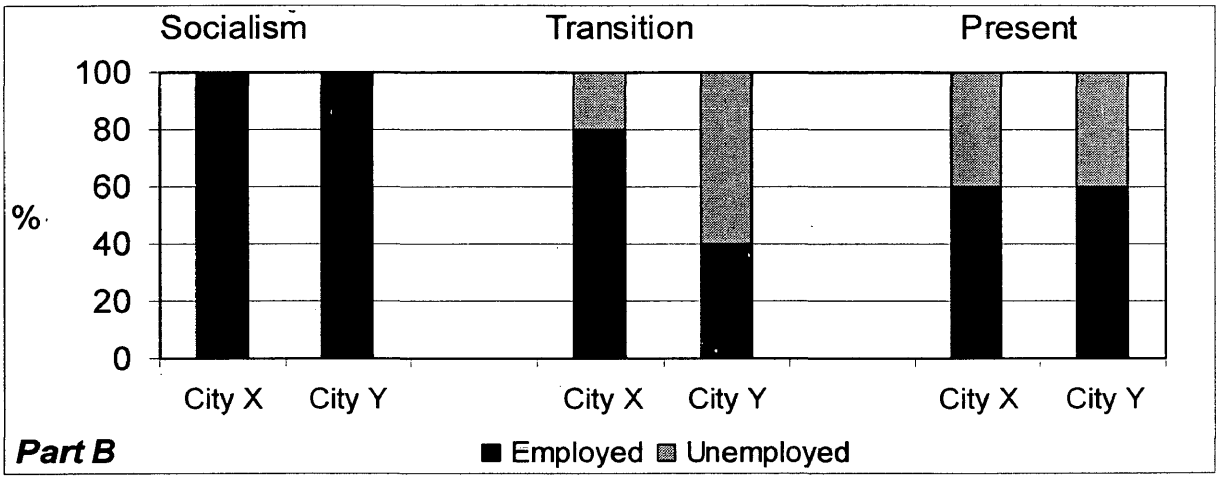


Figure 1. Theoretical Model of Employment Accessibility





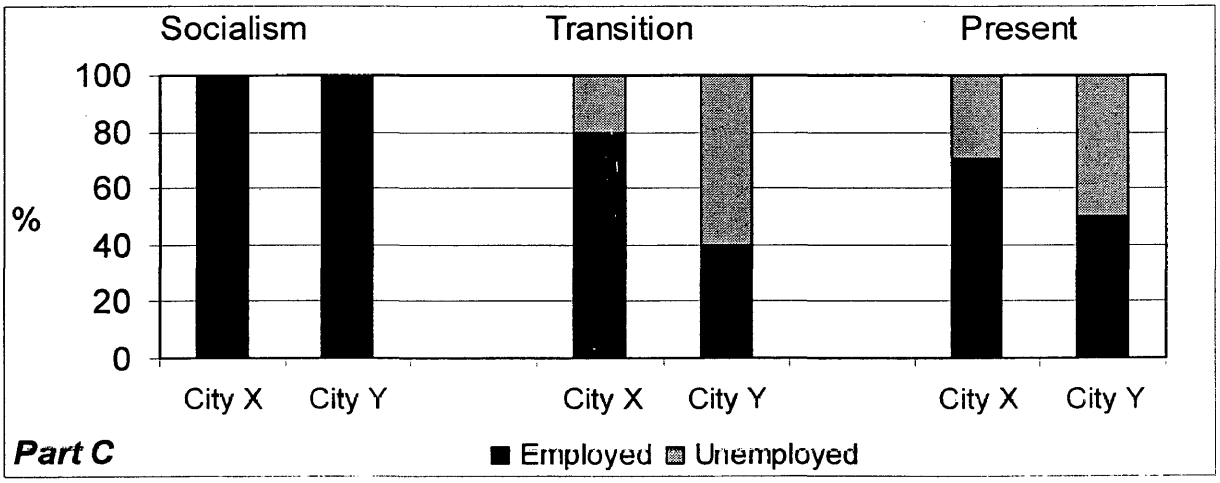


Figure 2. Model of Transition in the Economy of two Cities

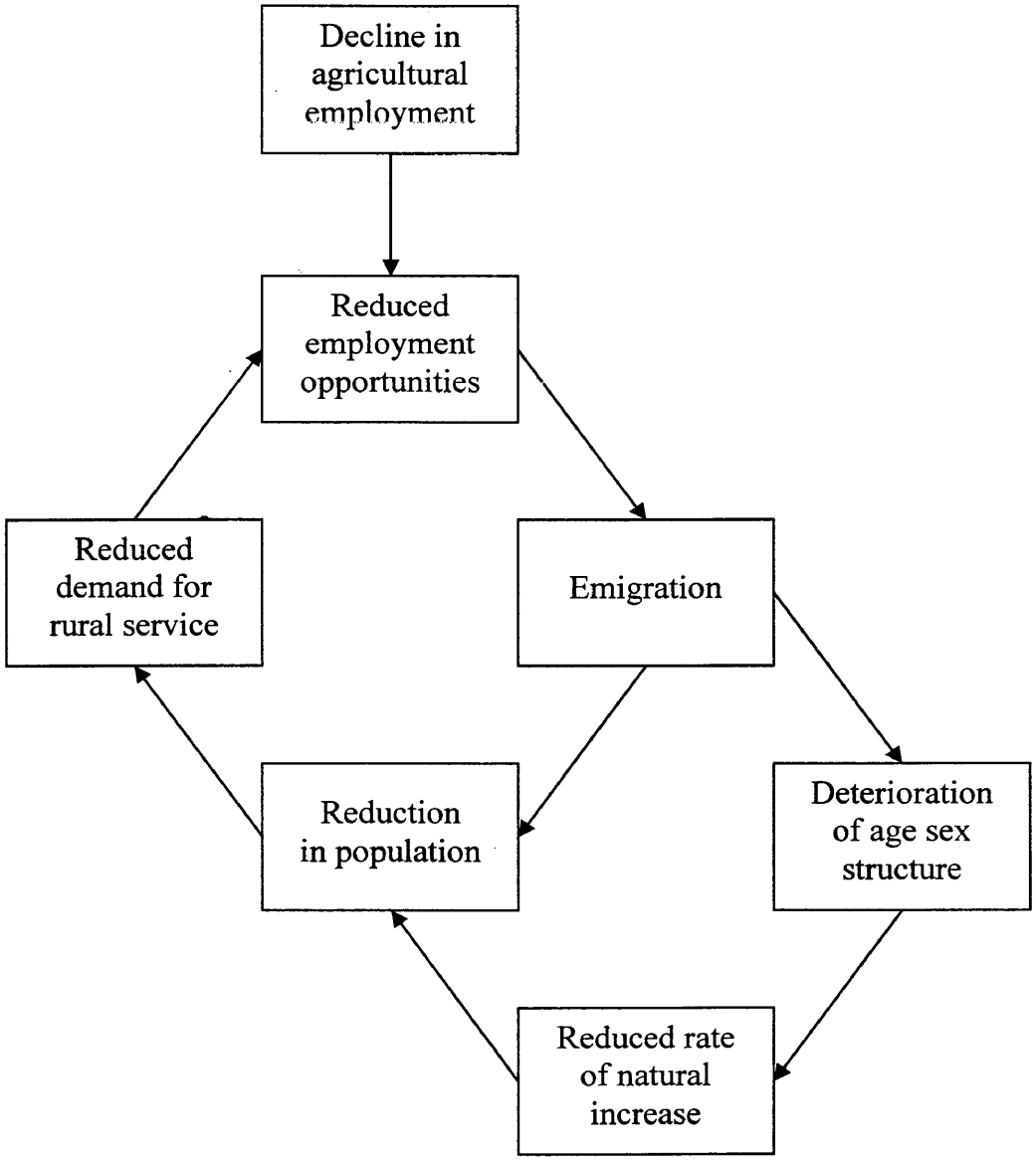


Figure 3. Theoretical Model of Rural Depopulation (according to Hodge and Whitby as in Pacione 1984)

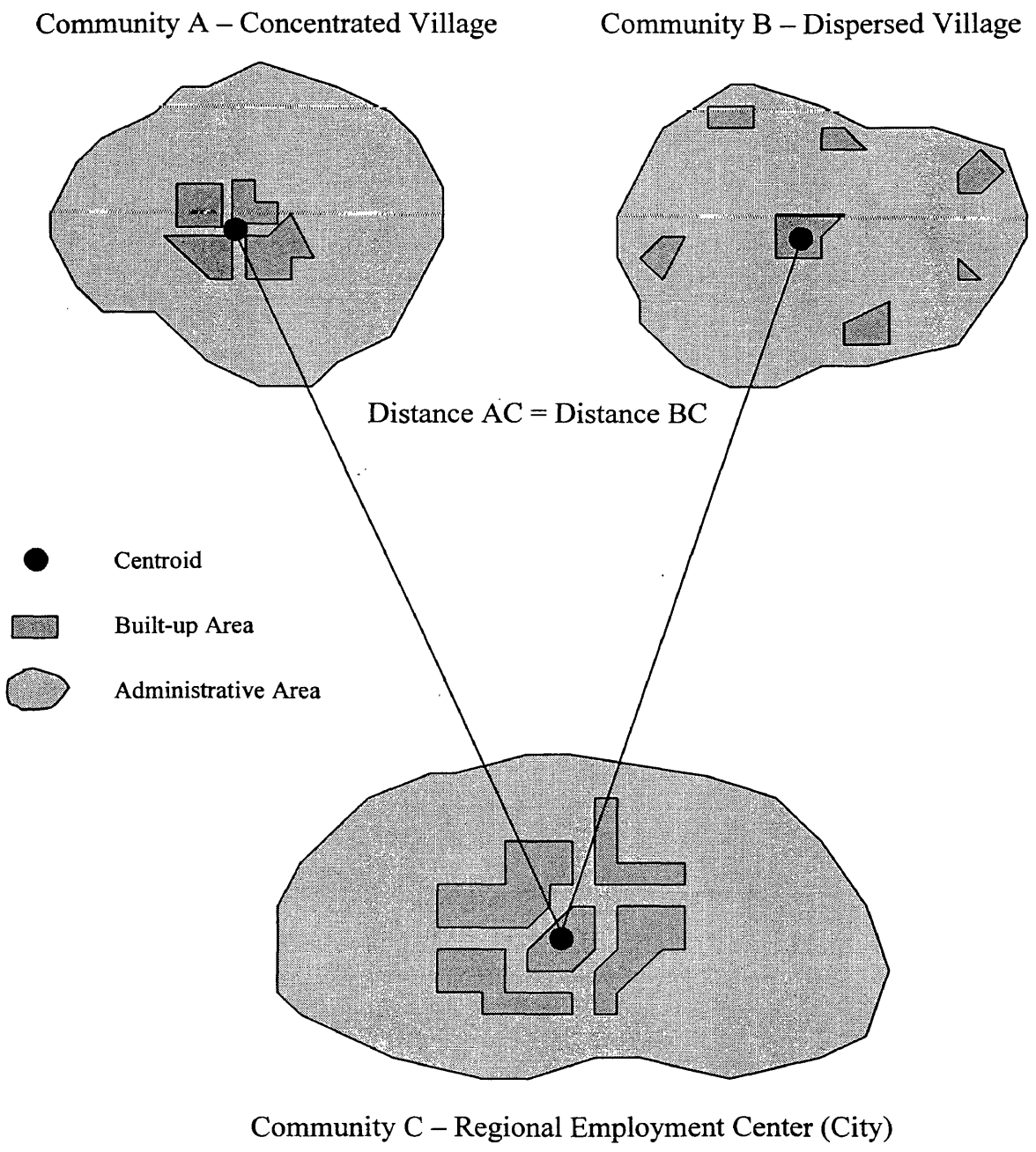


Figure 4. Impact of Settlement Dispersion on Accessibility

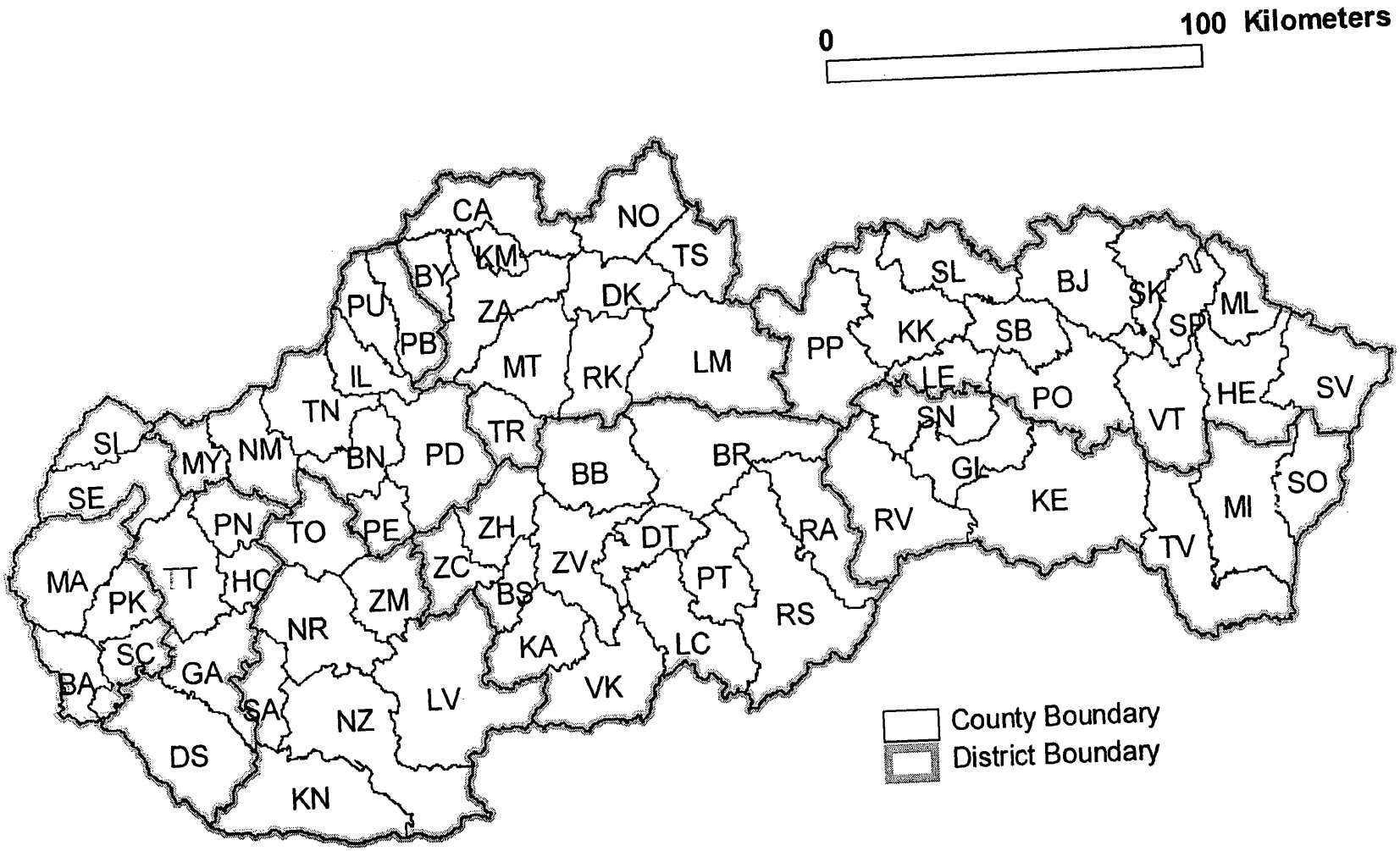


Figure 5. "Customized Counties" in Slovakia (See text for explanation and next page for the list of customized counties.)

County	Acronym	County	Acronym	County	Acronym
Bratislava	BA	Lučenec	LC	Šaľa	SA
Bánovce nad Bebravou	BN	Malacky	MA	Senec	SC
Banská Bystrica	BB	Martin	MT	Senica	SE
Banská Štiavnica	BS	Medzilaborce	ML	Skalica	SI
Bardejov	BJ	Michalovce	MI	Snina	SV
Brezno	BR	Myjava	MY	Sobrance	SO
Bytča	BY	Námestovo	NO	Spišská Nová Ves	SN
Čadca	CA	Nitra	NR	Stará Ľubovňa	SL
Detva	DT	Nové Mesto nad Váhom	NM	Stropkov	SP
Dolný Kubín	DK	Nové Zámky	NZ	Svidník	SK
Dunajská Streda	DS	Partizánske	PE	Topoľčany	TO
Galanta	GA	Pezinok	PK	Trebišov	TV
Gelnica	GL	Piešťany	PN	Trenčín	TN
Hlohovec	HC	Poltár	PT	Trnava	TT
Humenné	HE	Poprad	PP	Turčianske Teplice	TR
Ilava	IL	Považská Bystrica	PB	Tvrdošín	TS
Kežmarok	KK	Prešov	PO	Veľký Krtíš	VK
Komárno	KN	Prievidza	PD	Vranov nad Topľou	VT
Košice	KE	Púchov	PU	Žarnovica	ZC
Krupina	KA	Revúca	RA	Žiar nad Hronom	ZH
Kysucké Nové Mesto	KM	Rimavská Sobota	RS	Žilina	ZA
Levice	LV	Rožňava	RV	Zlaté Moravce	ZM
Levoča	LE	Ružomberok	RK	Zvolen	ZV
Liptovský Mikuláš	LM	Sabinov	SB		

Figure 5. "Customized Counties" in Slovakia (Continued from the previous page.)

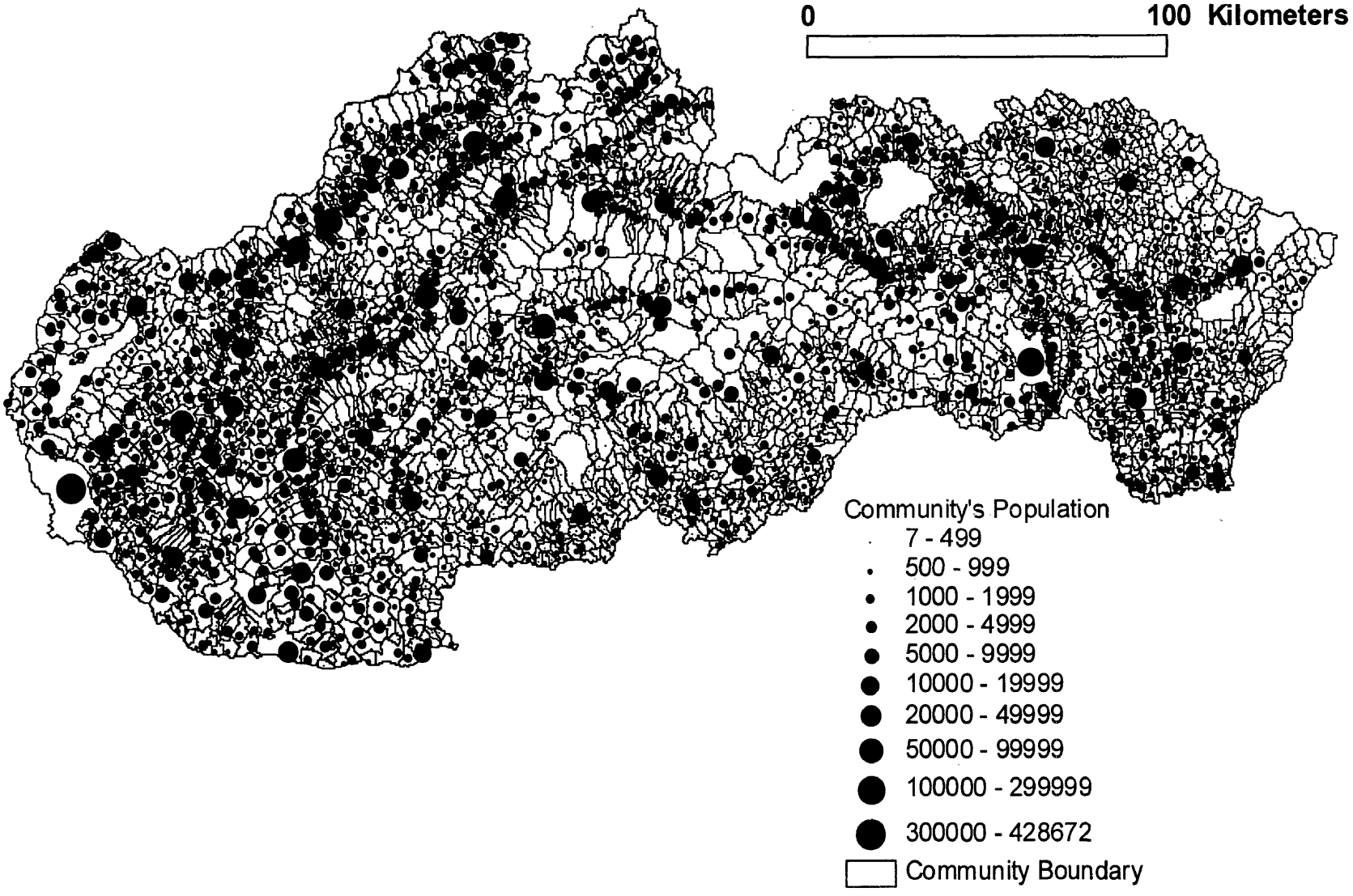


Figure 6. Spatial Distribution and Size of Communities in Slovakia (Source data: SRSO 2001b)

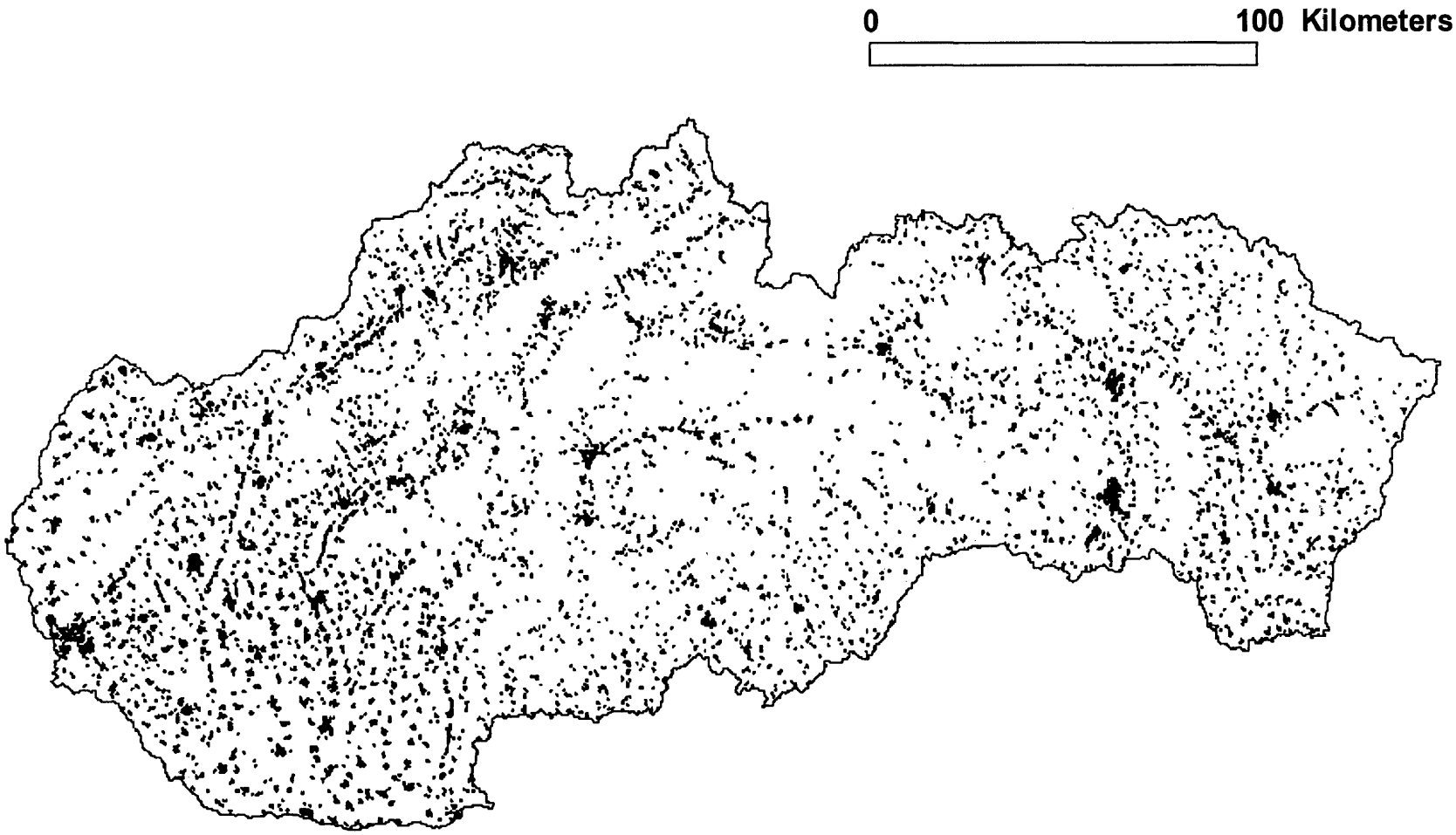


Figure 7. Built-up Areas in Slovakia (Source data: GCI 1998)

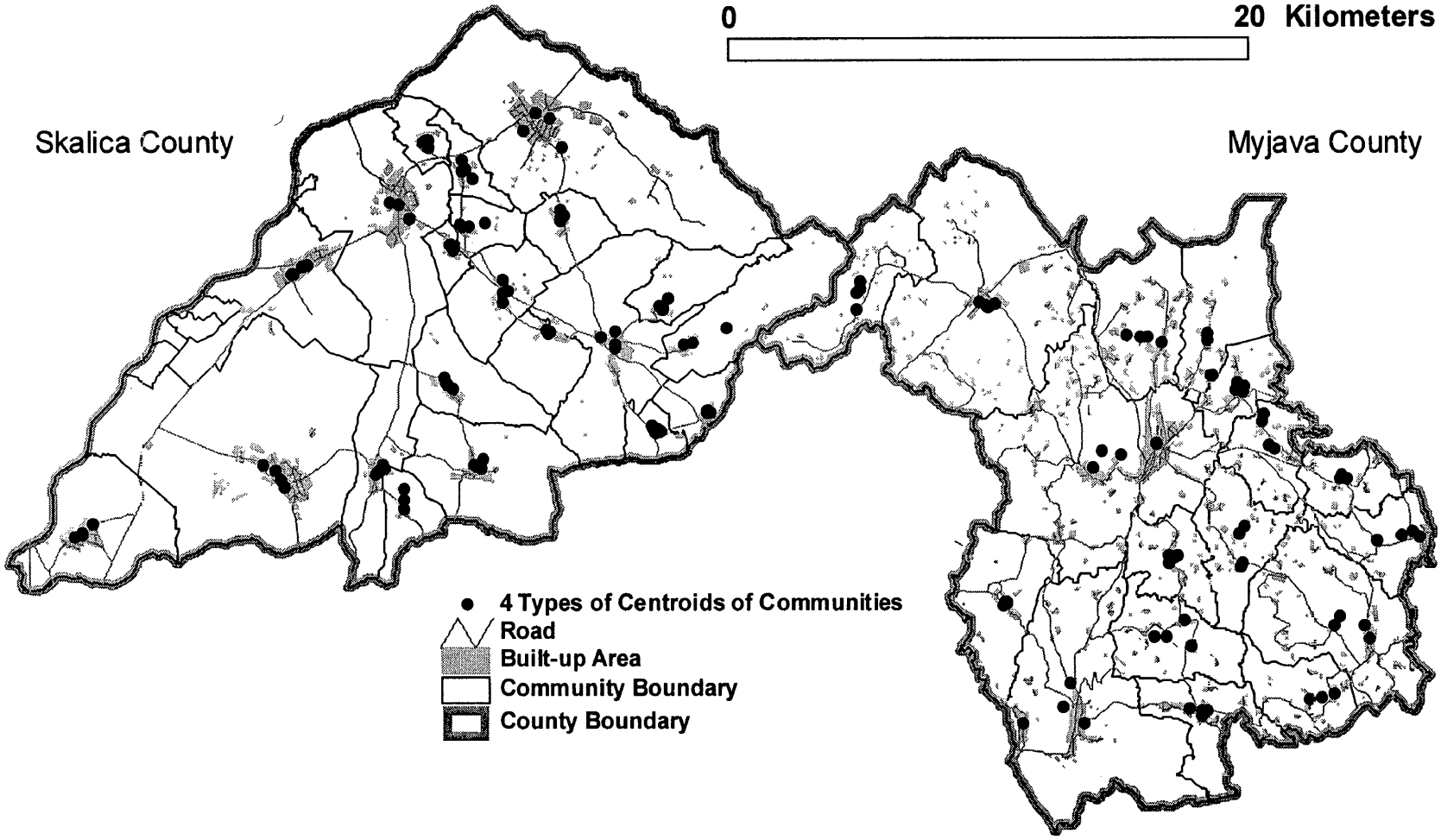


Figure 8. Communities and Built-up Areas in the Myjava and Skalica Counties (Source data: GCI 1998)

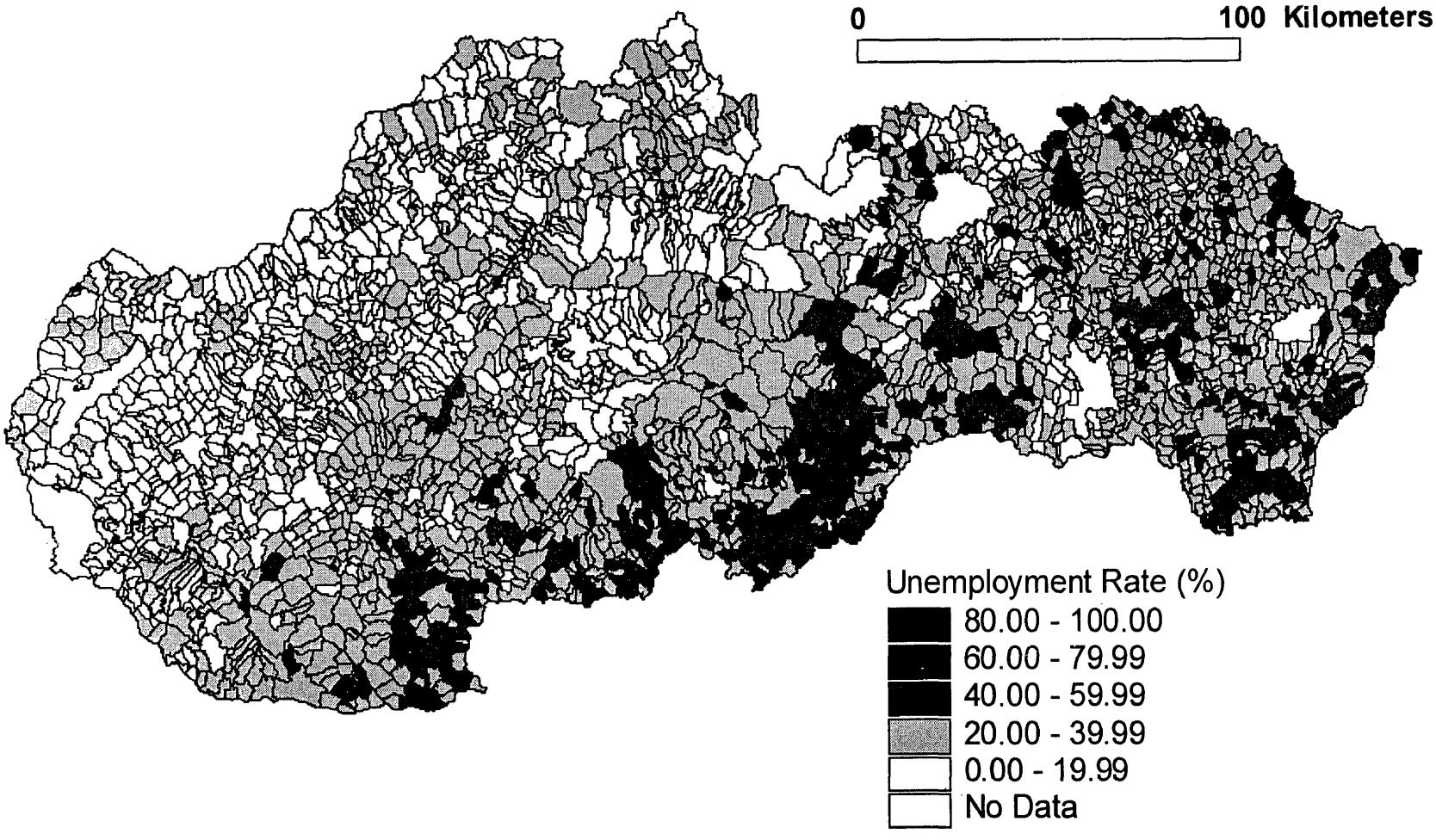


Figure 9. Unemployment Rate in the Communities of Slovakia as of 31 December 2001
(Source data: NLO 2002 and SRSO 2001b)

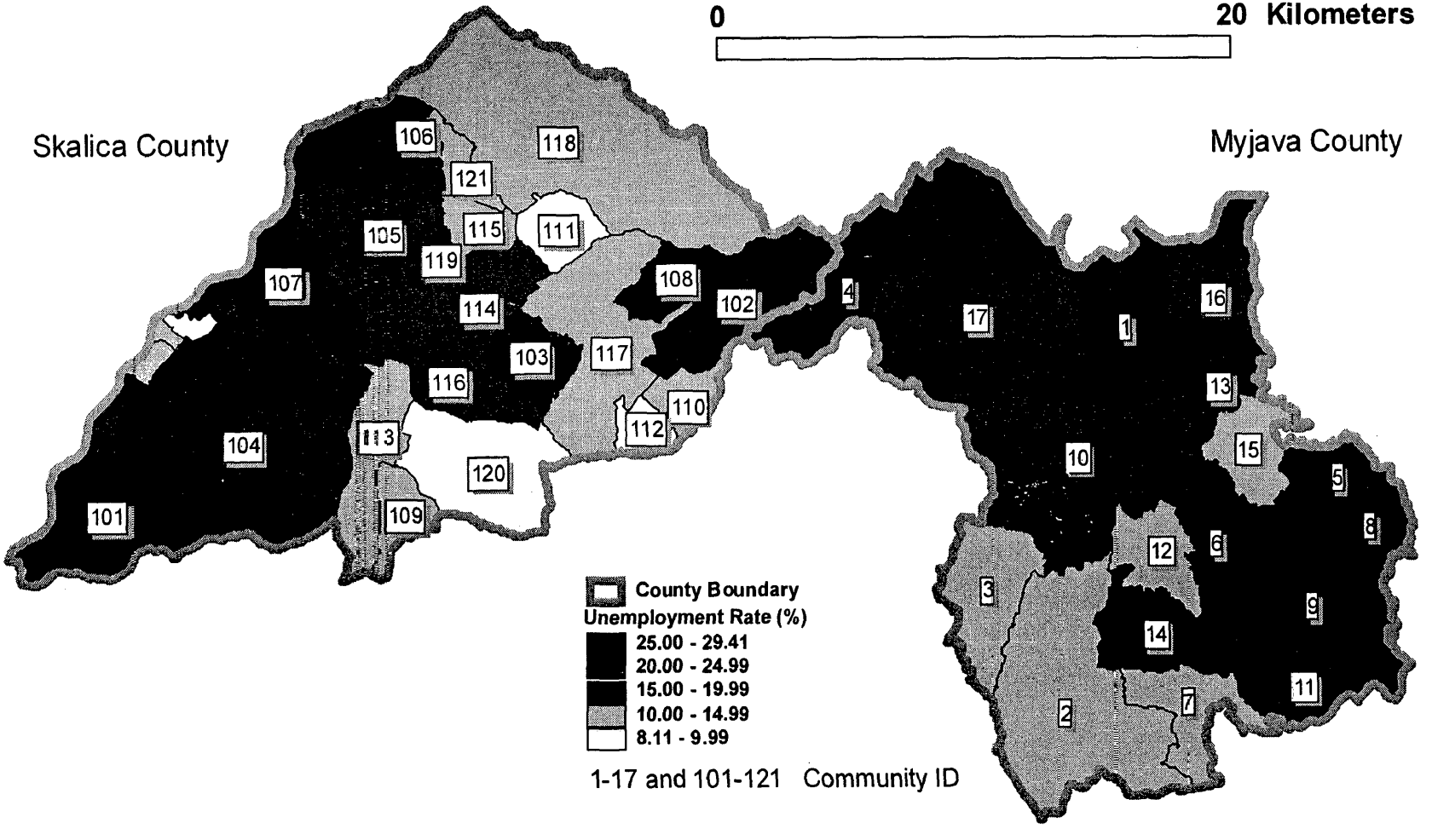


Figure 10. Unemployment in the Communities in the Myjava and Skalica Counties (See next page for additional legend.)

Myjava County

ID	*Community*
1	Brestovec
2	Brezová pod Bradlom
3	Bukovec
4	Chvojnica
5	Hrašné
6	Jablonka
7	Košariská
8	Kostolné
9	Krajné
10	Myjava
11	Podkylava
12	Polianka
13	Poriadie
14	Priepasné
15	Rudník
16	Stará Myjava
17	Vrbovce

Skalica County

ID	*Community*
101	Brodské
102	Chropov
103	Dubovce
104	Gbely
105	Holíč
106	Kátov
107	Kopčany
108	Koválovec
109	Letničie
110	Lopašov
111	Mokrý Háj
112	Oreské
113	Petrova Ves
114	Popudinské Močidľany
115	Prietržka
116	Radimov
117	Radošovce
118	Skalica
119	Trnovec
120	Unín
121	Vrádište

Figure 10. Unemployment in the Communities in the Myjava and Skalica Counties
List of communities and their identification numbers. (Continued from the previous page.)

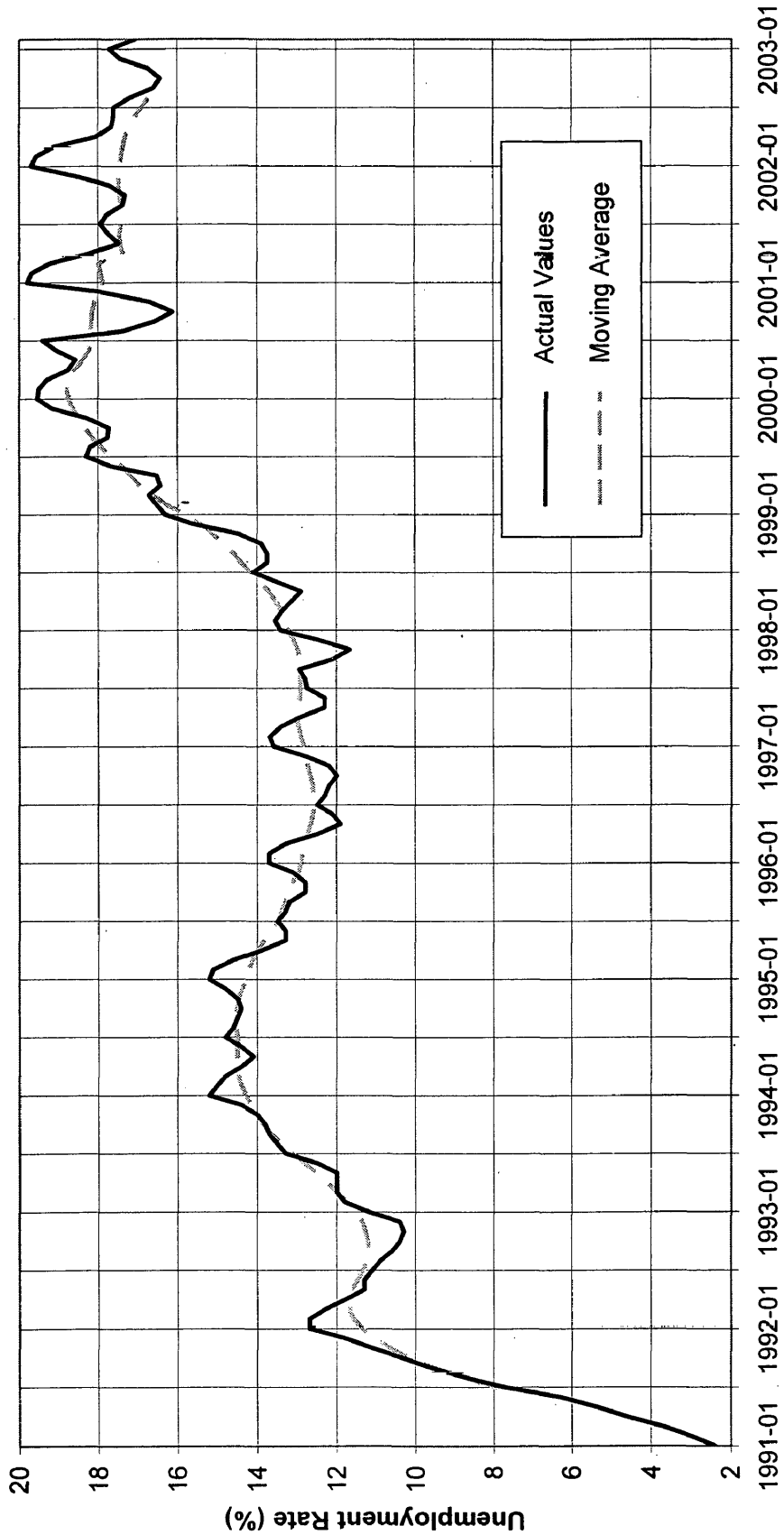


Figure 11. Approximate Monthly Unemployment Rates in Slovakia between January 1991 and February 2003 (Source data: SRSO 2001a and NLO 2003)

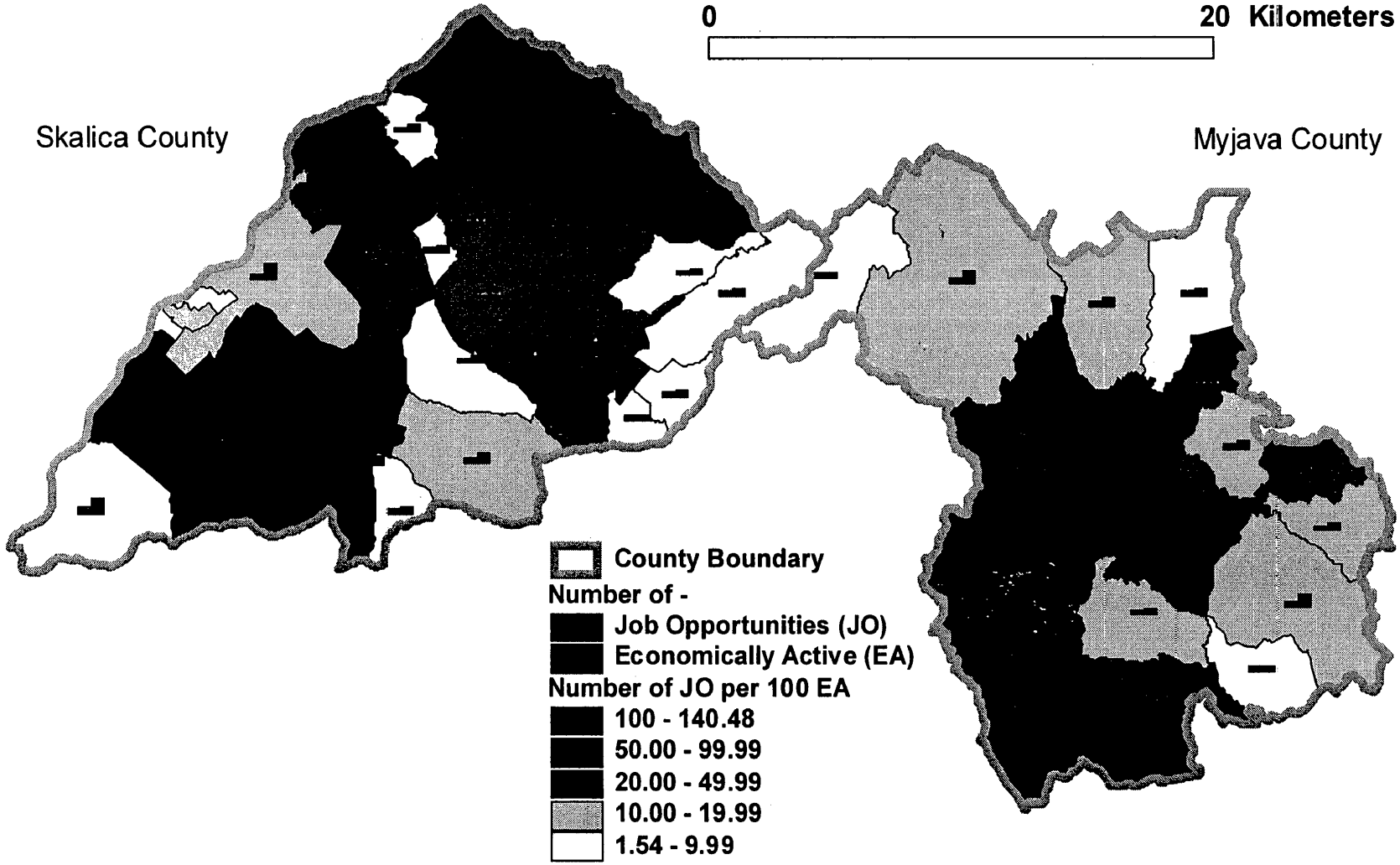


Figure 12. Job Opportunities and the Economically Active (Labor Force) in the Myjava and Skalica Counties (Source data: NLO-CLO in Myjava 2002, NLO-CLO in Skalica 2002, and SRSO 2001b)

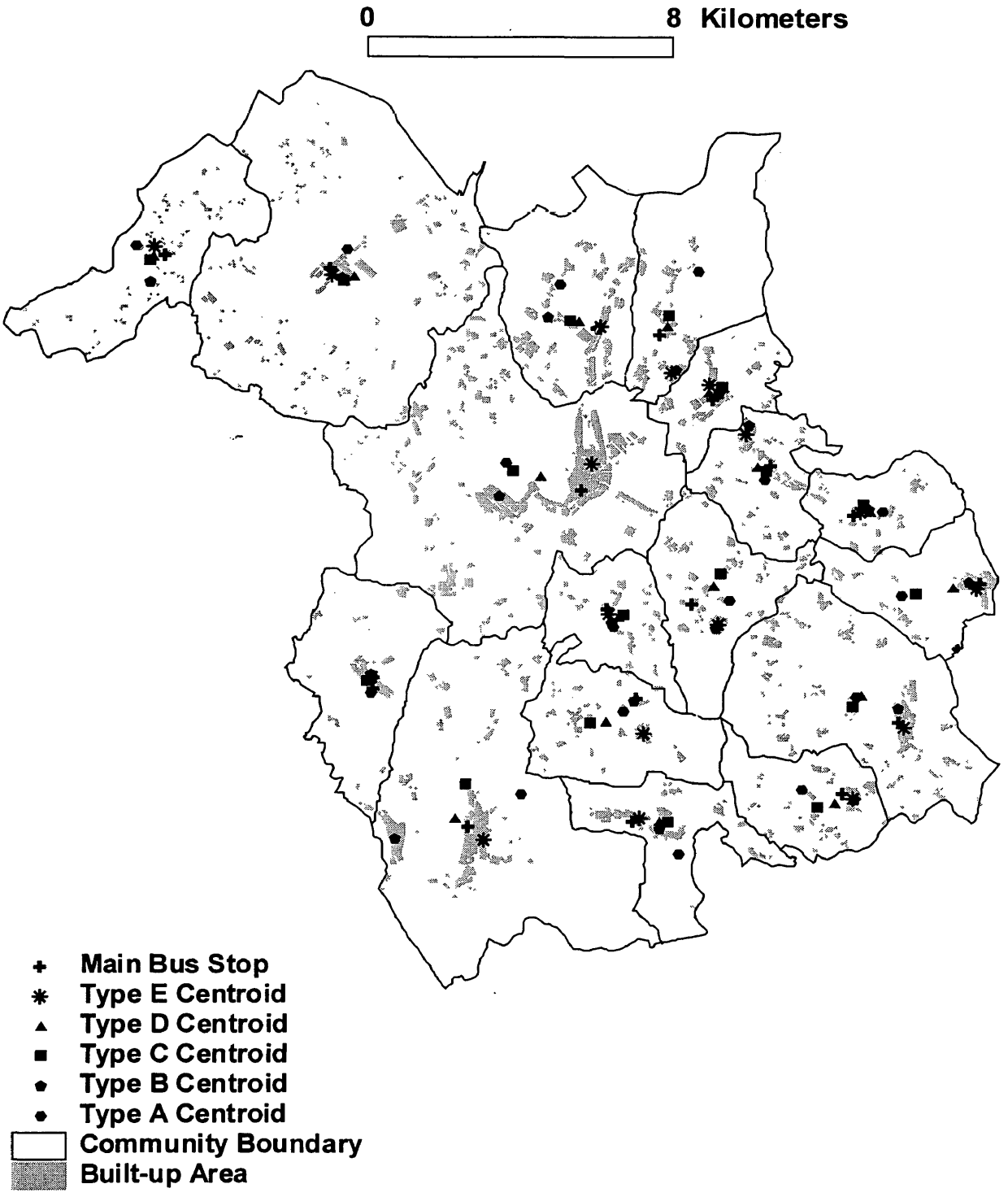


Figure 13. Different Types of Centroids in the Communities in the Myjava County

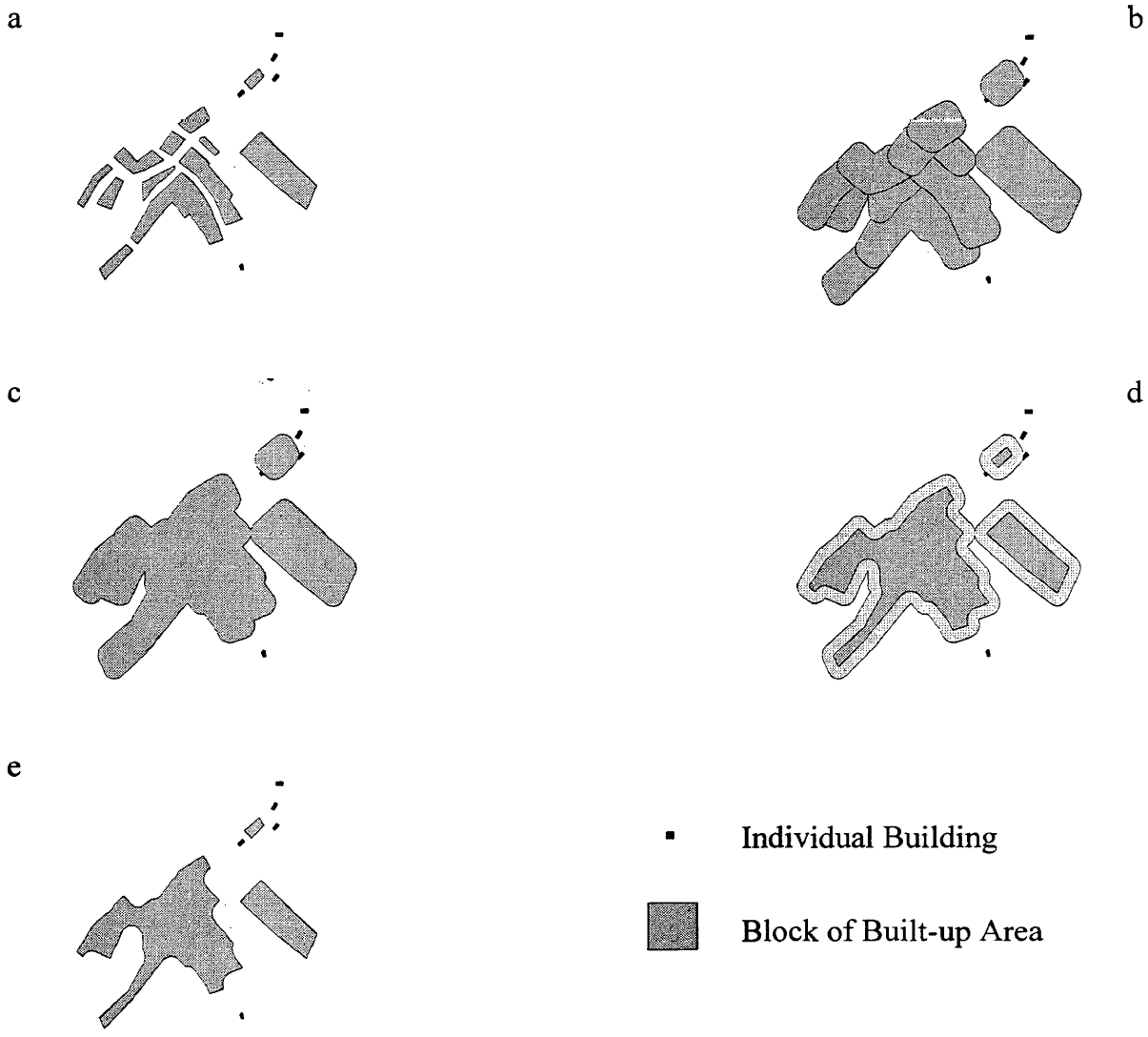


Figure 14. Preprocessing of Data on Built-up Areas ("Blending Procedure")

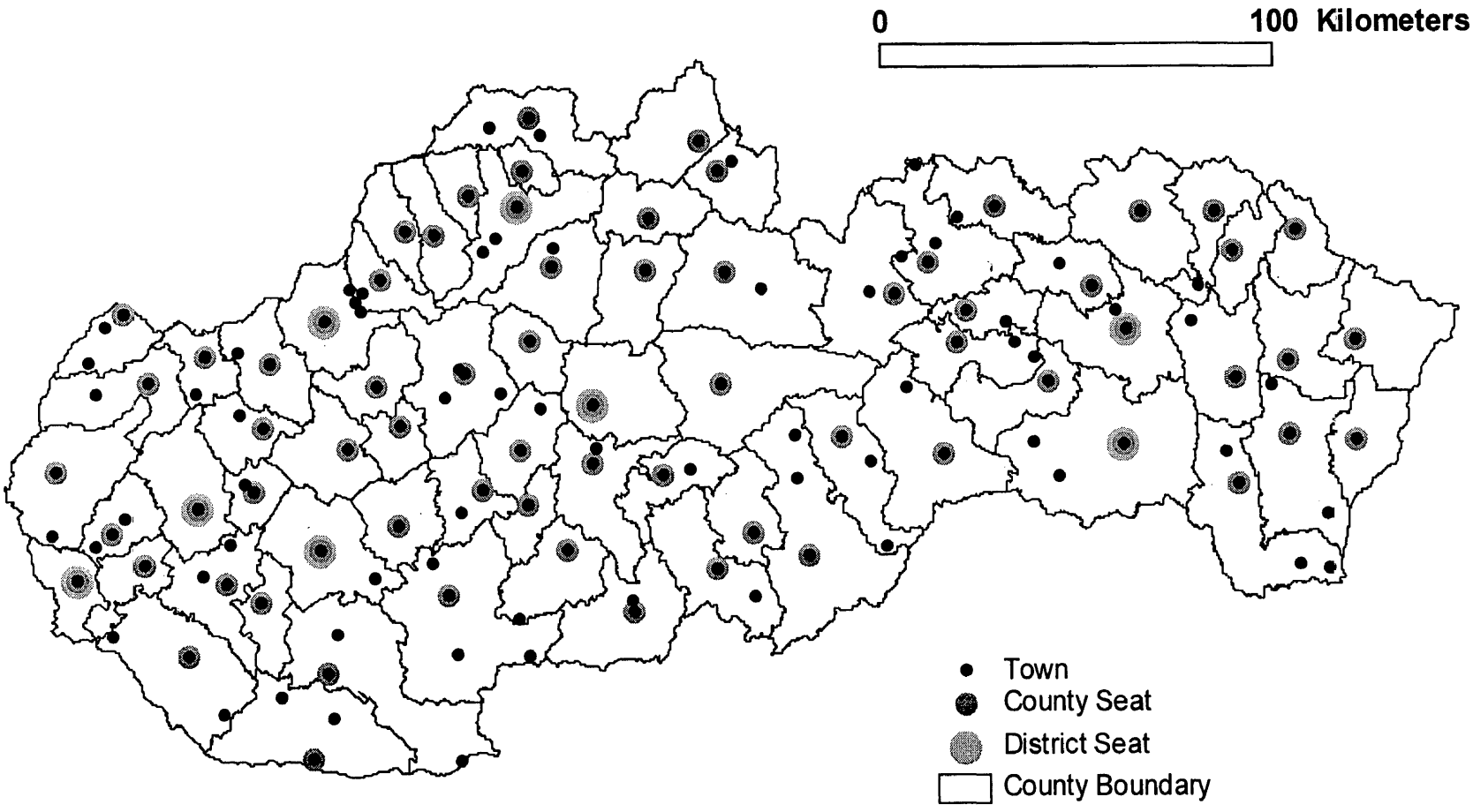


Figure 15. District Seats, County Seats and Towns as Crude Proxies for Regional Employment Centers

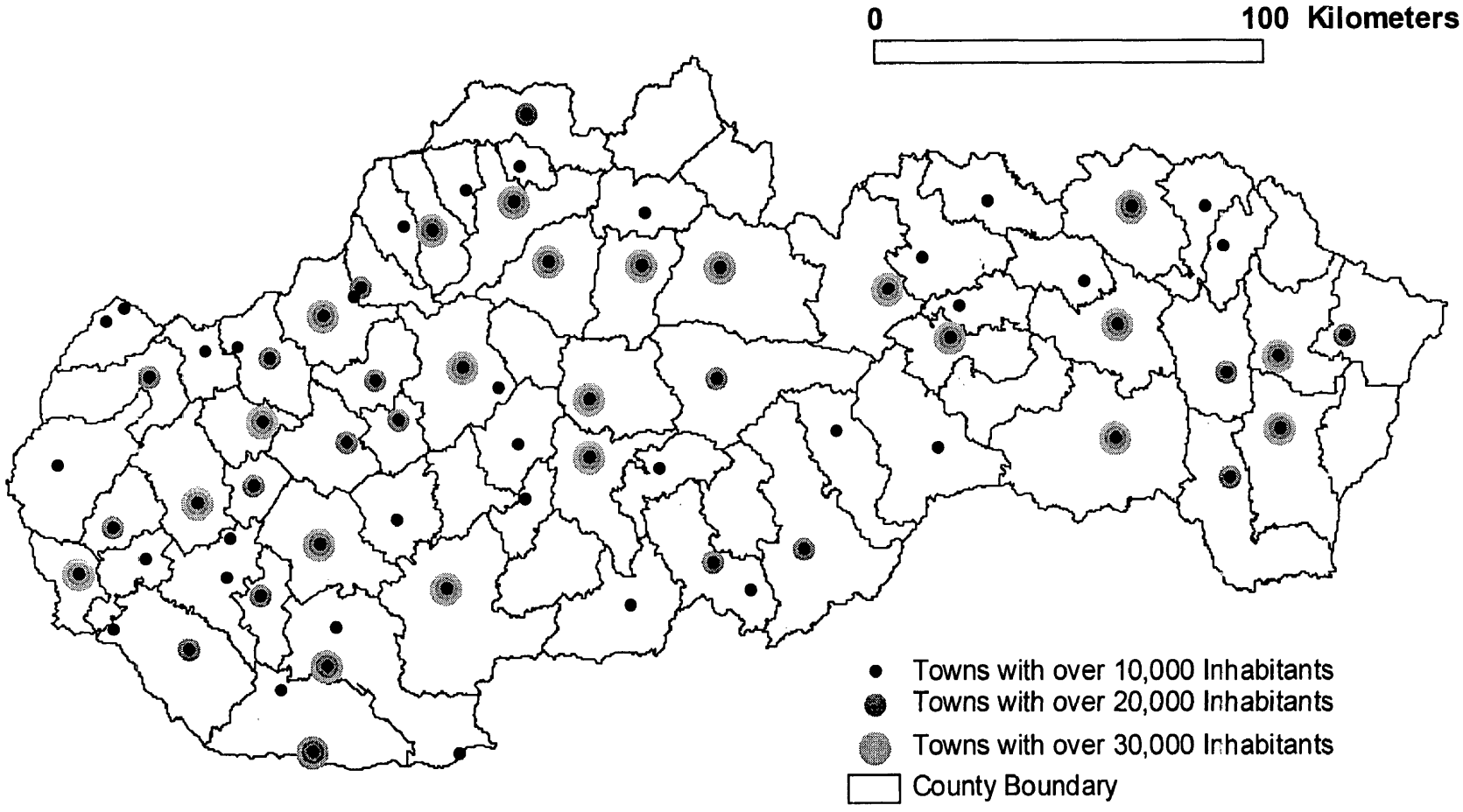


Figure 16. Towns with more than 30,000 / 20,000 / 10,000 Inhabitants as Crude Proxies for Regional Employment Centers (Source data: SRSO 2001b)

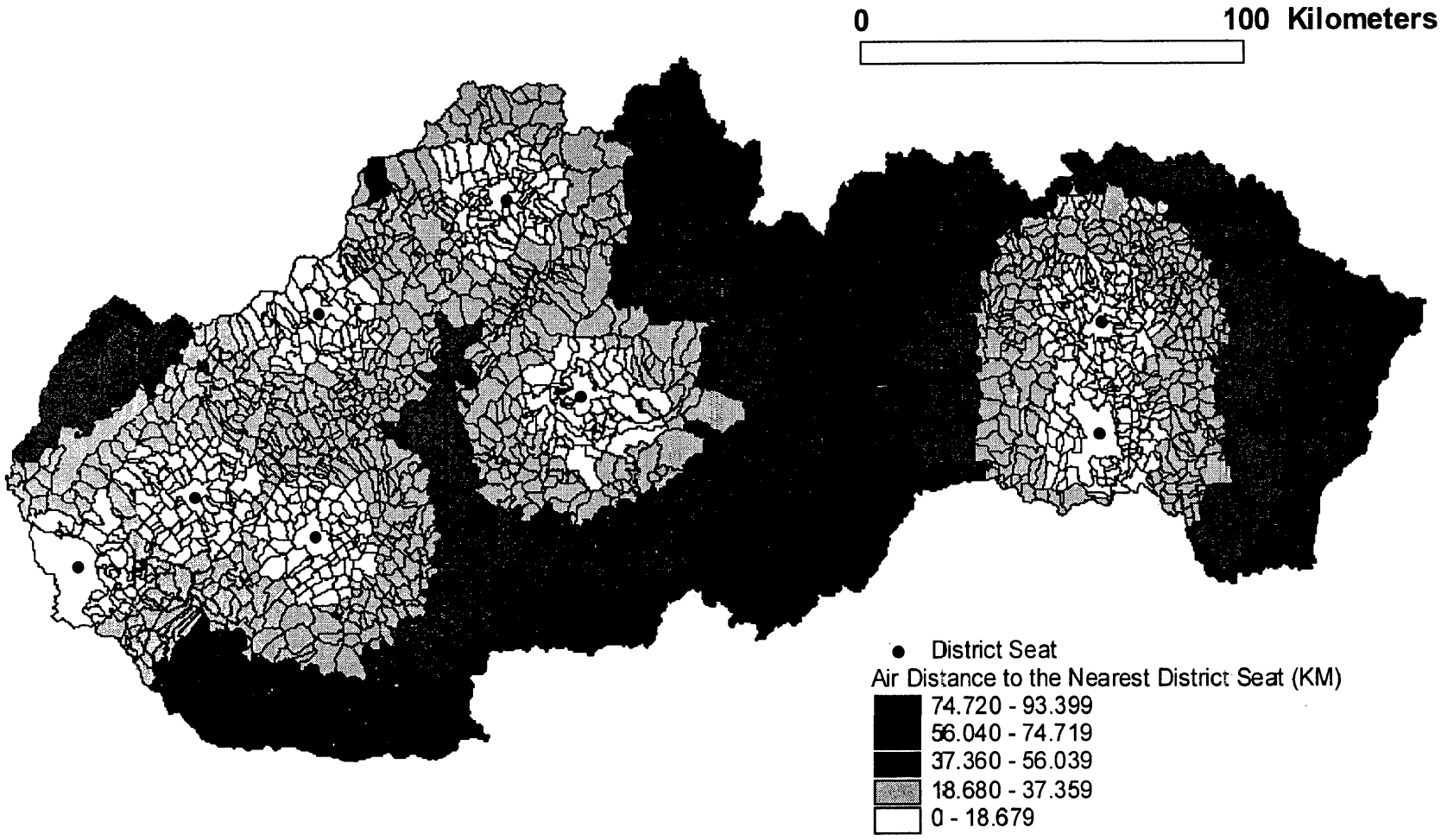


Figure 17. Air Distance of a Community to the Nearest District Seat

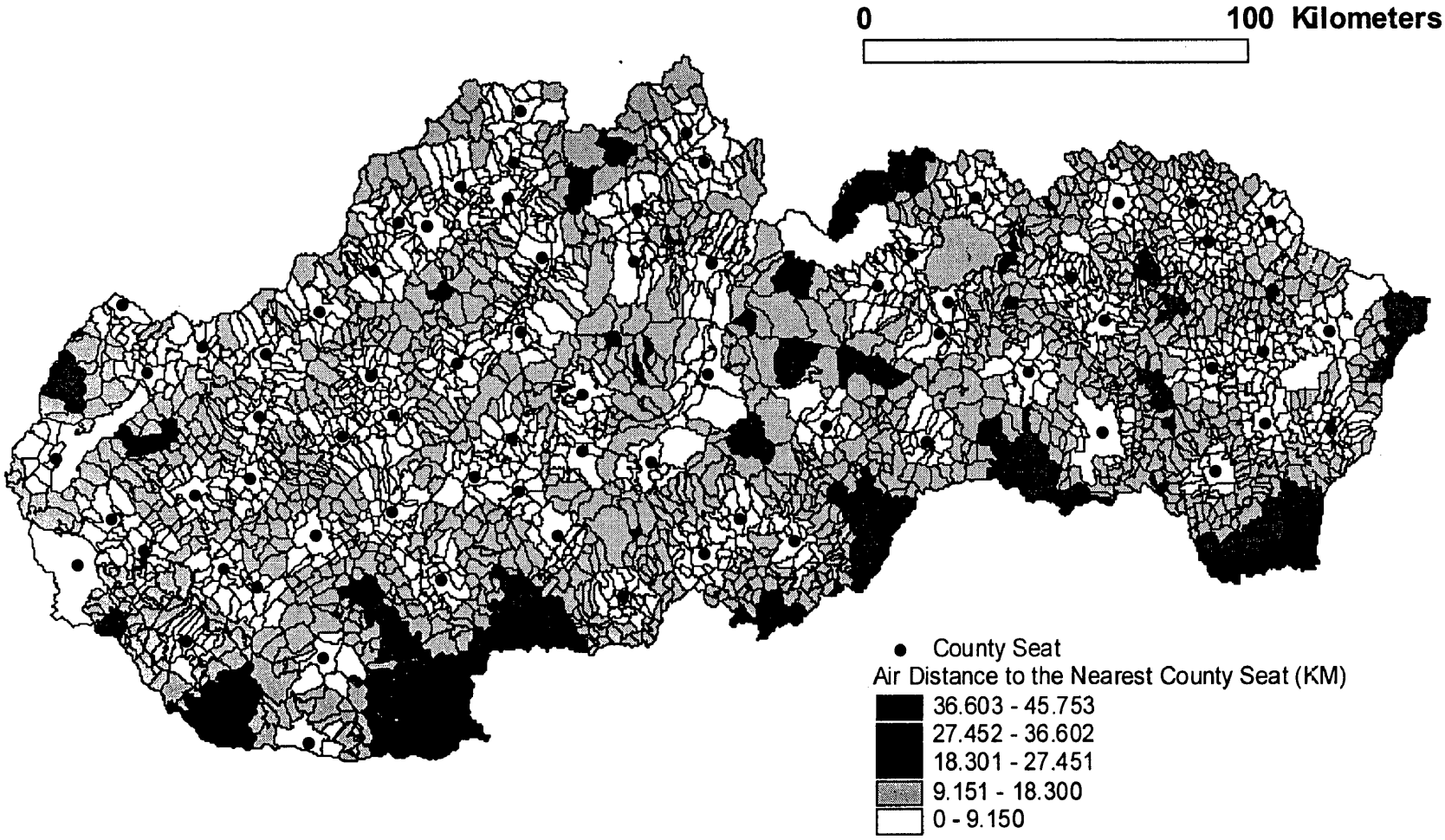


Figure 18. Air Distance of a Community to the Nearest County Seat

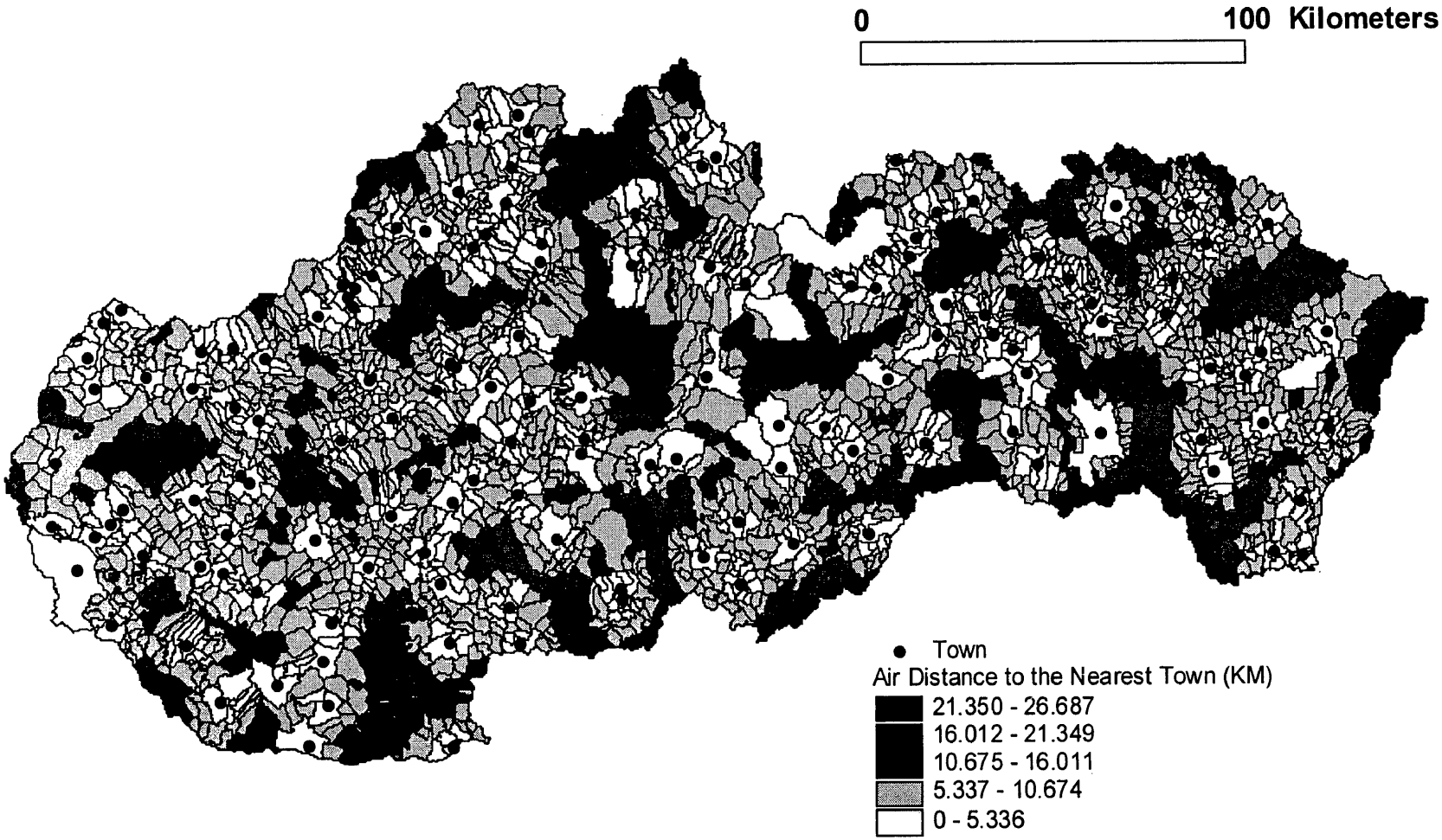


Figure 19. Air Distance of a Community to the Nearest Town

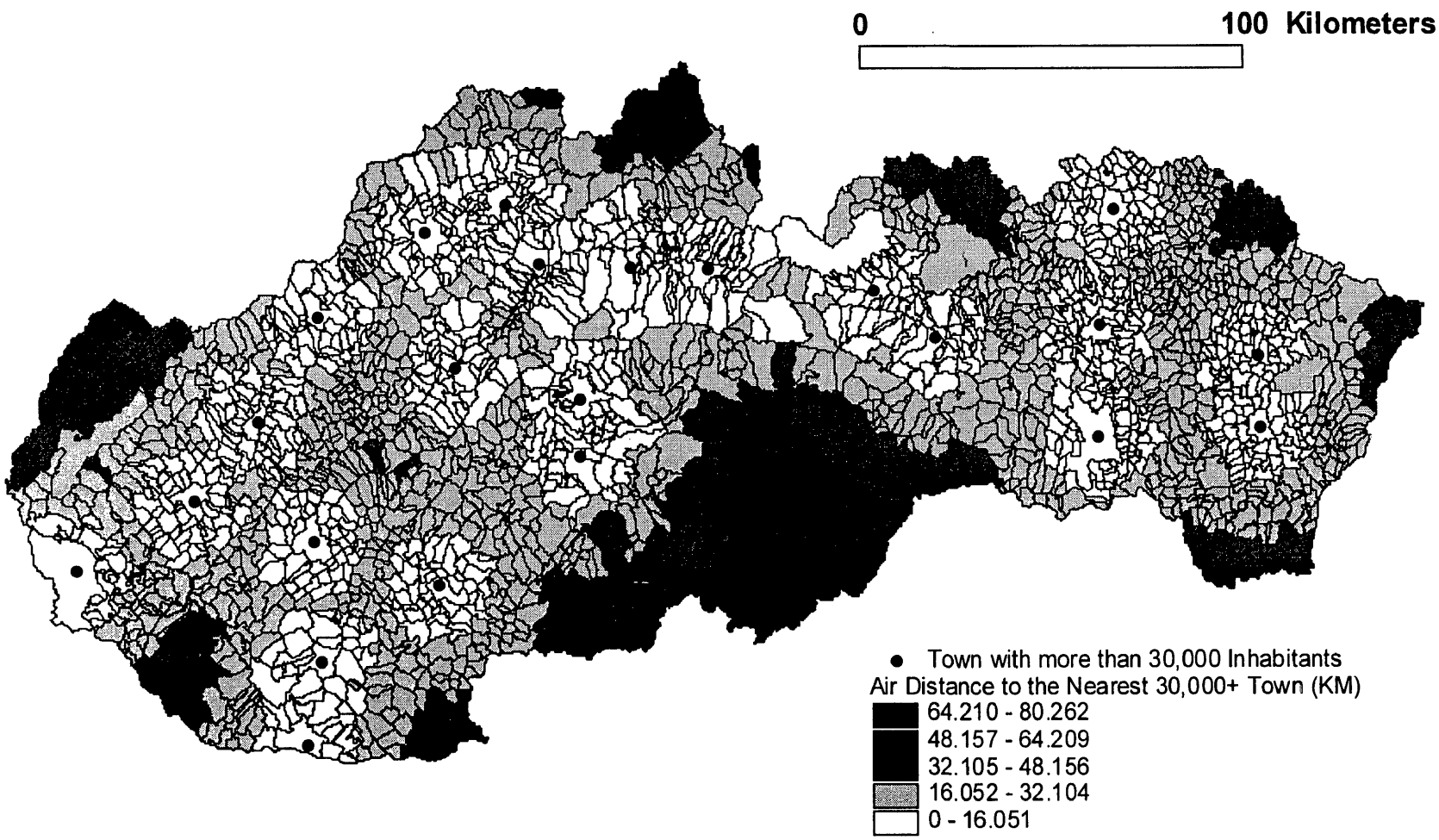


Figure 20. Air Distance of a Community to the Nearest Town with more than 30,000 Inhabitants

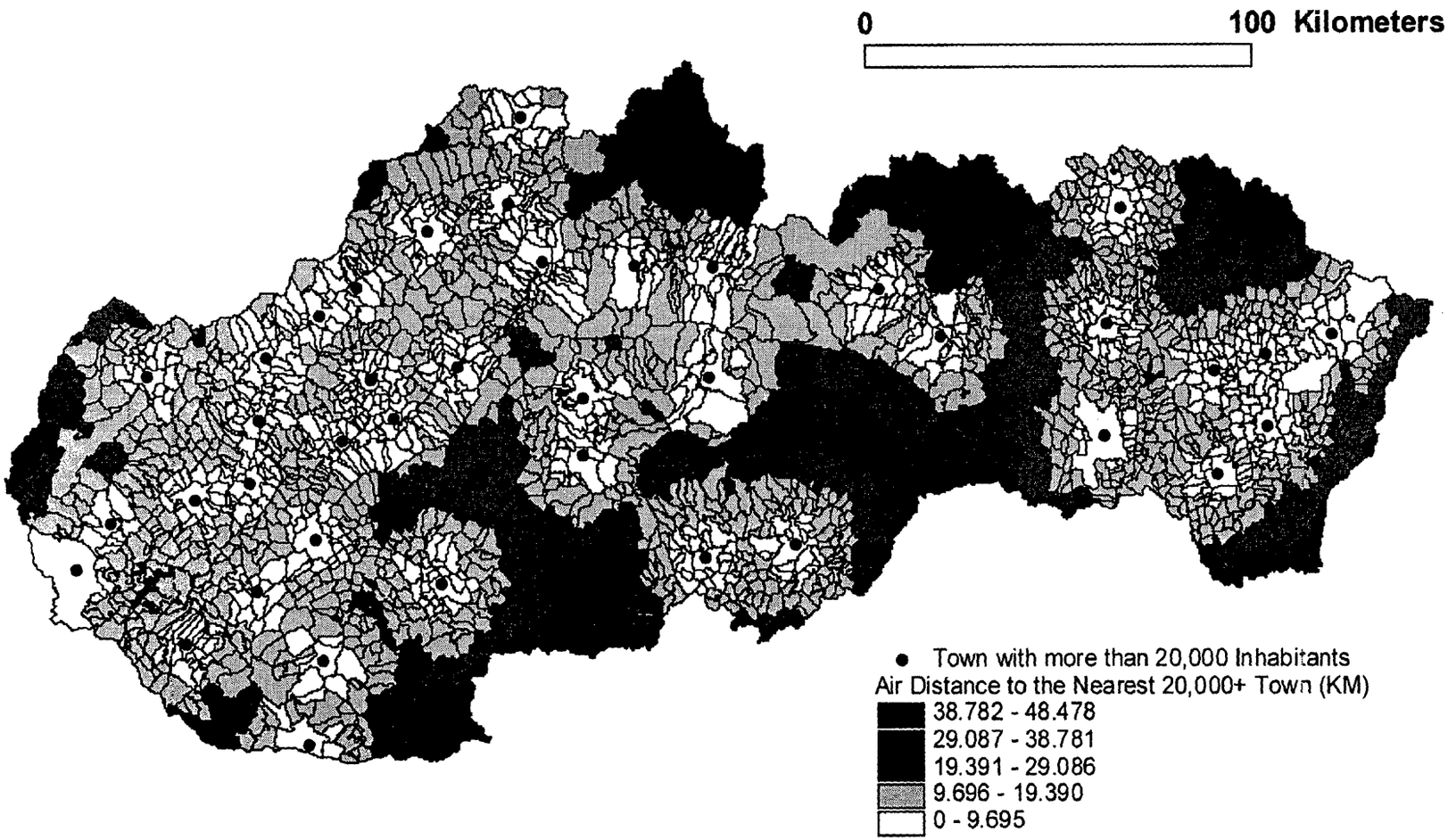


Figure 21. Air Distance of a Community to the Nearest Town with more than 20,000 Inhabitants

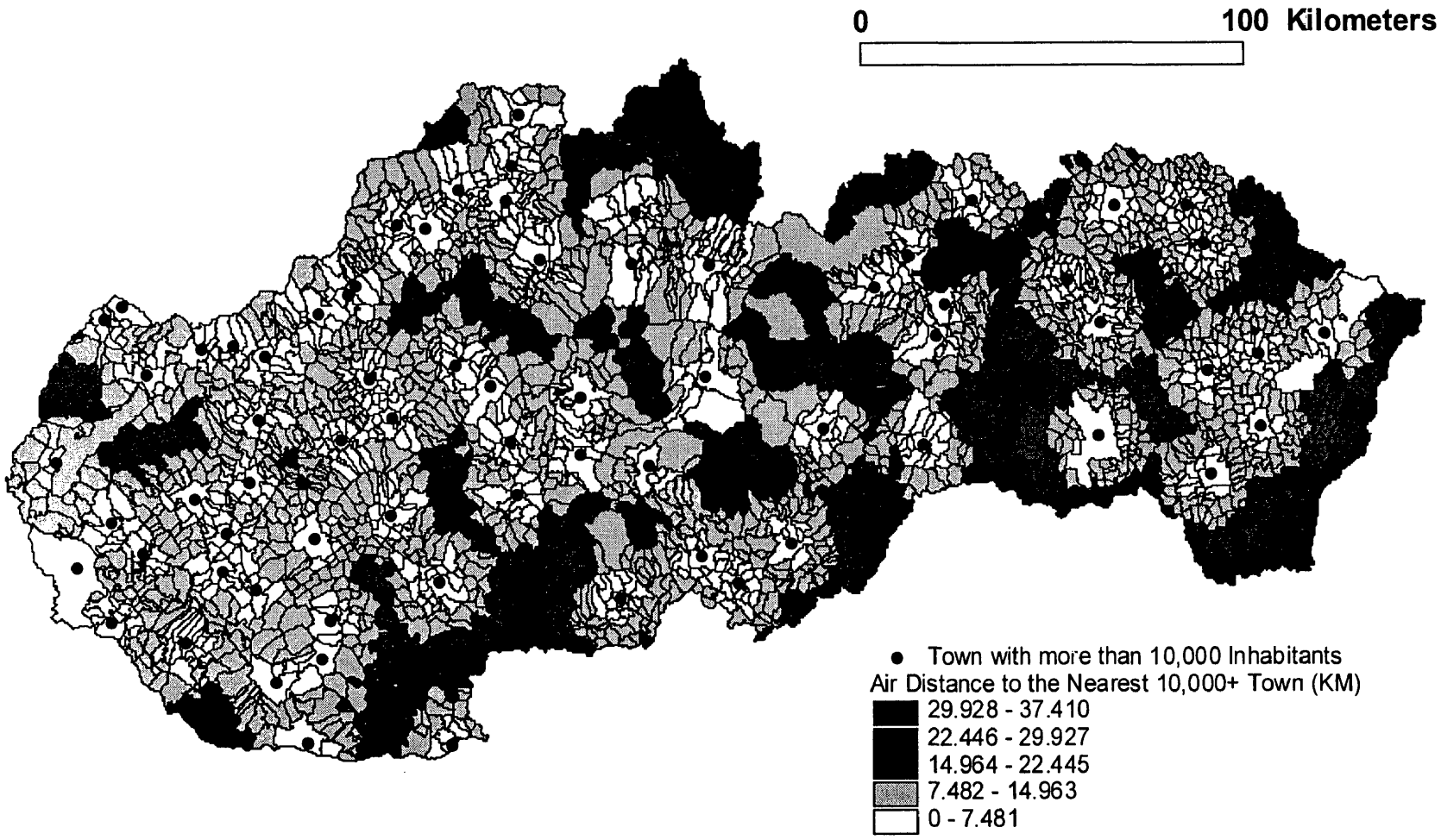


Figure 22. Air Distance of a Community to the Nearest Town with more than 10,000 Inhabitants

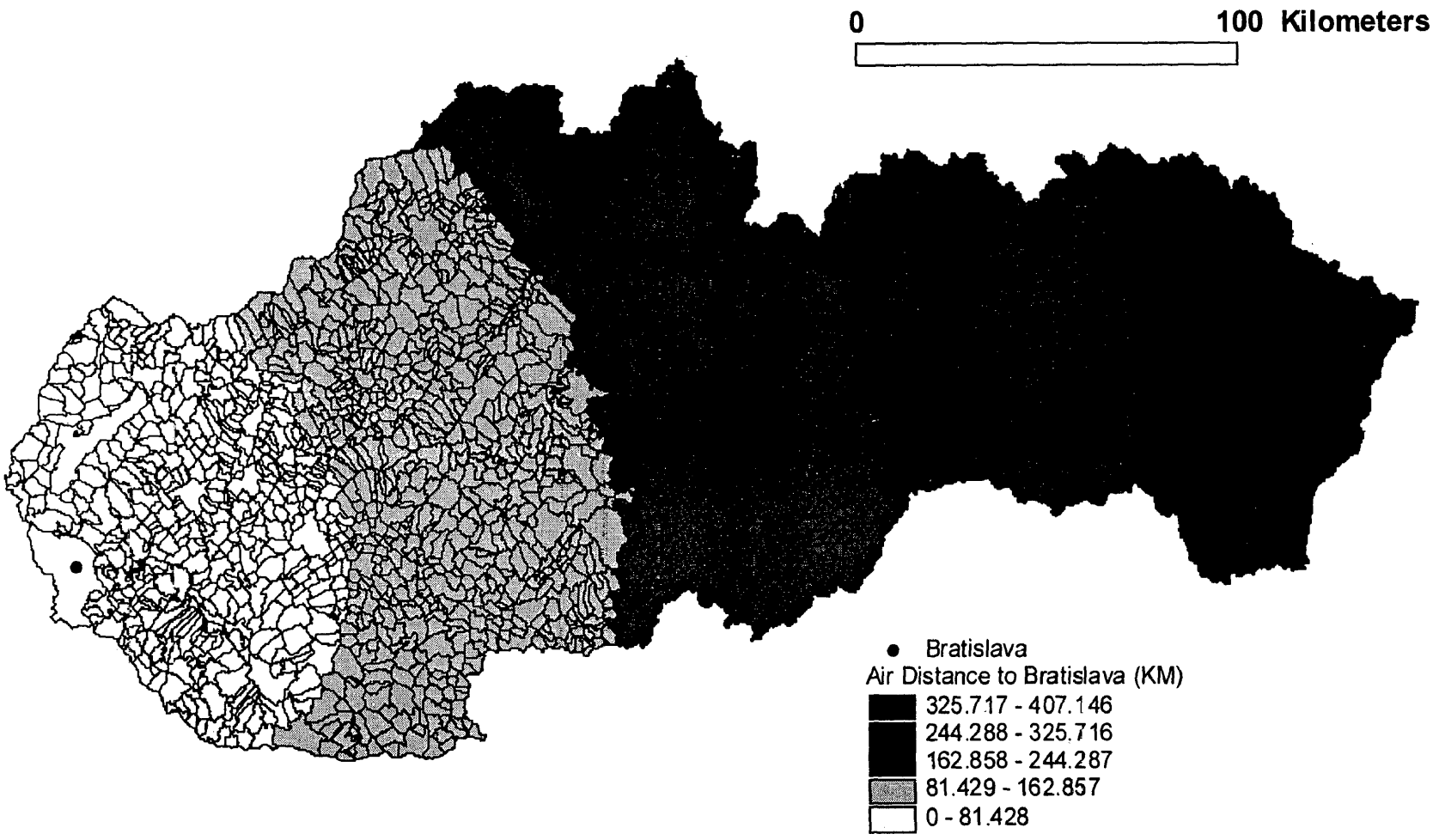


Figure 23. Air Distance of a Community to Bratislava

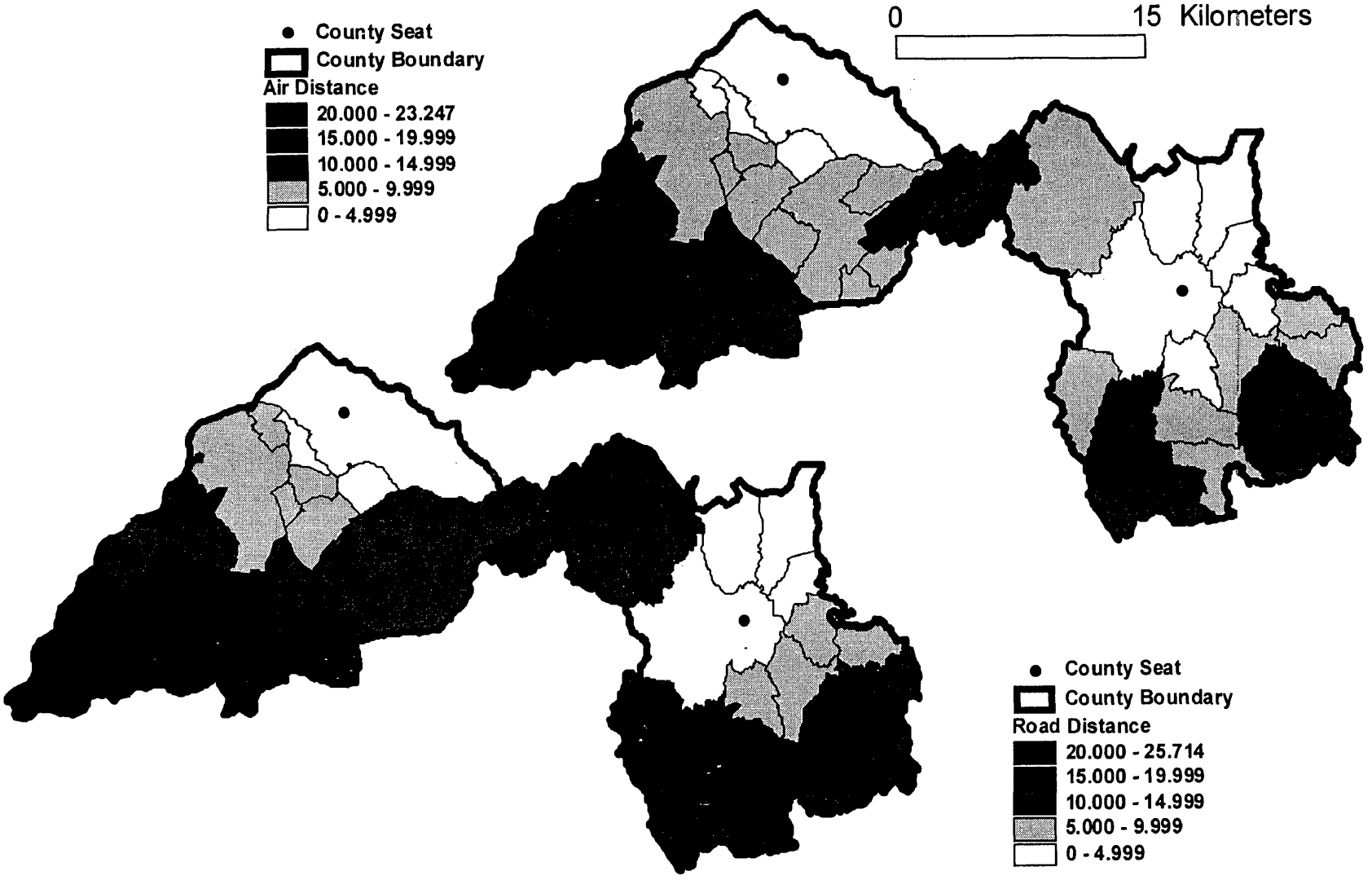


Figure 24. Air Distance and Road Distance of the Communities in the Myjava and Skalica Counties to the Nearest County Seat

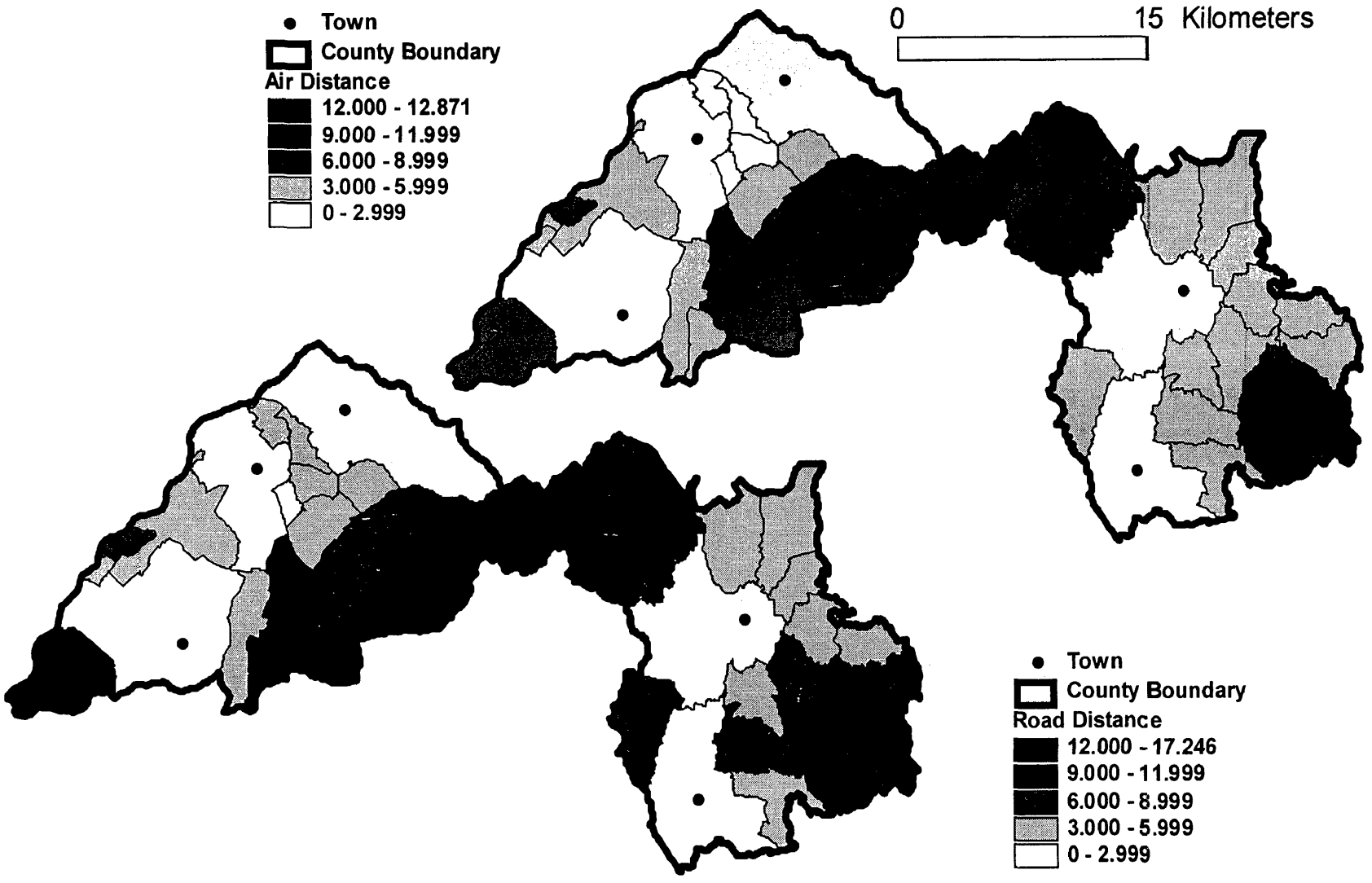


Figure 25. Air Distance and Road Distance of the Communities in the Myjava and Skalica Counties to the Nearest Town

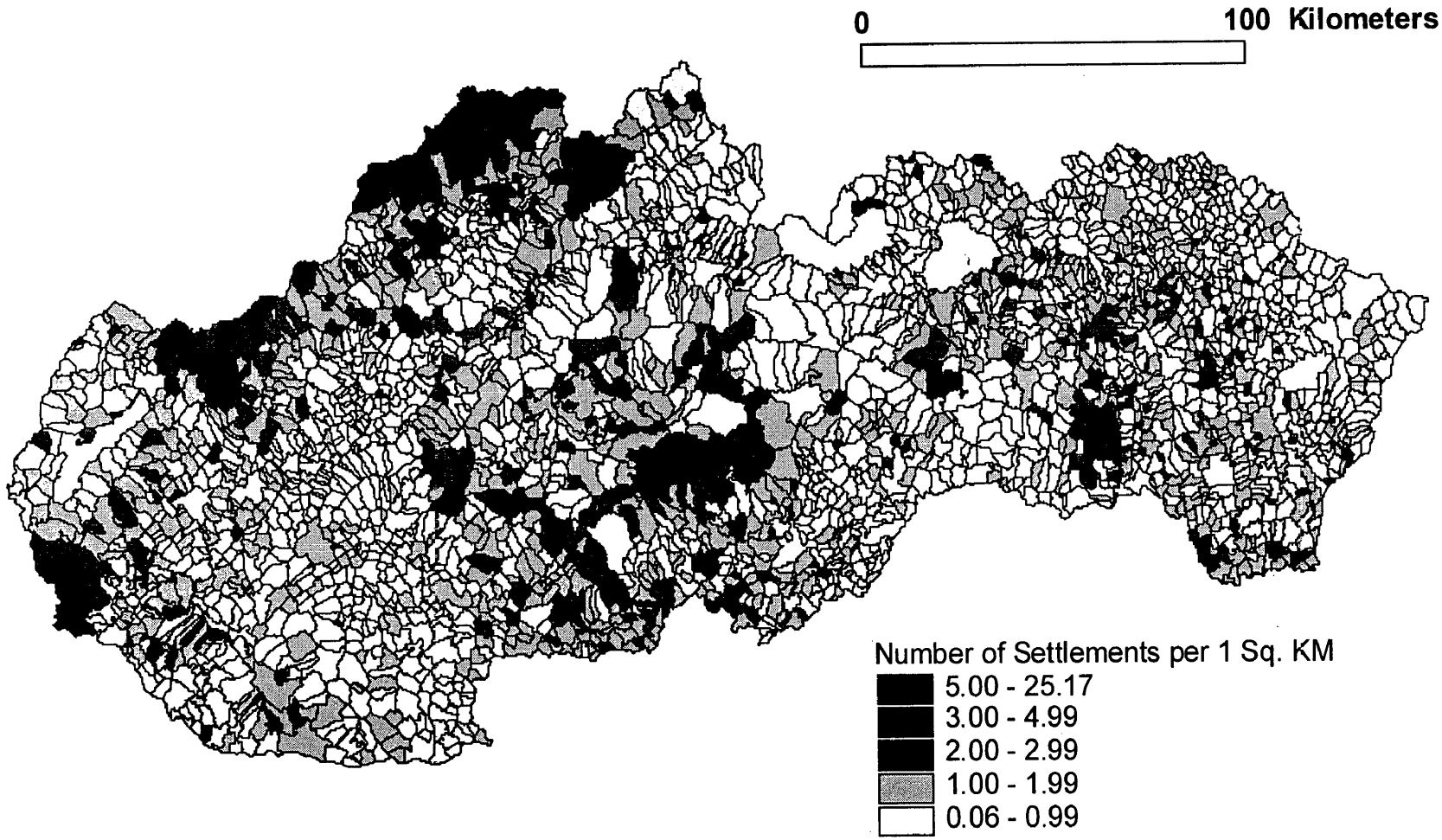


Figure 26. Settlement Density in the Communities of Slovakia – Regular Method

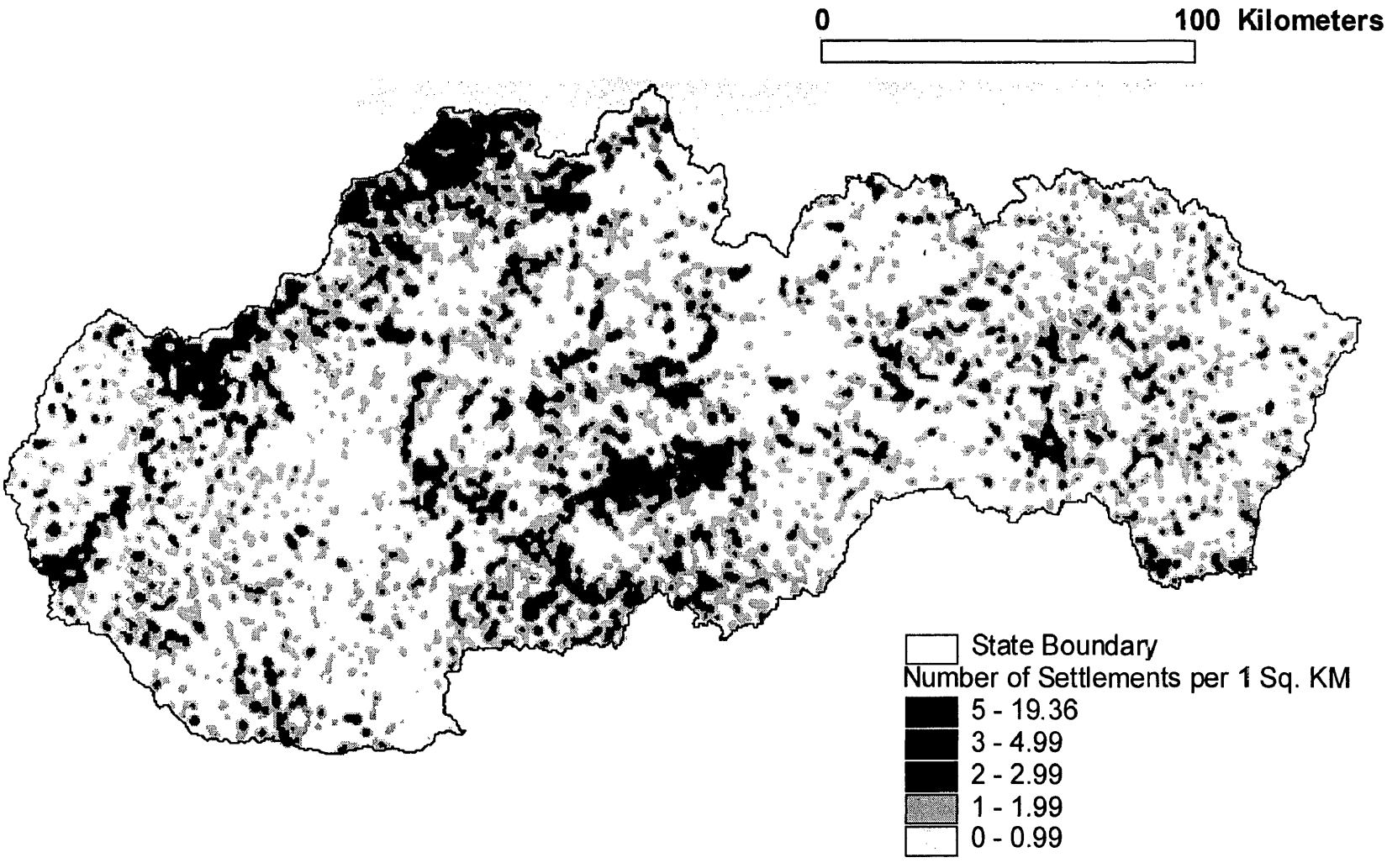


Figure 27. Settlement Density in Slovakia – Kernel Method

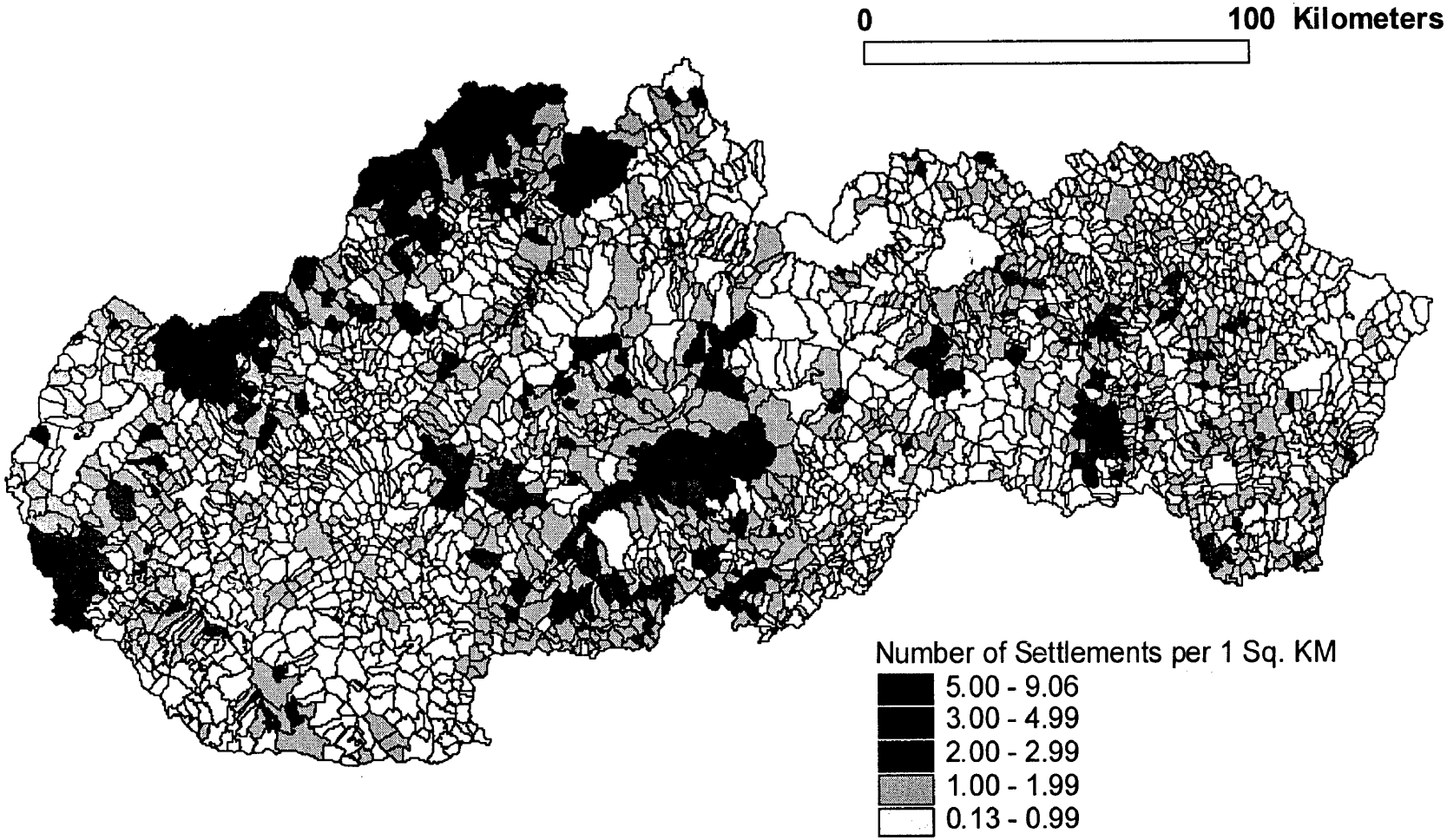


Figure 28. Settlement Density in the Communities of Slovakia – Kernel Method

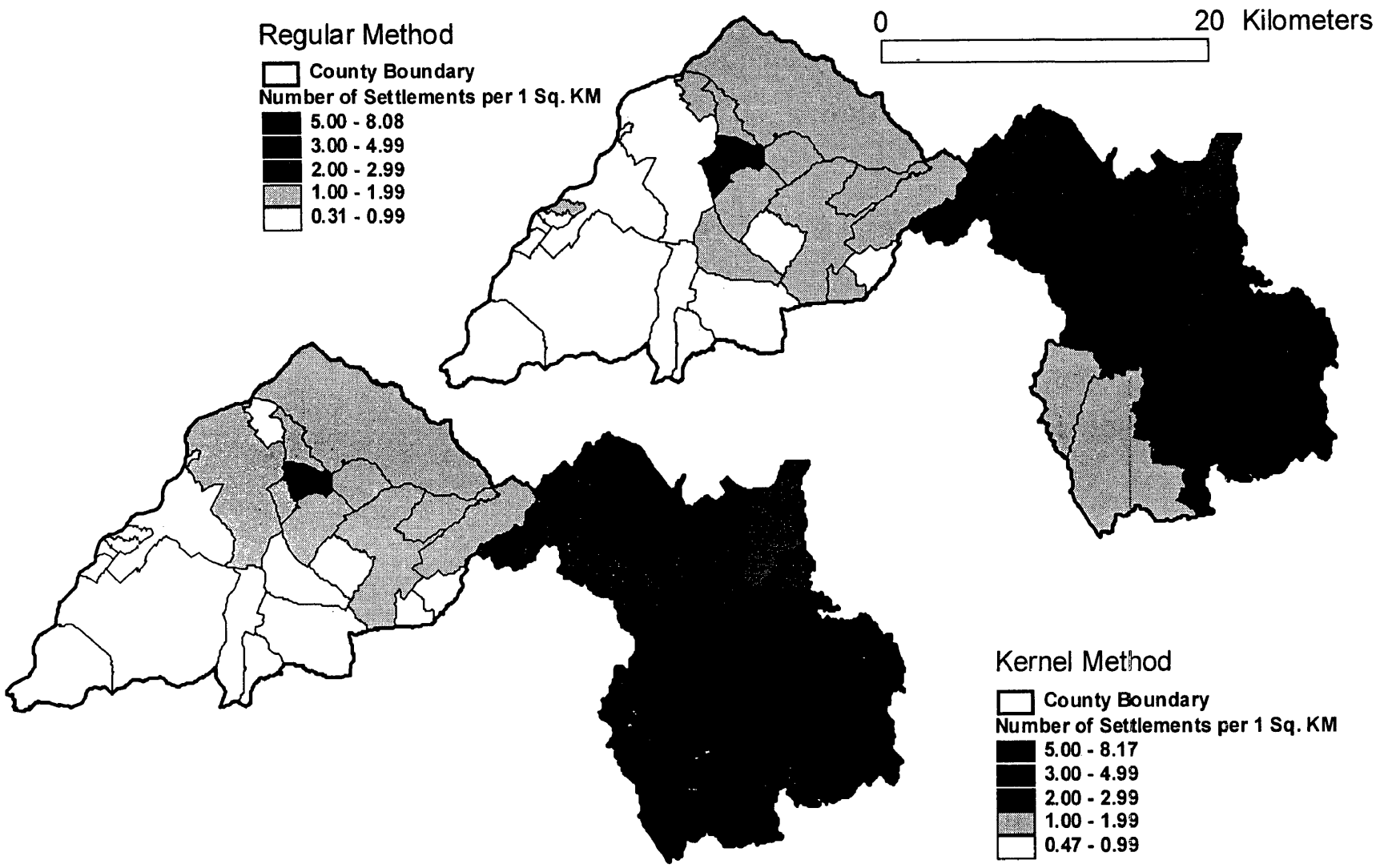


Figure 29. Settlement Density in the Communities in the Myjava and Skalica Counties – Regular and Kernel Method

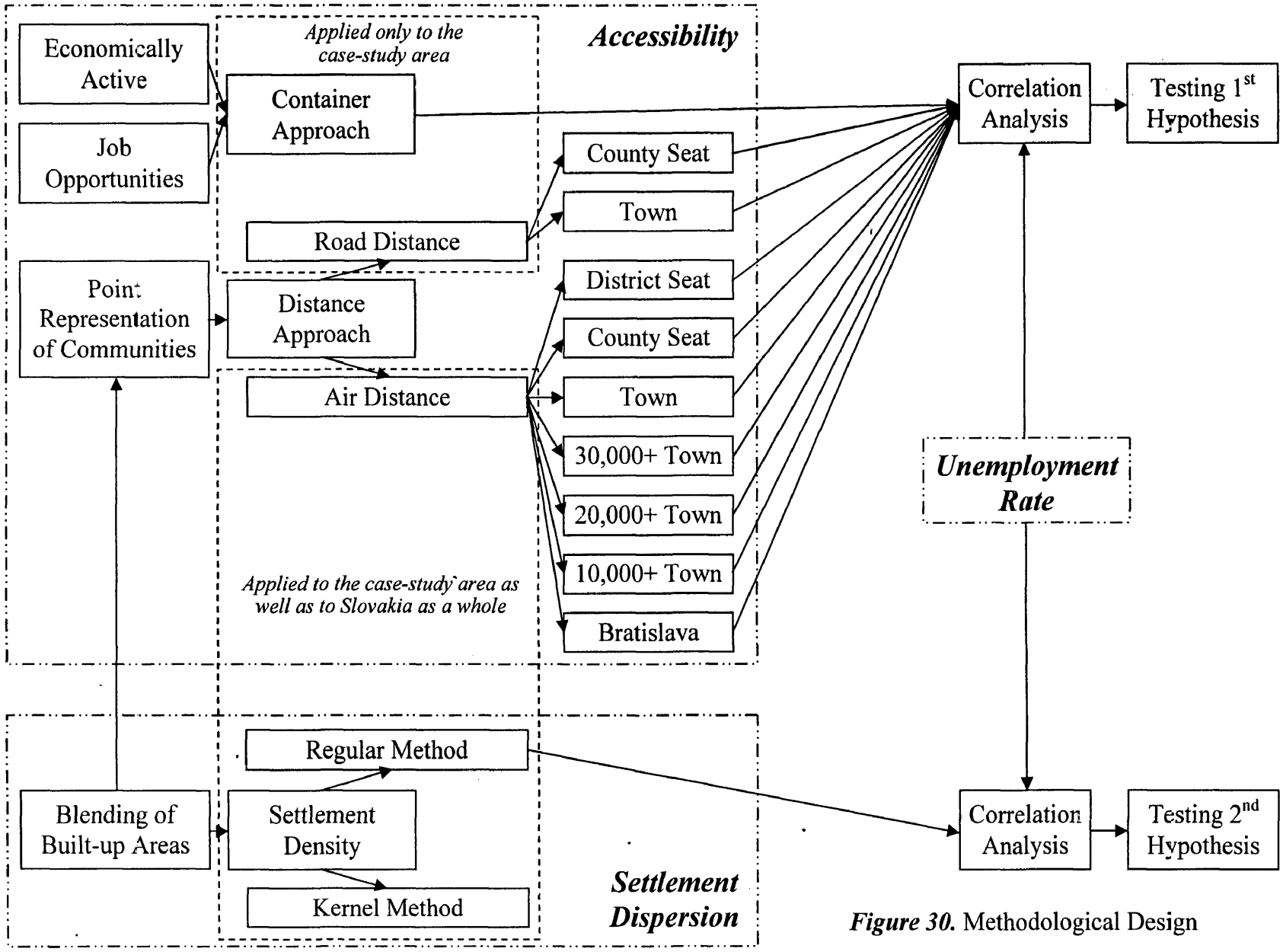


Figure 30. Methodological Design

Correlation Coefficients	Size n	Spearman's ρ	Kendall's τ	Pearson's r[1]	Figure Number
Accessibility - Distance Approach					
Slovakia					
Air Distance to the Nearest District Seat (8)	2873	**0.513	**0.360	**0.518	32
Air Distance to the Nearest County Seat (71)	2810	**0.308	**0.206	**0.307	33
Air Distance to the Nearest Town (138)	2743	**0.218	**0.146	**0.226	34
Air Distance to the Nearest 30,000+ Town (23)	2858	**0.403	**0.277	**0.453	35
Air Distance to the Nearest 20,000+ Town (40)	2841	**0.364	**0.244	**0.296	36
Air Distance to the Nearest 10,000+ Town (72)	2809	**0.325	**0.217	**0.287	37
Air Distance to Bratislava (1)	2880	**0.435	**0.291	**0.356	38
Myjava County					
Air Distance to the Nearest County Seat	16	0.229	0.133	0.360	39
Air Distance to the Nearest Town	15	0.375	0.238	*0.519	40
Road Distance to the Nearest County Seat	16	0.274	0.150	0.360	41
Road Distance to the Nearest Town	15	*0.514	0.352	*0.537	42
Skalica County					
Air Distance to the Nearest County Seat	20	0.182	0.158	0.269	39
Air Distance to the Nearest Town	18	0.119	0.085	0.256	40
Road Distance to the Nearest County Seat	20	0.235	0.147	0.249	41
Road Distance to the Nearest Town	18	0.158	0.085	0.324	42
Myjava and Skalica Counties					
Air Distance to the Nearest County Seat	36	0.158	0.117	0.232	39
Air Distance to the Nearest Town	33	0.296	0.208	*0.354	40
Road Distance to the Nearest County Seat	36	0.194	0.117	0.226	41
Road Distance to the Nearest Town	33	0.318	0.193	*0.408	42
Accessibility - Container Approach					
Job Opportunities per 1 Economically Active					
Myjava County	17	*-0.586	*-0.426	*-0.529	43
Skalica County	21	-0.232	-0.152	-0.249	43
Myjava and Skalica Counties	38	*-0.332	-0.220	*-0.346	43
Settlement Dispersion					
Settlement Density - Regular Method					
Slovakia	2881	**-0.104	**-0.069	**-0.096	44
Myjava County	17	*0.485	*0.353	0.299	45
Skalica County	21	-0.175	-0.143	-0.206	45
Myjava and Skalica Counties	38	0.176	0.127	0.223	45

1 - Values of Pearson's r are only informative, because the assumption of normality is not met.

* - Correlation is significant at the 0.05 level (2-tailed).

** - Correlation is significant at the 0.01 level (2-tailed).

Figure 31. Results of Correlation Analyses

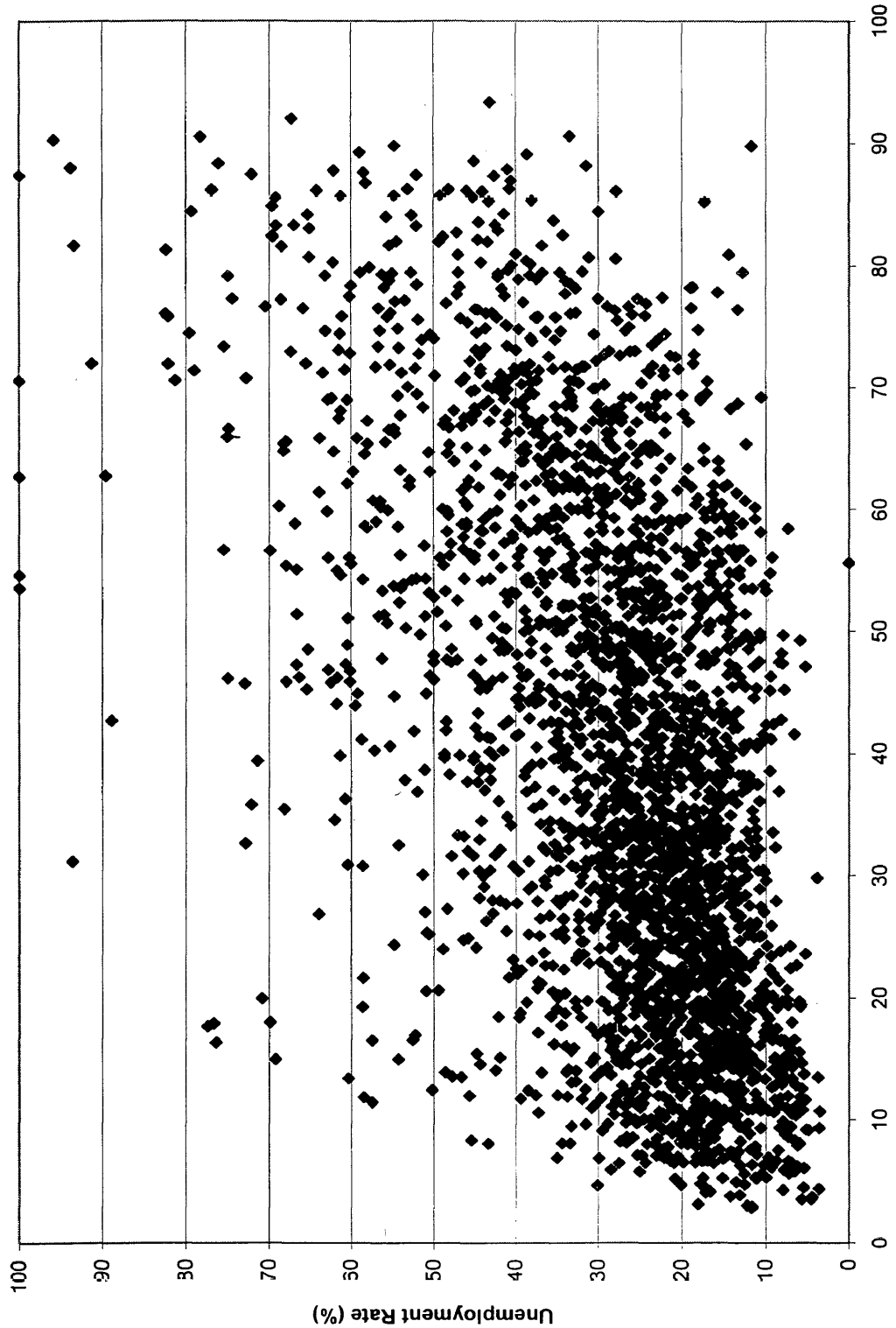


Figure 32. Relationship between Unemployment Rate and Air Distance to the Nearest District Seat - Slovakia

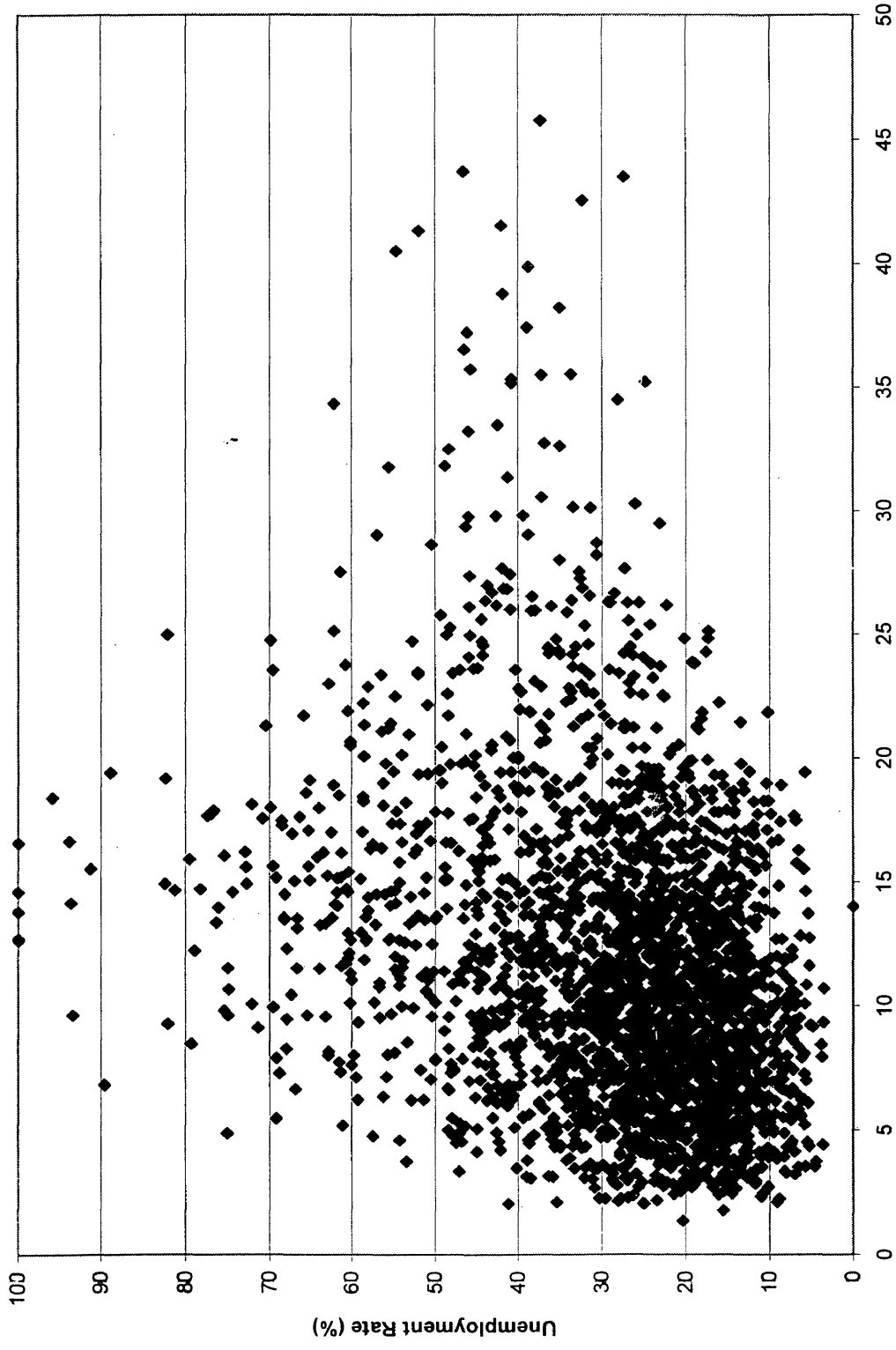


Figure 33. Relationship between Unemployment Rate and Air Distance to the Nearest County Seat - Slovakia

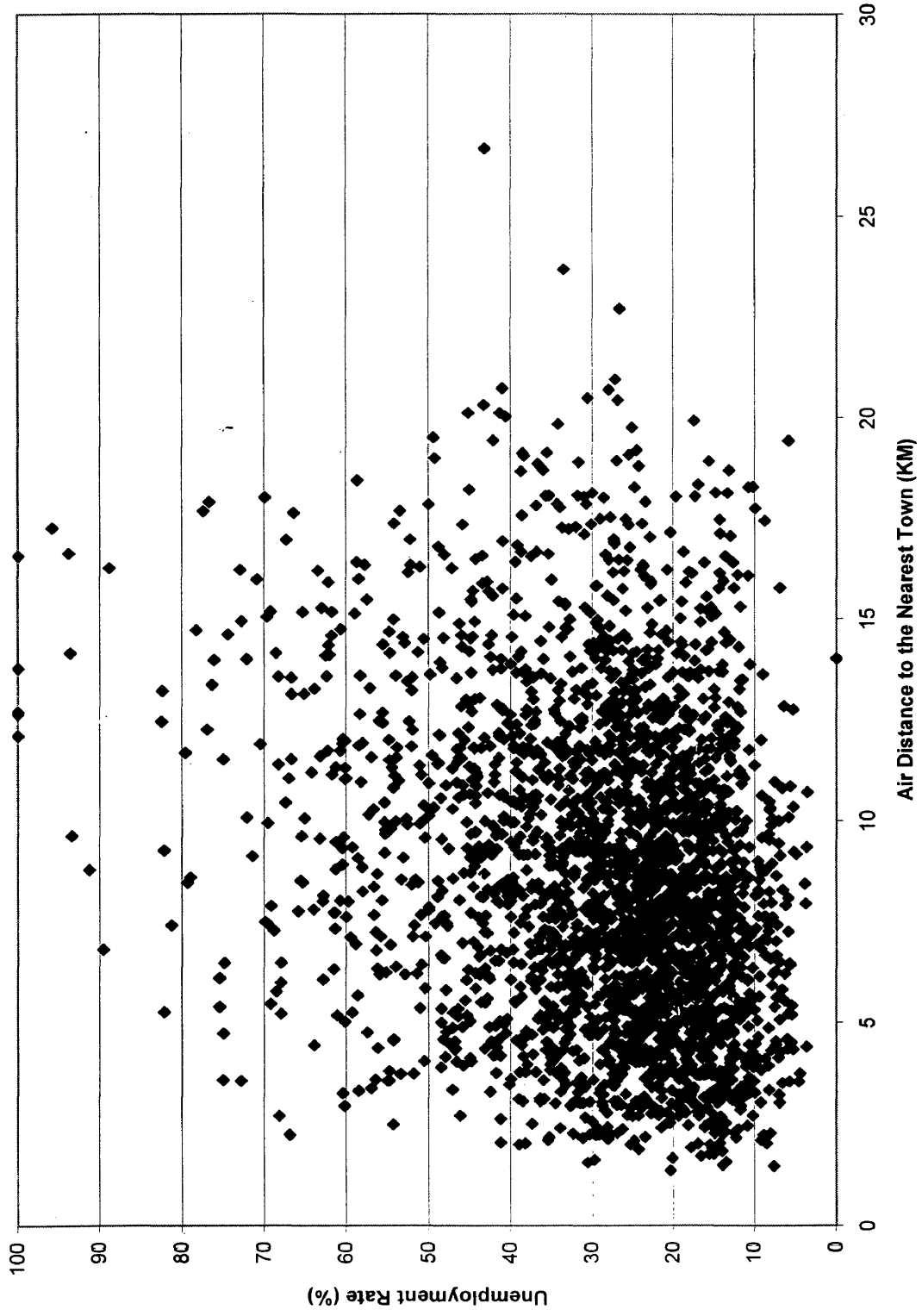


Figure 34. Relationship between Unemployment Rate and Air Distance to the Nearest Town - Slovakia

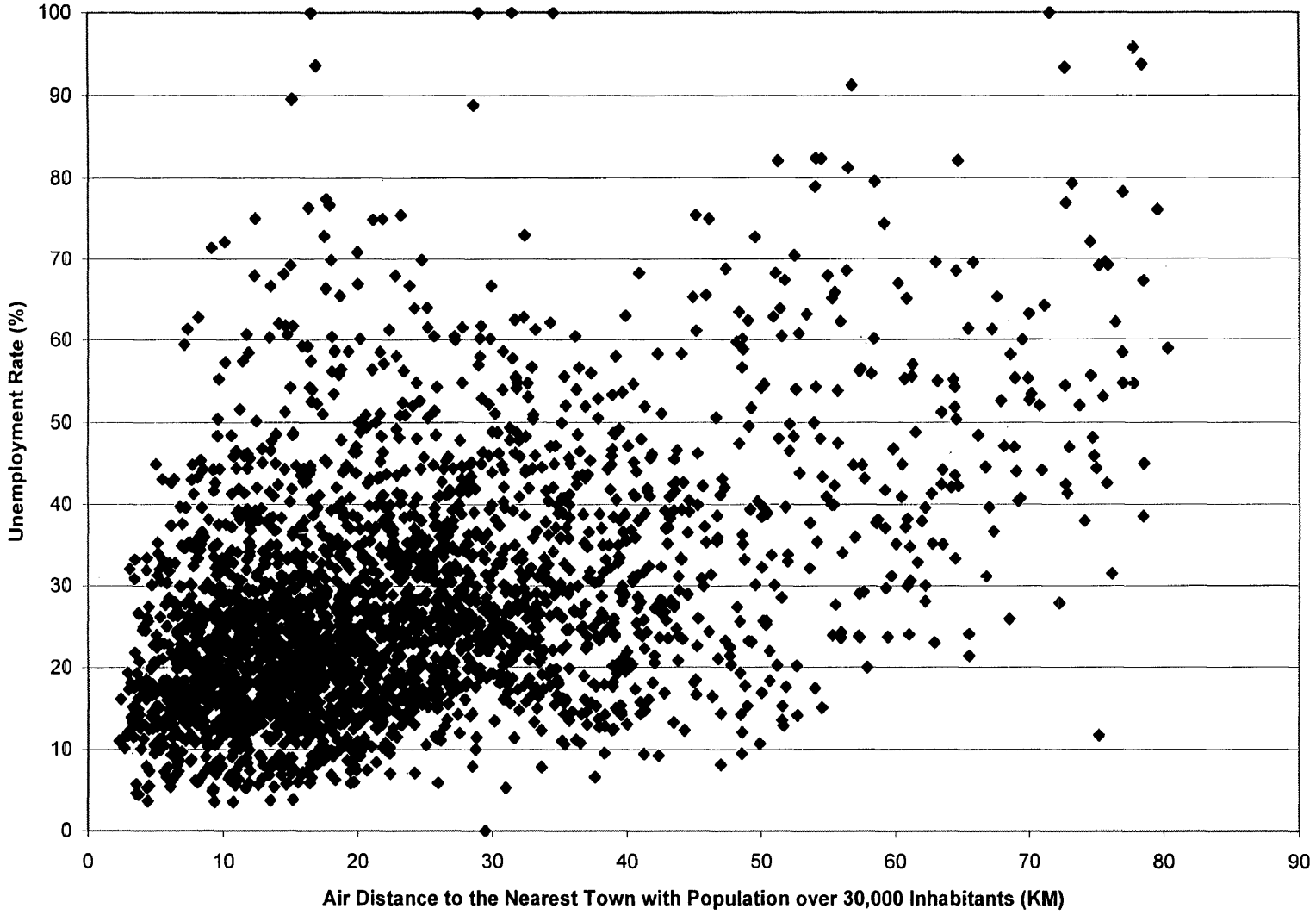


Figure 35. Relationship between Unemployment Rate and Air Distance to the Nearest 30,000+ Town - Slovakia

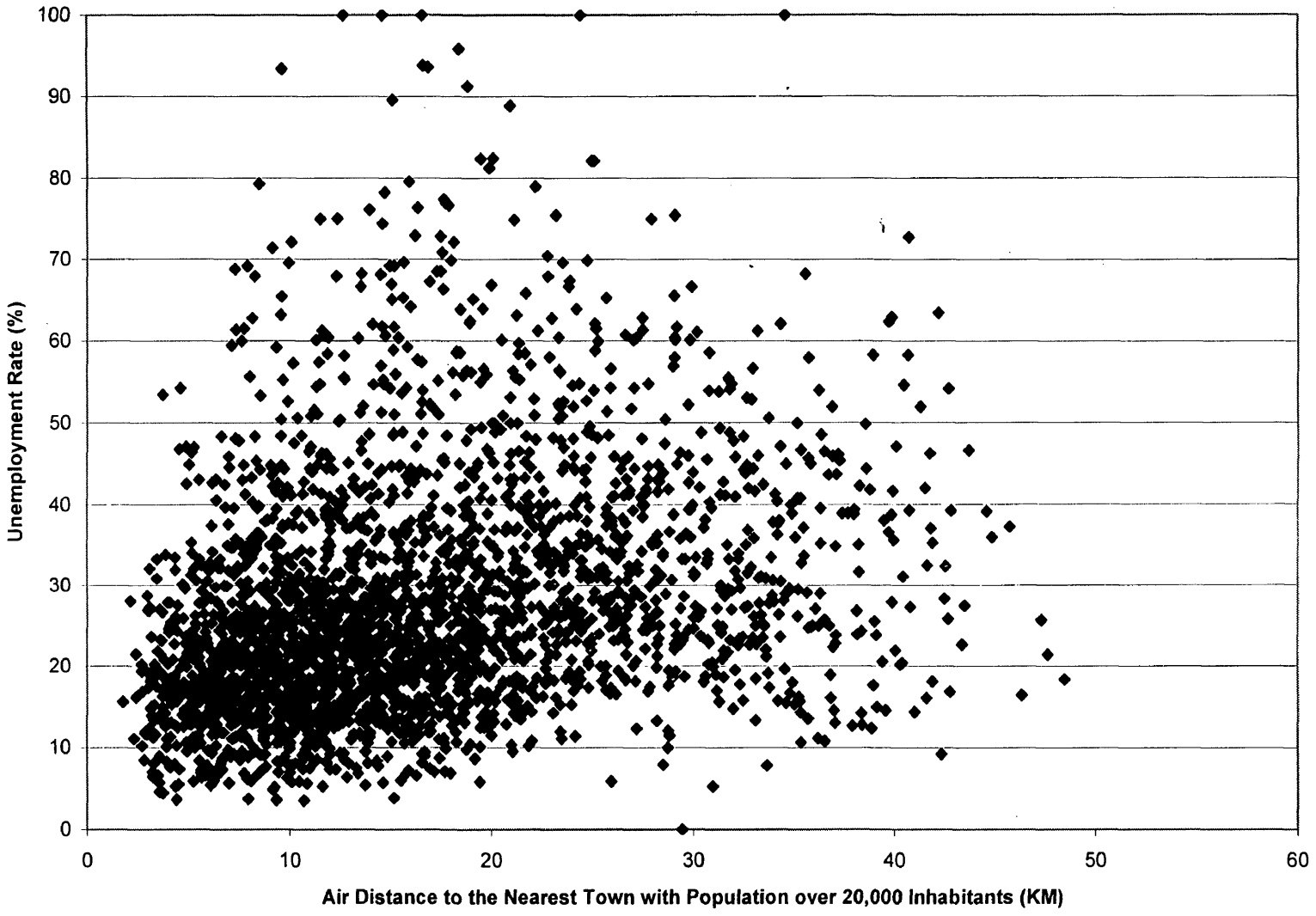


Figure 36. Relationship between Unemployment Rate and Air Distance to the Nearest 20,000+ Town - Slovakia

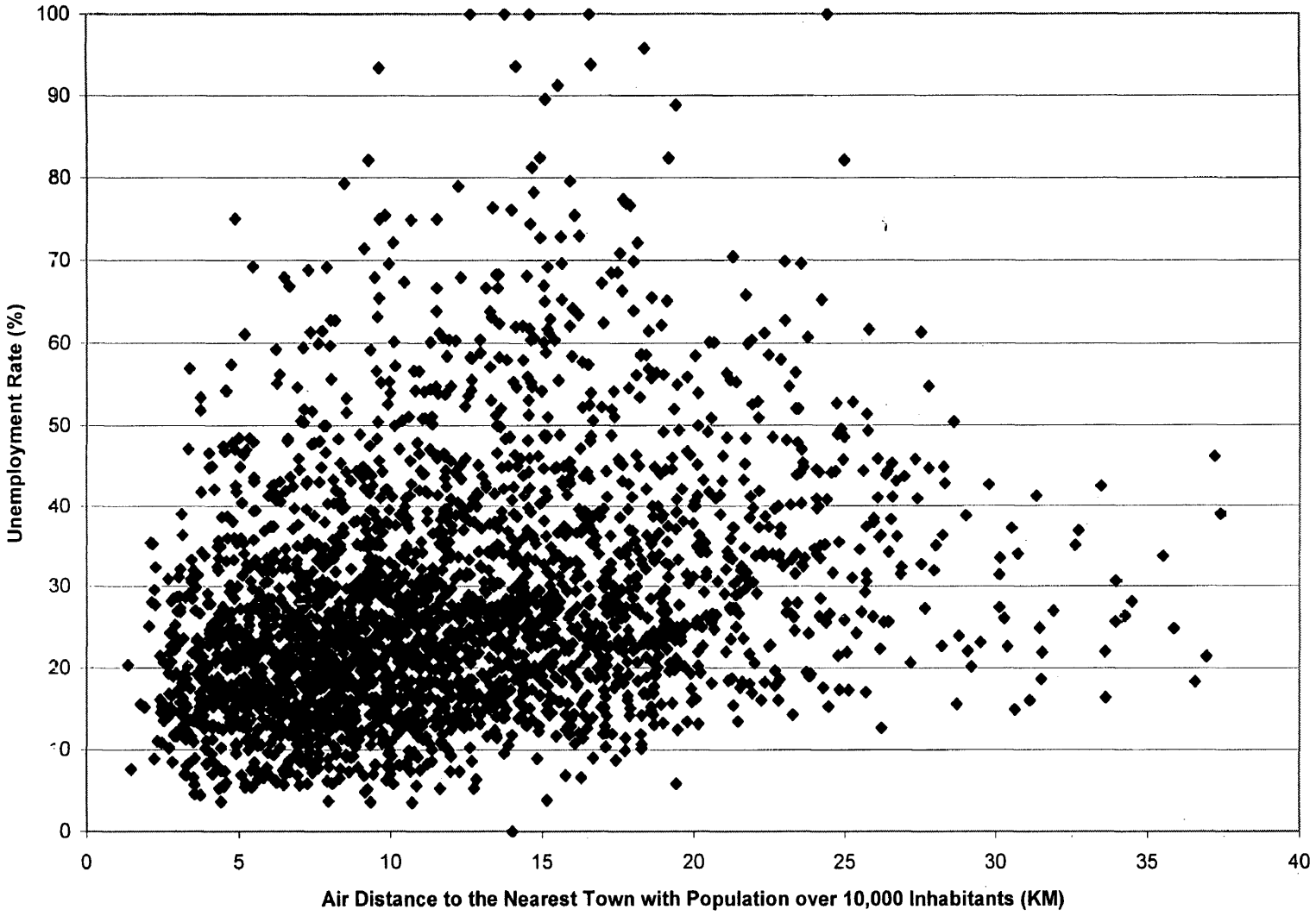


Figure 37. Relationship between Unemployment Rate and Air Distance to the Nearest 10,000+ Town - Slovakia

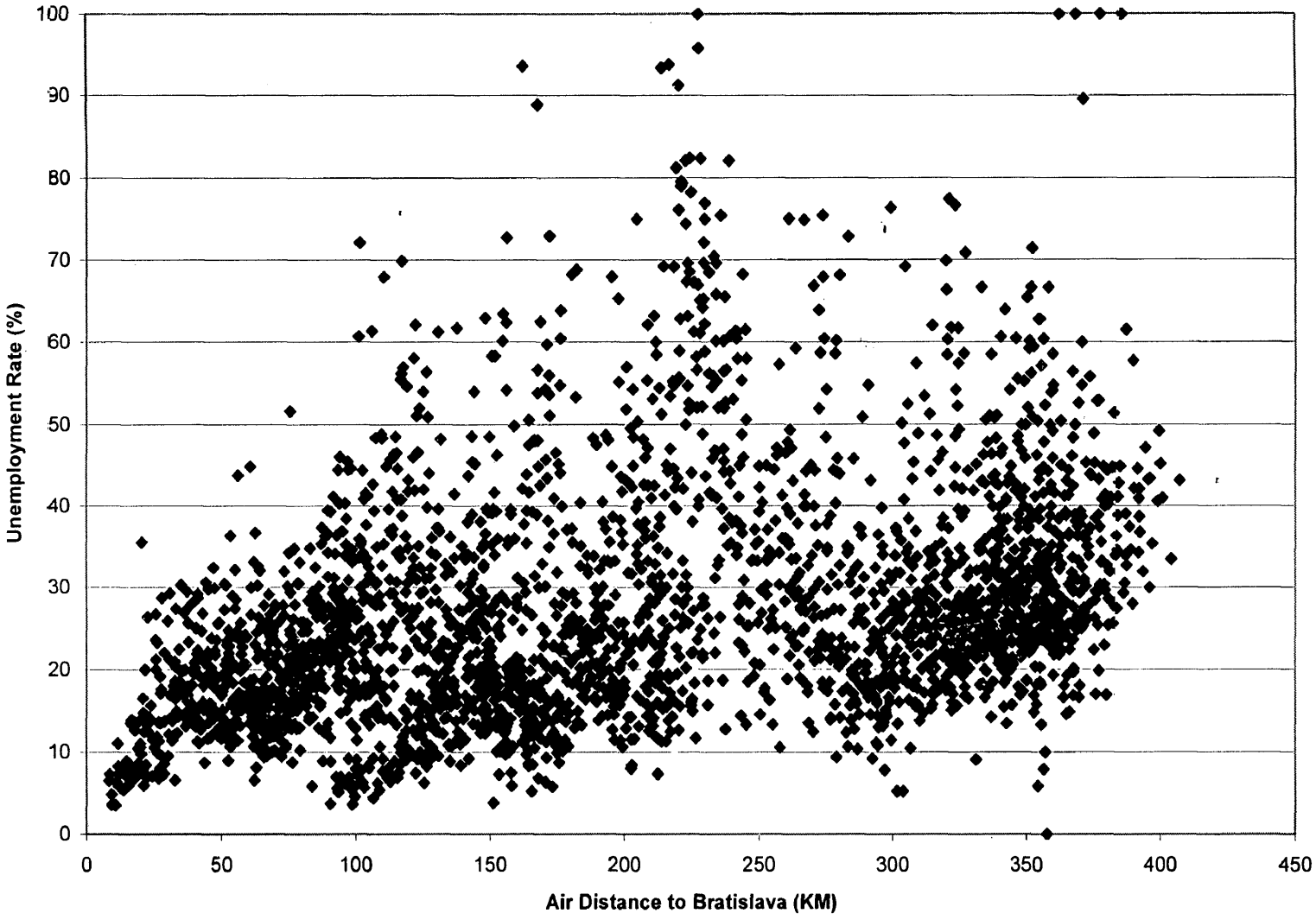


Figure 38. Relationship between Unemployment Rate and Air Distance to Bratislava - Slovakia

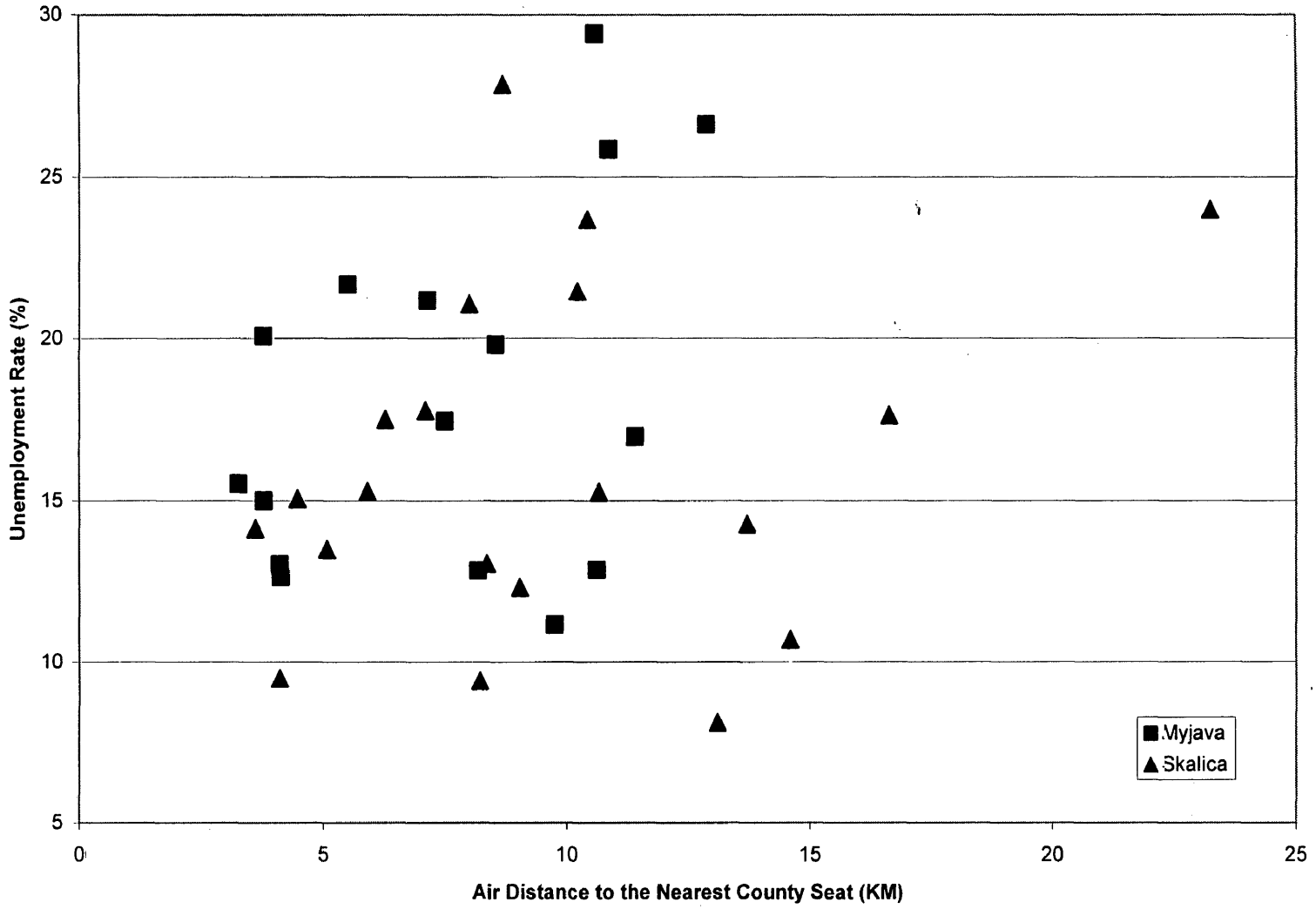


Figure 39. Relationship between Unemployment Rate and Air Distance to the Nearest County Seat – Myjava and Skalica Counties

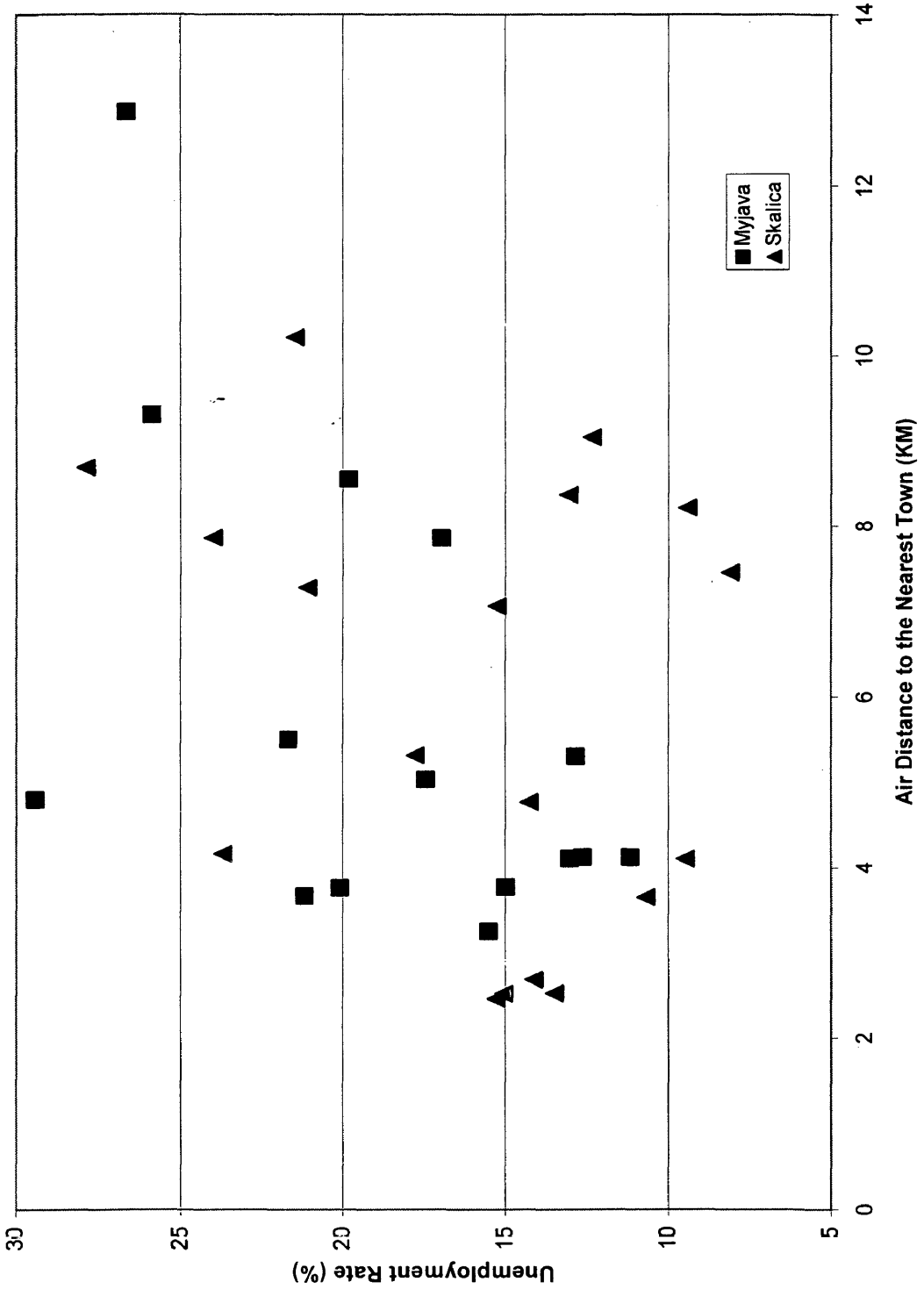


Figure 40. Relationship between Unemployment Rate and Air Distance to the Nearest Town – Myjava and Skalica Counties

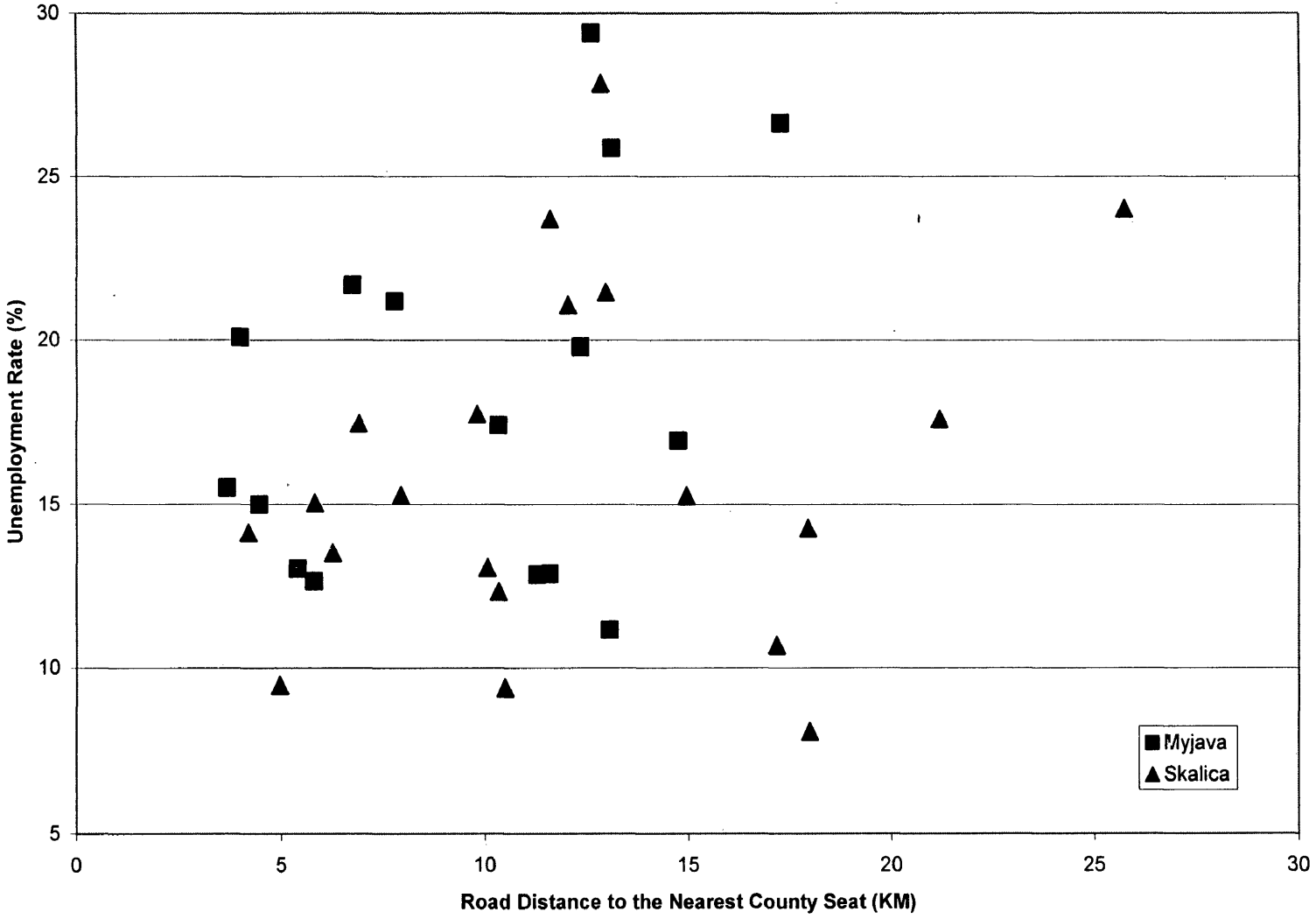


Figure 41. Relationship between Unemployment Rate and Road Distance to the Nearest County Seat – Myjava and Skalica Counties

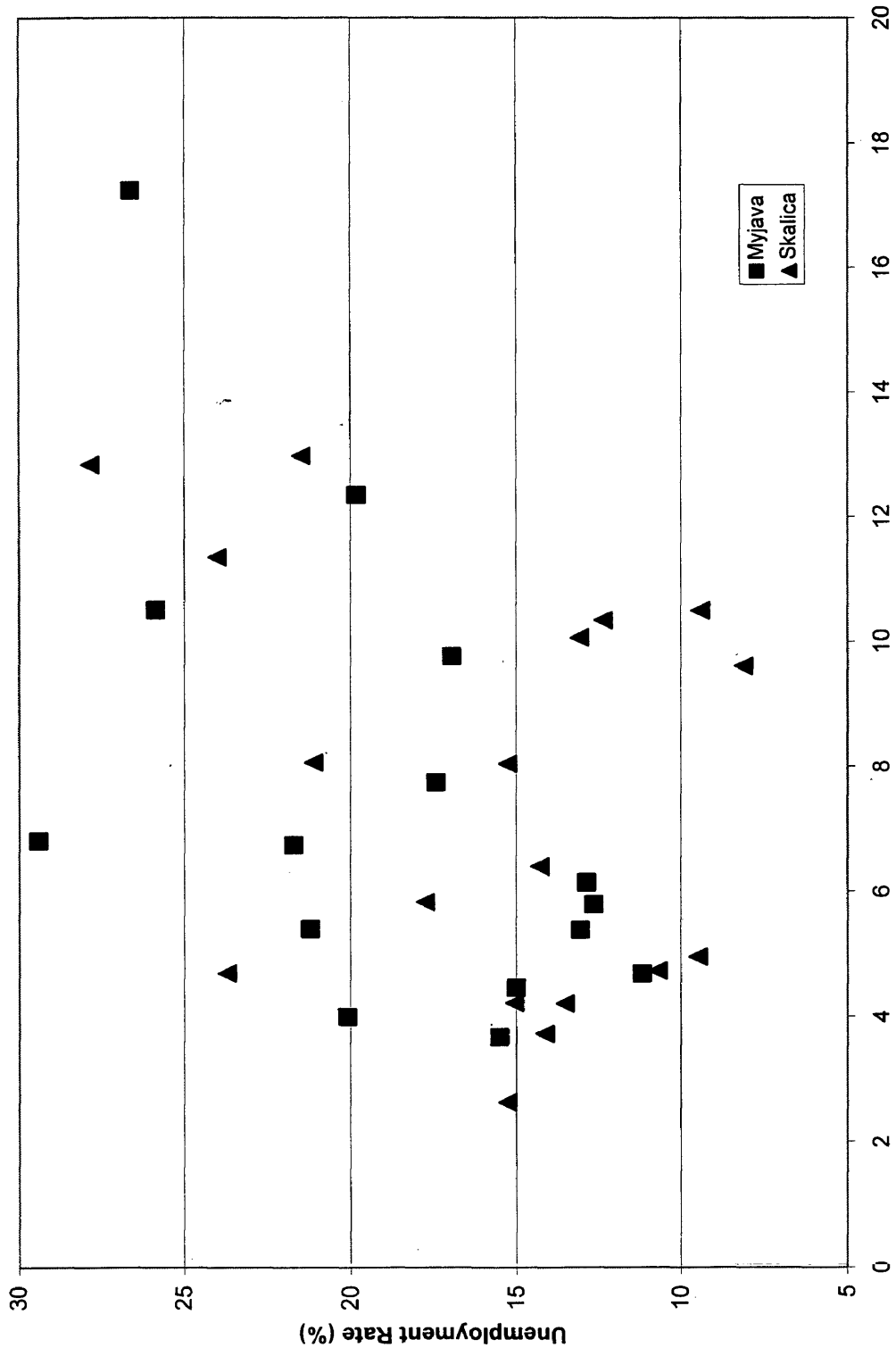


Figure 42. Relationship between Unemployment Rate and Road Distance to the Nearest Town – Myjava and Skalica Counties

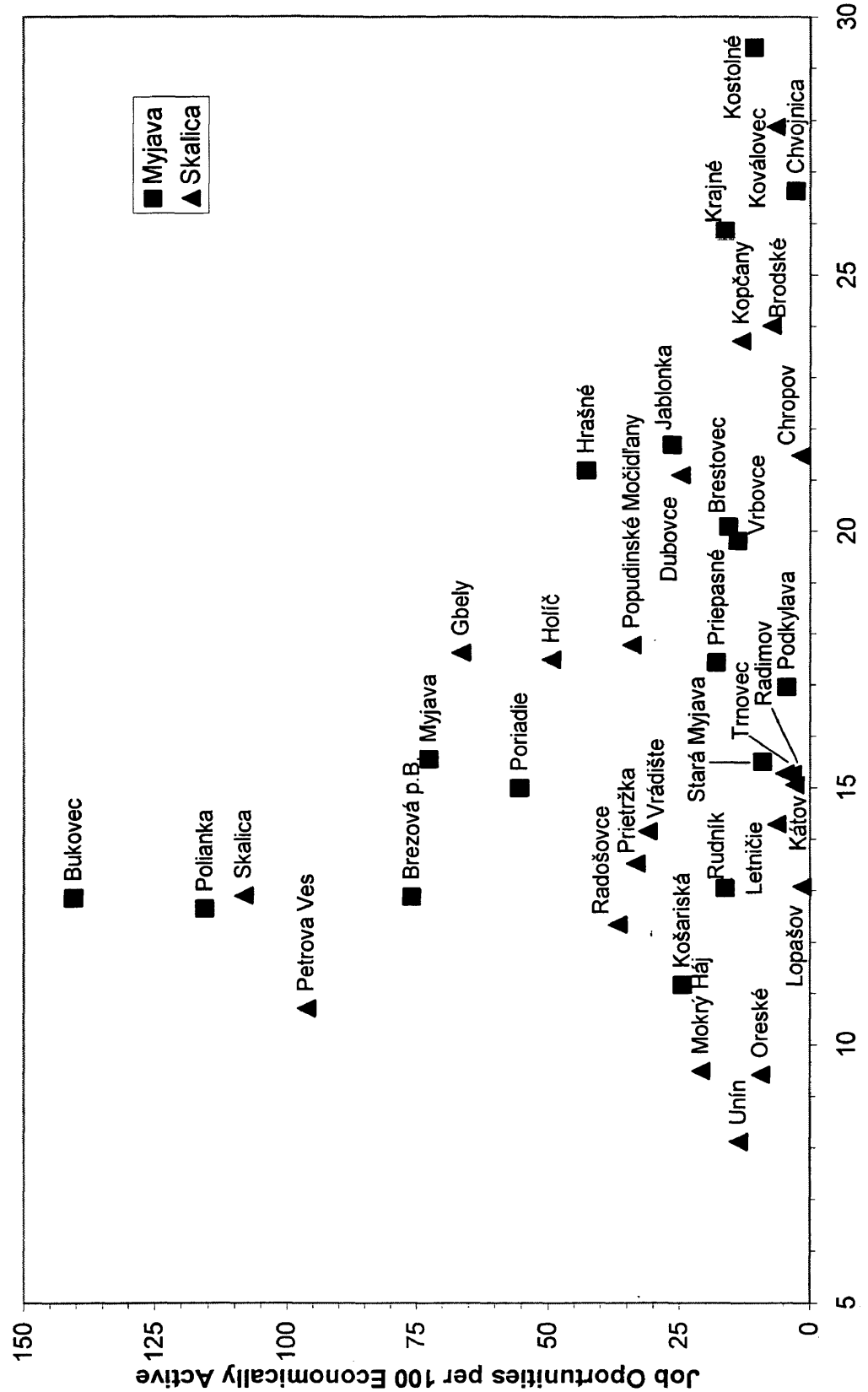


Figure 43. Relationship between Unemployment Rate and the Number of Job Opportunities per 100 Economically Active – Myjava and Skalica Counties

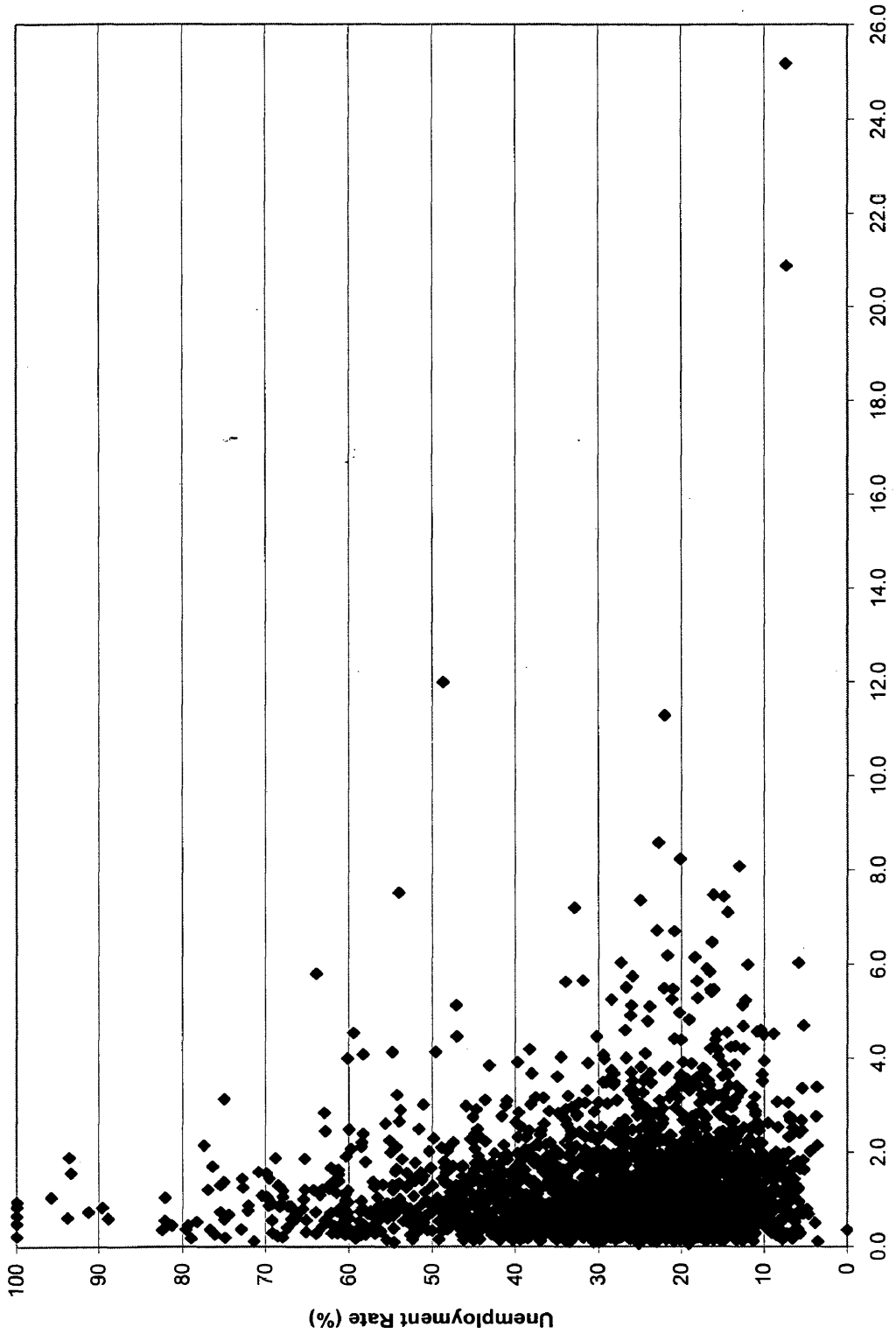


Figure 44. Relationship between Unemployment Rate and Settlement Dispersion - Slovakia

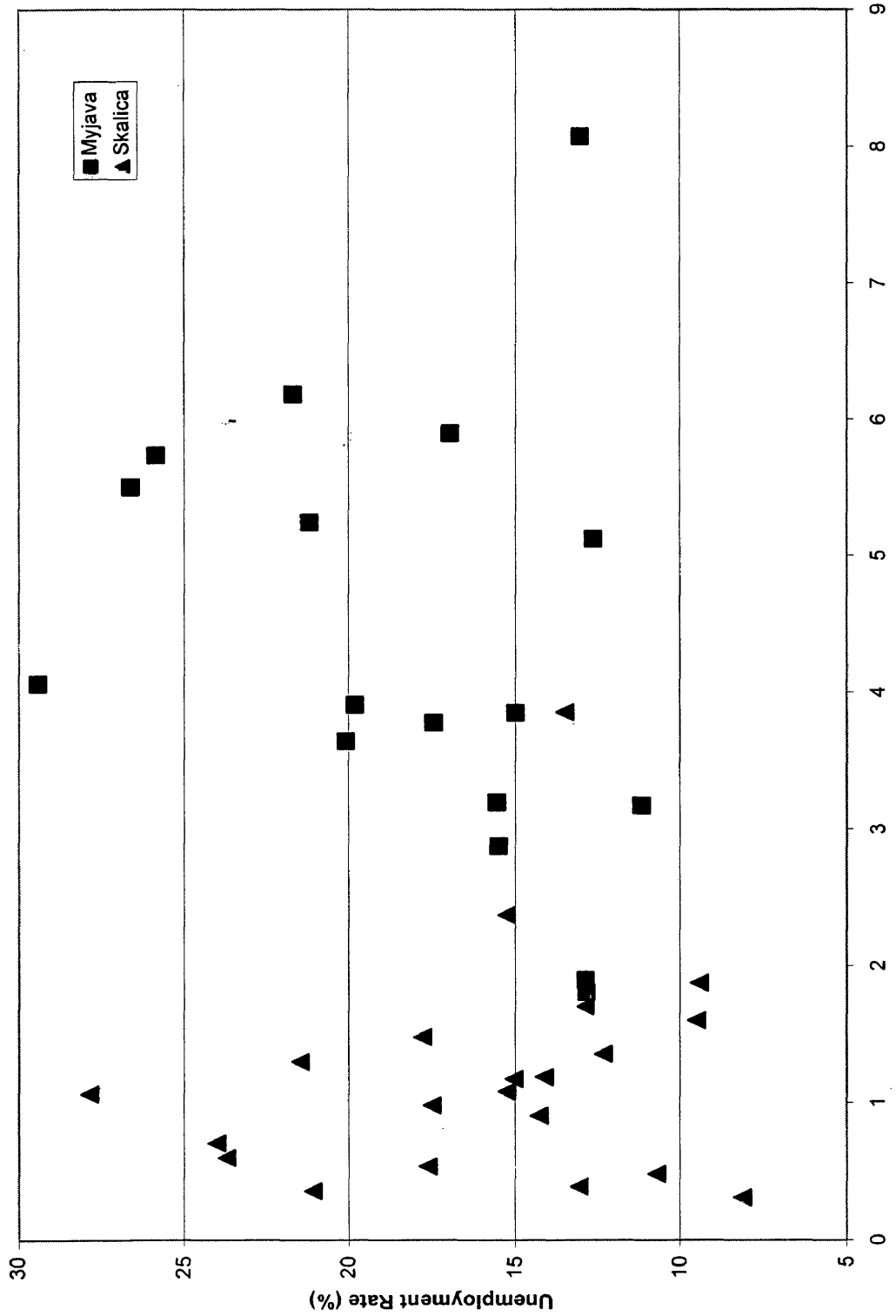
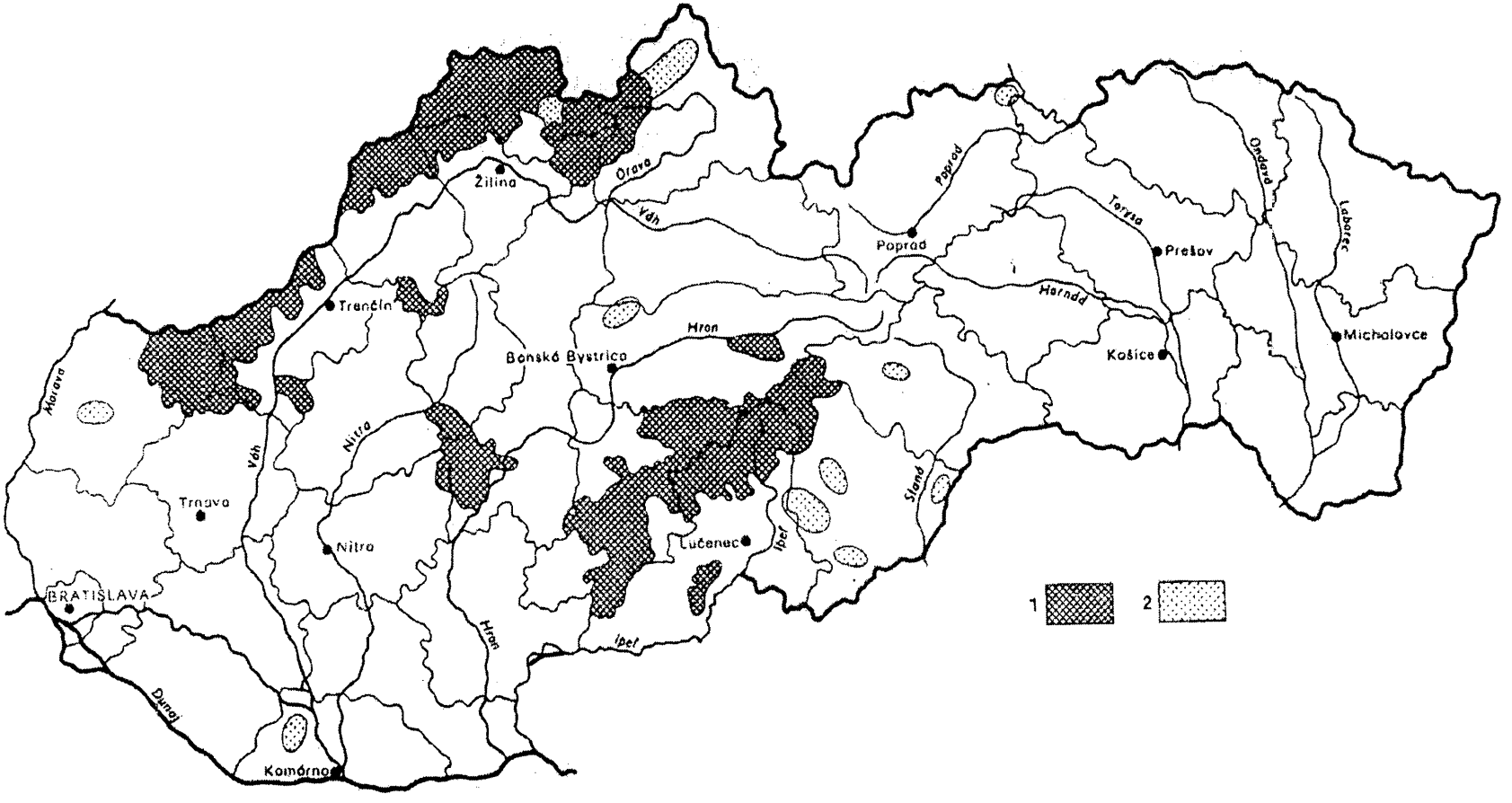


Figure 45. Relationship between Unemployment Rate and Settlement Dispersion – Myjava and Skalica Counties



1 – Areas with communities with more than 10 % of their residents living in dispersed settlements

2 – Other areas with dispersed settlements

Figure 46. Areas of Dispersed Settlement in Slovakia (Source: Verešík 1974)

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