Alina Potrykowska

SPATIAL STRUCTURE OF COMMUTING TO WORK AND SCHOOL IN WARSAW

Studies on the development of urban agglomerations in Poland have hardly in-
cluded structural studies on the agglomerations themselves, their systems and
internal differences of spatial, demographic and social structures (A. Andrzeje-
wski, 1973, p. 7). The studies have been aimed at defining and explaining the
essence and general determinants of development processes of urban agglome-
rations, their scale and range, as well as the delimitation of agglomeration
boundaries. The authors of studies dealing with delimitation apply different
units of reference for defining given features used as criteria and different
techniques of delimitation depending on the basic purpose (cogniteve, statisti-
cal, planning) the delimited areas are to serve.

Recently there has been a tendency not to apply complex delimitation criteria
and to eliminate structural criteria in favour of linkage measures (P. Korce-
lli, 1974, 1976). According to this assumption the boundaries of urban agglo-
merations are identified with areas characterized by a high degree of closures
of zones of everyday contacts between inhabitants of agglomerations, specially
of ranges of commuting between place of work and place of residence, i.e.
the functional range of urban regions. Such divisions were introduced by B. J.
L. Berry (1973) and P. Hall (1973) –see P. Korcelli (1976).

The notion of a functional urban region (or daily urban system) refers to the
zones of direct contacts of inhabitants and spatial relations between systems
of places of residence, work, education, services, social contacts, and re-
creation. The introduction of the notion of a functional urban region is the
main assumption of this study [1]. According to this notion the boundaries of
the external zone of the Warsaw agglomeration should be identified with an
area where the spatial system delimited on the basis of the differentiation of
places of work and residence is a direct reference unit. The spatial range in
question is determined by commuting to work in Warsaw from the suburban
area of the Warsaw agglomeration in 1973, and the direct measure of linkage
is the index expressing the percentage of commuters to Warsaw in the number
of professionally active population, living in a given administrative unit, i. e.
commune or town (Staff's Register, 1973), Fig. 1.

Mag., Instytut Geografii i przestrzennego Zagospodarowania PAN, Warszawa,
Krakowskie przedmiescie 30, glej izvleček na koncu zbornika.

The theoretical basis for studies on the spatial structure of functional urban regions is the theory of social interaction in space. The spatial structure of a city is created by a system of overlapping patterns (such as: those of places of work, residence, shopping, recreation, social and other contacts), corresponding with the basic spheres of man's life and activity. I assume that interaction of systems, especially that of places of residence and places of work shapes the spatial structure of agglomerations. The intensity of interactions increases together with the growth of spatial accessibility between the elements of those systems. It is necessary to determine spatial relations between systems of places of work and residence within a determined functional region of Warsaw, delimited by means of the index of linkages (based on commuting to work in Warsaw in 1973). One of the ways of dealing with this problem is to treat the central place (centres of comuting, employment, services) as a point of adherence of forces acting in different directions and on various distances (A. Jagielski 1969, p. 659). The centre of the area creates a certain type of field, known as the field of influence, which in the spatial sense constitutes a function of distance between the central point and other points. In literature concernced with this problem is a corresponding division of areas of commutation into central regions and regions on which certain influence is exerted (Zones of influence of large cities...1973; J. Cegielski, 1973, p. 33).

This concept corresponds with the commutation range concept. The choice of adequate statistical measures of commutation range depends on the result of the estimation of connections between the field and distances of commutation (A. Jagielski, 1969, p. 660). The equidistant zones, 20 km in width, have been delimited around Warsaw. The transport junction situated close to the Warsaw Central Railway Station is the centre of the area. The equidistant zones may be regarded as active zones of influence exerted by Warsaw. Various relations concerning the spatial changeability of the intensity of commutation in particular distance zones have been analysed. Concentric differentiation of the intensity of commutation in particular distance zones and the fact the density system of commutation is a negative function of distance are characteristic of the Warsaw functional region. Three areas with a different degree of linkages and intensity of commutation to work in Warsaw have been differentiated:

central zone - including the city of Warsaw and area within a 20 km radius, it constitutes a compact area with the highest linkage indices of over 70 %, and it concentrates 42 % of all commuters to work in Warsaw.

Internal zone of commutation, which includes all areas of the present metropolitan voivodship within a 50 - 60 km radius. The differentiation in the degree of commutation on the right and left banks of the Vistula is a characteristic feature. The right bank part of the zone goes beyond the voivodship boundaries in the west (60 km). This zone possesses a high degree of commutation intensity, over 50 %. This zone, together with the central zone, includes about 90 % of all commuters to work in Warsaw.

External zone of commutation, which is the most external zone within a 100 km radius. It has the lowest linkage index (below 30 %) and includes 10 % of all commuters to work.

A similar spatial distribution may be presented in the case of commuters to over-elementary schools in Warsaw (Commuting to.... schools, 1975). About 90 % of pupils commute from the metropolitan voivodship to secondary schools in Warsaw, i.e. from areas with high linkage indices. Similar observations have been made concerning the distribution of commutation to secondary schools in Warsaw depending on time zones. Over a half of commuting pupils (56.2 %) lives within an one-hour izochrone zone, whereas 89.6 % in an 1-1.5 hour zone (Table 1).

The spatial distribution and structure of commutation is characterized by certain regularities. Among commuters to work men prevail (60 of the total). The smallest difference between men and women commuters is in the central zone and amounts to 1.3 % for commutation from cities and 1.8 % for commutation from communes. The bigger the distance from the centre, the difference between the number of men and women commuters becomes greater (in the external zone it is 8 times bigger). With the increase of distance, the percentage of men commuters increases, and so does the number of commuters from the countryside (Table 2).

It should however be remembered that the spatial distribution of commutation to Warsaw is not a simple function of distance. There exist sector differences in size and intensity of commutation in the functional region of Warsaw. In the structure of commutation to work the Wolomin route is dominant (23.1 % of all commuters) both in size and intensity of commutation. The linkage index in this sector assume the highest values (70-90 %). The counterpoise of this sector as far as the percentage and intensity of commutation are concerned is the Skierniewice route (18.4 %). The sector differentiation of the spatial structure of commutation to work in the functional region of Warsaw is illustrated in Table 2. However, it should be emphasized that the present spatial distribution of commutation is caused by the changes which took place during the last 20 years in the Warsaw region. Until 1958 the dominant roel in the spatial distribution of the relations: place of work to place of residence, could be asigned to commutation from Western directions, especially on the Skierniewice route (Table 3).

The sector differences in size and intensity of commutation are even sharper when the region is divided into the left - and right-bank parts (in relation to the Vistula flow). The prevalence of commutation in the right-bank part (58.7 %of all commuters in 1973) is connected i.a. with a surplus of manpower in this weakly industrialized part of the region. The commutation distribution is different in the industrialized left-bank part, where the intensity is lower (41.3 % of all commuters). It is characteristic that the prevalence of commutation over surplus manpower is much stronger in the left-bank part than in the right-bank part.

Commutation to work in the region presents a variety of very complex movements. In the suburgan zone commutation to work in Warsaw prevails and amounts to about three-quaters of total commutation. Every fifth person commutes to industrial plants located in the suburban zone. Commutation from the suburban zone outside the region is not significant. It is characteristic that the number of commuters to Warsaw is higher than the manpower surplus.

In the structure of commutation to work in the region not only Warsaw dominates, but also industrial towns, located near the capital along the Skierniewice railway line, like Ursus, Pruszków, Grodzisk Mazowiecki, Piastów, Milanówek and also Wolomin, Otwock, attract commuters. Studies on the socio-economic changes caused by industrialization and urbanization in the region of Warsaw have shown that the presented system of commutation to work is rather specific in its socio-professional structure. The commuters from towns and communes located in the centre of the region possess higher qualifications than those commuting from rural areas who usually are employed on hard--work jobs.

On the basis of the above observation it may be assumed that there exist interdependences between the systems of places of work and those of residence within the functional region of Warsaw.
Let us assume that those relations are twofold:

A/ size and spatial distribution of commutation to work depend on the socio--economic and demographic structures of population;

B/ daily commutation to work brings about changes in the socio-demographic structure of population.

Moreover:

C/ sector spatial distribution of commutation to work corresponds with the differentiation of socio-economic features of population.

D/ concentric spatial distribution of commutation to work corresponds with the differentiation of demographic features of population.

Hypotheses C and D fall under the ecological concept which says that the spatial system of urban population differentiation consists of sector and concentric elements, while the differentiation of socio-economic features acquires the form of sectors and the differentiation of demographic features acquires a concentric form.

In order to determine the interdependences between the systems of places of work and the system of places of residence the multiple regression model has been applied:

$$Y = a + B_1 x_1 + B_2 x_2 + \ldots + B_k x_k + \varepsilon$$

where Y is a dependent variable describing the system of places of work, and the set of independent variables (x_k) describes the socio-demographic structure of the area of functional urban region of Warsaw, in 1973. The dependent variable is in the form of an index expressed by a percentage of the number of commuters to work, from a given unit to Warsaw, to the number of people professionally active, living in a given unit, i.e. a town or a commune.

The independent variables are: x_1 - distance (in km); x_2 - the density of population per sq. km; x_3 - percentage of males in the total population; x_4 - natural increase in ‰o; x_5 - net-migrations per 1000 inhabitants; x_6 - pecentage of places of work and places of residence of total employees; x_7 - employment in manufactury per 1000 inhabitants; x_8 - percentage of employment in agriculture; x_9 - percentage of employees with higher education; x_{10} - percentage of employees with primary education; x_{11} - housing units completed in 1973 per 1000 new households; x_{12} - rooms completed in 1973 per 1000 inhabitants; x_{13} - housing units per 1000 inhabitants.

A correlation matrix (see table 4) portrays the observed direction and degree of association between individual variables. Out of the total of thirteen independent variables nine were found to be significantly correlationed with the dependent variable. The Backward Elimination Procedure has been used to select the variables which contribute to the reduction of the "unexplained" variation of the dependent variable.

The equation estimated for the independent variables is the following:

$$Y_c = 104.720 - 0.489x_1 + 0.0016x_2 - 0.065x_3 - 0.1538x_6 - 0.03645x_7 + 0.5314x_8 - 0.0778x_9 - 0.5099x_{10} - 0.0438x_{13}$$

$$R = 0.7703$$

In general, it may be assumed that the results of the multiple regression analysis have confirmed the presented hypotheses as to the existence of interdependences between the distribution of places of work and residence in the Warsaw functional region. The role of variables x_1 (distance), and x_9 (percentage of employees with higher education) should be especially emphasized. A mutual relationship between the distributions shapes the spatial structure of the region. The intensity of the interaction increases with the increased spatial accessibility between the elements of those differentiations.

Bibliography:

1. Aangeenbrug, R. T., 1974, Automobile Commuting in Large Suburbs:
   A Comparative Analysis of Private Car Use in the Daily Journey to Work.
   In: M. E. E. Hurst "Transportation Geography", McGraw-Hill, pp. 463-473.

2. Andrzejewski, A., 1973, Introduction to A. Stasiak, "Rozwój aglomeracji
   miejskich w Polsce" (The growth of agglomerations in Poland), Studia
   KPZK PAN.

3. Cegielski, J., 1952, Ludność i stosunki mieszkaniowe na obszarze WZM
   (Population and housing conditions in the area of WZM).

4. Cegielski, J., 1977, Problemy dojazdów do pracy. Próba syntezy. (Prob-
   lems of commuting to work. An attempt at a synthesis), Warsaw.

5. Chojnicki, Z., 1974, Podstawowe zalozenia modelu przestrzennego miasta
   (Basic assumptions of the city spatial model), Miasto, no. 9.

6. Dziewoński, K., 1975, The place of urban agglomerations in the settlement
   system of Poland, Geographia Polonica, 30.

7. Gillespie, A., 1977, Journey to work trends within British labour markets,
   1961-1971. Paper presented to the I. B. G. Urban Studies Group Conference
   on Evolving Urban Systems, London.

8. Gliszczyński, F., 1967, Problematyka przestrzenna sytuacji mieszkaniowej
   i budownictwa mieszkaniowego Warszawy i jej strefy podmiejskiej.(The spa-
   tial structure and developmental trends of housing conditions in the Warsaw
   urban region), Studia KPZK PAN, vol. 21.

9. Hall, P., 1974, International urban systems: outline of a research pro-
   ject. Conference on National Settlement Systems and Strategies, IIASA,
   Laxenburg, Austria.

10. Jagielski, A., 1969, Niektóre przestrzenne aspekty dojazdów do pracy.
    (Some spatial aspects of commuting), Przeglad Geograficzny, no. 4.

11. Johnson, J. J., 1974, Suburban growth. Geographical processes at the
    edge of the western city, John Wiley.

12. Karbownik, W., Marcysiak, J., Topczewska, T., 1973, Ocena stanu
    wiedzy i bibliografia wazniejszych opracowań w zakresie zagadnień zagos-
    podarowania i przebudowy obszarów podmiejskich. (Current state of know-
    ledge on and bibliography of more important studies on problems of deve-
    lopment and redevelopment of suburban areas), Warsaw.

13. Korcelli, P., 1974, Teoria rozwoju struktury przestrzennej miast. (Theory of intra-urban spatial structure), Studia KPZK PAN, vol. 45.

14. Korcelli, P., 1976, Aglomeracje miejskie w systemach osadniczych. Główne hipotezy i perspektywy badawcze (Urban agglomerations within settlement systems. Selected hypotheses and research perspectives)."Przeglad Geograficzny", vol. 48.

15. Korcelli, P., 1977, An approach to the analysis of functional urban regions: a case study of Poland, IIASA, Laxenburg, Austria.

16. Lijewski, T., 1967, Dojazdy do pracy w Polsce. (Commuting in Poland), Studia KPZK PAN, vol. 15.

17. Namyslowski, J., 1977, Ośrodki dojazdów codziennych na przykladzie aglomeracji dolnej Wisly. (Centres of everyday commutation: a case study of the agglomeration of the Lower Vistula), Miasto, no. 6.

18. Namyslowski, J., 1977, Dojazdy uczniów do szkól ponadpodstawowych w głównych ośrodkach aglomeracji Bydgosko-Toruńskiej. (Commuting to over-elementary schools in the centres of the Bydgoszcz-Toruń Agglomeration), Bydg. Tow. Nauk., Prace Wydzialu Nauk Humanistycznych, Series A, no. 19.

19. Pióro, Z., 1977, Procesy rozwojowe aglomeracji. Z badań nad zachowaniami przestrzennymi mieszkańców aglomeracji warszawskiej. (Development processes of contemporary agglomerations. Spatial behaviour of the Warsaw agglomeration inhabitants), Warsaw.

20. Badanie ruchu w Warszawie, 1972 (Studies of traffic in Warsaw. Report of the Office of Studies and Projects of Urban Engineering and Transport in Warsaw, by S. Furman and a group), Warsaw.

21. Smith, D. M., 1975, Patterns in Human Geography, London.

22. Stasiak, A., 1973, Rozwój aglomeracji miejskich w Polsce (The growth of agglomerations in Poland), Studia KPZK PAN.

23. Strefy wplywow duzych miast w świetle dojazdów do pracy. (Zones of infuence of large cities in the light of commuting), GUS, 1973, Series: "Statystyka Regionalna", 35.

24. Wróbel, A., 1960 Województwo warszawskie. Studium ekonomicznej struktury regionalnej. (The Warsaw voivodship. A study of the economic regional structure), Prace Geograficzne IG PAN, 24.

Statistical sources:

Dojazdy uczniów do szkól ponadpodstawowych do Warszawy, 1975. (Commuting to over-elementary schools in Warsaw, 1975), GUS, Warsaw.

Spis kadrowy, 1973. (Staffs' register, 1973), GUS, Warsaw.

Ludność i zasoby mieszkaniowe. (Population and housing) 1976, GUS Warsaw, Series: "Statystyka Polski", no 70.

Table 1. Structure of commuting to over-elementary schools in Warsaw in 1975 (by commuting time)

Commuting time in min.	Left-bank area	Right-bank area	Commuting total
under 60 min.	38.1	18.2	56.3
60 - 90 min.	22.3	11.1	33.4
90 - 120 min.	6.3	2.6	8.9
over 120 min.	1.3	0.1	1.4
	68.0	32.0	100.0

Source: Commuting to over-elementary schools in Warsaw, 1975, GUS. Calculations made by the author.

322

Table 2. Structure of commuting to work in Warsaw in 1973 by distances and sectors (according to directions)

Zones	Sectors	Płock		Łowicz		Skierniewice		Radom		Otwock		Siedlce		Wołomin		Nasielsk		Total	
		men	women	men	women	men	women	men	women	men	women	men	women	men	women	men	women	men	women
under 20 km	towns			0.26	0.27	4.67	4.56	1.27	1.06	1.16	1.04	1.87	1.63	6.12	5.78	1.59	1.28	16.94	15.61
	communes	2.24	1.69	0.34	0.28	0.55	0.48	2.86	2.39			0.55	0.38	0.72	0.59	1.47	1.04	8.74	6.86
20–40km	towns			0.52	0.43	1.44	1.24	0.68	0.58	0.58	3.30	2.32	1.06	0.90	0.63	0.46	0.80	0.44	6.37
	communes	1.32	0.69	0.31	0.20	0.48	0.35	1.46	0.90	1.34	0.77	1.59	1.26	2.51	1.52	0.45	0.25	9.47	5.94
40–50km	towns					0.73	0.40	0.15	0.06					0.20	0.11	0.14	0.05	1.21	0.62
	communes	0.06	0.03	0.19	0.09	0.43	0.27	0.20	0.07	0.96	0.48	0.46	0.26	1.53	0.76	0.58	0.10	4.42	2.06
50–60km	towns			0.47	0.25			0.09	0.06	0.12	0.03	0.04	0.02	0.07	0.05	0.10	0.02	0.84	0.43
	communes	0.15	0.02	0.21	0.05	0.11	0.02	0.22	0.08	0.60	0.20	0.56	0.23	0.83	0.26	0.29	0.07	2.98	0.93
60–80km	towns			0.14	0.02	0.38	0.11	0.06	0.01	0.04	0.01	0.02		0.17	0.05	0.30	0.04	1.08	0.25
	communes	0.02	0.01	0.41	0.06	0.69	0.09	0.46	0.05	1.00	0.02	0.63	0.03	0.74	0.18	0.10	0.02	4.04	0.63
80–100 km	towns	0.08	0.01					0.04	0.01	0.02	0.01	0.11	0.01		0.01	0.01		0.26	0.05
	communes	0.02		0.10	0.01	0.09		0.13		0.05		0.11	0.01	0.70	0.11	0.13		1.33	0.11
Over 100 km	towns	0.02		0.04	0.01	0.01								0.04	0.01	0.04	0.01	0.14	0.03
	communes	0.02										0.02		0.03	0.01	0.01		0.10	0.01
Total		6.4		4.7		17.1		12.9		13.6		11.8		24.2		9.3		100.0	

Source: Calculated by the author on the basis of "Staffs' Register", 1973.

Table 3. Structure of commuting to work in Warsaw in 1951–1973 (by directions)

Direction	1951	1958	1968	1973
south–western (Skierniewice)	29.5	24.3	20.4	17.1
western (Łowicz)	4.2	7.6	7.9	8.7
northern (Nasielsk)	10.9	12.0	11.6	11.7
north–eastern (Wołomin)	12.9	21.0	24.2	24.2
eastern (Siedlce)	12.2	12.2	12.7	11.8
south–eastern (Otwock)	22.2	14.8	14.3	13.6
southern (Radom)	8.1	8.1	8.9	12.9
	100.0	100.0	100.0	100.0

Source: Calculated on the basis of material compiled by Miejska i Wojewódzka Komisja Planowania Gospodarczego, and on the basis of data from "Staff' Register", GUS, Warsaw 1973.
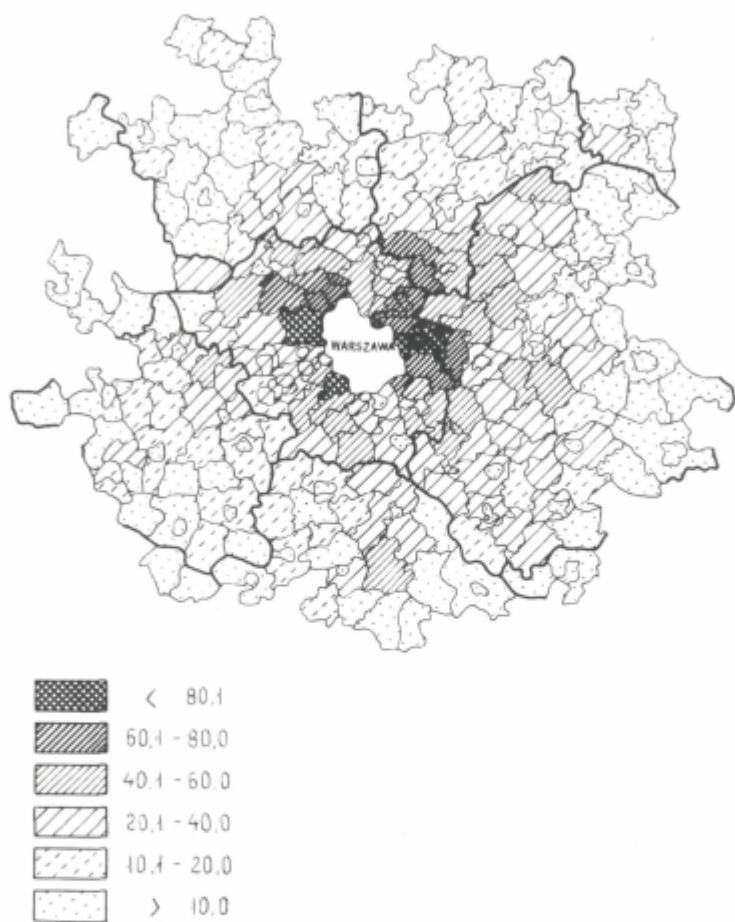
Table 4. Correlation matrix

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	Y
x_1	1	-0.343	0.088	0.112	-0.179	0.084	-0.253	0.187	-0.476	-0.124	-0.029	-0.099	-0.311	-0.7178
x_2		1	-0.343	-0.254	0.539	0.445	0.649	-0.309	0.237	0.188	0.233	0.202	0.435	0.1152
x_3			1	0.303	-0.424	-0.337	-0.299	0.139	-0.181	-0.144	-0.240	-0.181	-0.295	0.0195
x_4				1	-0.290	-0.184	-0.173	0.043	-0.048	-0.127	-0.078	-0.052	-0.299	0.0943
x_5					1	0.565	0.525	-0.294	0.098	0.228	0.525	0.421	0.351	-0.0766
x_6						1	0.752	-0.144	-0.016	0.409	0.477	0.387	0.348	-0.4027
x_7							1	-0.334	0.055	0.426	0.290	0.238	0.422	-0.0907
x_8								1	0.074	-0.152	-0.131	-0.117	-0.201	-0.1432
x_9									1	-0.227	0.107	0.137	0.195	0.4521
x_{10}										1	0.095	0.113	0.208	-0.1206
x_{11}											1	0.931	0.142	-0.0949
x_{12}												1	0.115	-0.0050
x_{13}													1	0.1069
Y														1

▓▓▓	< 80.1
▨▨▨	60.1 - 80.0
▧▧▧	40.1 - 60.0
▨▨▨	20.1 - 40.0
░░░	10.1 - 20.0
▫▫▫	> 10.0

Fig. 1. The percentage of commuters to Warsaw in the number of
professionally active population.

Alina Potrykowska

PROSTORSKA SESTAVA DELOVNE IN ŠOLSKE DNEVNE MIGRACIJE
V VARŠAVO

Pojem funkcionalne mestne regije (ali dnevni mestni sistem) se nanaša na območja neposrednega kontakta prebivalcev in prostorskih odnosov med sistemi krajev bivanja, dela, izobraževanja, storitev, socialnih stikov in rekreacije. Uvedba pojma funkcionalne mestne regije je glavni predmet študije. Neposredna mera povezav mesta z okolico je koeficient, ki izraža 'stotek dnevnih migrantov v Varšavo od števila zaposlenega aktivnega prebivalstva, živečega v določeni administrativni enoti. Predpostavljamo, da medsebojni odnos med sistemi, posebno med krajem bivanja in kraji zaposlitve, oblikuje prostorsko strukturo aglomeracij. Moč medsebojnih stikov narašča z rastjo prostorske dostopnosti med elementi teh sistemov. Analiza je pokazala, da obstajajo tri osnovna območja z različno stopnjo povezav in intenzivnostjo dnevnega odhajanja na delo v Varšavo.

1. Središčna cona, ki vključuje Varšavo z okolico do razdalje 20 km. Sestavlja zgoščeno območje z najvišjo vrednostjo kazalcev povezav, ki znaša več kot 70 %. Na tem območju živi 42 % dnevnih migrantov, ki so zaposleni v Varšavi.

2. Notranja cona dnevne migracije vsebuje območja sedanjega varšavskega vojvodstva znotraj polmera 50 do 60 km. Značilna je razlika v stopnji dnevne povezanosti med levim in desnim bregom Visle. Notranja cona na desnem bregu Visle je razširjena na zahodu preko vojvodskih meja in je zelo intenzivno vključena v dnevno migracijo. V središčni in notranji coni živi 90 % dnevnih migrantov.

3. Zunanja cona dnevne migracije sega do razdalje 100 km izven Varšave, v njej pa živi 10 % dnevnih migrantov.

Podobna prostorska razporeditev velja za dnevne migrante v šole. Potrebno je podčrtati, da prostorska razporeditev dnevnih migrantov v Varšavo ni enostavna funkcija oddaljenosti, saj obstajajo predeli, kjer so razlike v obsegu in intenzivnosti dnevnih migracij. Te razlike so še večje, če primerjamo med seboj območji na obeh bregovih Visle. Prevlada dnevnih migrantov z desnega brega Visle (58,7 % vseh dnevnih migrantov) je posledica viška delovne sile v tej slabše industrializirani regiji.

Na osnovi podane analize lahko predpostavimo, da obstaja soodvisnost med sistemoma delovnih mest in kraji bivanja v funkcionalni regiji Varšave.

a) Velikost in prostorska razporeditev dnevnih migracij delovne sile zavisi od

socialno-ekonomske in demografske sestave prebivalstva.

b) Dnevne migracije delovne sile spreminjajo socialno-ekonomsko sestavo pre-
bivalstva.

c) Razlika v prostorski razporeditvi vozačev sovpada z razlikami v demograf-
skih potezah prebivalstva.

Da bi se preverile hipoteze in ugotovila soodvisnost med sistemom delovnih mest
in sistemom kraja bivanja, je bil uporabljen model multiple regresije. Rezul-
tati analize so na splošno potrdili postavljene hipoteze, torej obstoj soodvis-
nosti med razporeditvijo delovnih mest in krajev bivanja v funkcionalni regiji
Varšave. Posebej je bila poudarjena vloga oddaljenosti in deleža zaposlenih,
ki imajo višjo izobrazbo. Intenzivnost medsebojnih učinkovanj narašča z ve-
čanjem prostorske dostopnosti.