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Transport typology of settlement centres of Czechia from public passenger transport point of view

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Abstract

A one hundred and sewenty settlement centres of at least sub-regional significance (according to Hampl, Müller 1996) were monitored from the point of view of their transport and complex significance. The quality of public rail and bus transport services in centres was evaluated according to number of all departing trains/busses and several weighted aggregates. Typology of centres shows a type of transport service in centres (competition of modes, modal split, specialization for long-distance or local connections) and enables comparison of transport service quality and complex significance of centres.

Key words: public passenger transport typology, settlement centres, Czechia, aggregate characteristics, transport and complex significance

Introduction

Although the use of public transport has demonstrated a significant decrease since 1989, its importance in transport services of centres cannot be substituted. A range of foreign studies (e.g. Nutley 1996) stress the need of public transport not only in the sense of environmentally considerate alternative to individual automobile transport but also as a service for citizens lacking the possibility to drive a car. The cognition of the relation between the size and the structure of transport services and complex regional importance of the served centre can represent a contribution to often-discussed possibility to optimise transport services. It is evident that transport importance of a centre (its size) is markedly conditioned as by its population size (or by complex-functional size) as by its transport localisation – it means predominantly by the localisation in road and railroad networks. Concurrently geographical localisation of a centre on different levels of hierarchy reflects its transport function: the importance of macro-localisation influences the number of international connections/lines, mezzo-localisation influences the organisation of internal long-distance transport and micro-regional significance of a centre influences then the organisation of local transport lines connecting a centre with its hinterland. Existing transport services of a centre is thus the result as of its complex significance as of the exposure of its localisation and transport localisation (for details see Marada 2003). The discussed conditioned relations lead to different way of ensuring transport services of public transport to centres from both points of view

– as from size differentiation as from structural differentiation. For example higher representation of long-distance bus lines can be expected for regionally important centres with favourable localisation on long-distance road corridors. A higher share of long-distance rail transport for smaller centres favourably localised on main railroads can stand as a different example. This situation can be used when creating transport typology of centres of Czechia.

Methodology of evaluation

Both a suitable delimitation of the observed set of centres and a selection of representative indicators characterising the quality of their transport services are the main methodological problems of typology. Hierarchical degree of regional significance of centres defined at work of Hampl, Müller (1996) has been chosen as a criterion. At least limited micro-regional significance has been assigned to totally 167 centres at the above cited work. Some of these centres have been agglomerated for their multicore character, on the contrary Ostrava conurbation has been, owing to its extensiveness, divided into several units thereby the observed set has been enlarged into 170 centres. Naturally data for more existing railway stations have had to be aggregated for some agglomerations or centres while "inner" transport among these stations have been excluded. The data thus express only "outer" transport (for more see Marada 2003).

Importance, i.e. the extent of public personal railroad and bus transports in centres, has been evaluated through the number of connections/lines leaving a centre namely on Wednesday, 24 May, 2000. Thus an offer of public transport in a working day not affected by different exceptions, concerning mostly Fridays and weekend days, is expressed. The data have been obtained from IDOS electronic timetable. Numbers of long-distance connections/lines have been numbered extra for the purposes of qualitative evaluation and transport typology in centres. Long-distance rail links (marked *FASTTRAIN*) have been set as the sum of number of fast and express trains, a category of long-distance bus connections is marked *LONGBUS* and contains bus lines of supra-district range. Remaining connections are of a local character and are marked as *LOCALTRAIN* and/or *LOCALBUS*. Considering higher importance of long-distance connections in hierarchical position of centres and considering capacity and concurrently lower number of rail links, different weights of these connections have been used when setting total transport significance characteristics: *TRAIN* – an aggregate of public railway transport has been defined as the sum of triple number of long-distance rail links (*FASTTRAIN*) and single multiple number of other (local) links (*LOCALTRAIN*); an aggregate of bus transport BUS has been constructed similarly (thus 3 × *LONGBUS* + *1*LOCALBUS*). The total evaluation of transport significance of centres has been accomplished through overall *TRANSPORT* aggregate set as a sum of triple value of *TRAIN* aggregate and single multiple of *BUS* aggregate.

For the purposes of typology the following indicators have been enumerated from these basic characteristics and their aggregates: the percentage of all long-distance connections on the total significance of the centre (*LONGLINE SHARE*), calculated in

per cent as quotient of nine multiple of *FASTTRAIN* characteristic plus three multiple of *LONGBUS* characteristic on *TRANSPORT* characteristic; further on the representation of rail transport in a centre (*TRAIN SHARE*) evaluated by percentage quotient of three multiple of *TRAIN* characteristic on *TRANSPORT* characteristic; the share of express trains on train connections (*FASTTRAIN SHARE*) has been calculated as percentage quotient of three multiple of *FASTTRAIN* characteristic on *TRAIN* characteristic; the share of long-distance bus connections (*LONGBUS SHARE*) has been set analogously. The given weights come from the weights set above.

Complex significance of observed centres has been evaluated through aggregate *KFV* expressing so-called complex functional size of centres in 1991 (see Hampl, Kühnl, Gardavský 1987). The aggregate considers the significance of a centre from residential, labour and service functions points of view.

Transport typology of centres

Table 1 presents correlative relations among selected size and structural characteristics of observed centres. A range of evident connections can be summarised in several points:

1) The share of long-distance connections with total transport significance of centres shows relatively close, positive dependency, which corresponds with the presumption that more important, from the point of location exposed centres will "claim" more long-distance contacts. The correlation of partial characteristics with the total share of long-distance connections documents that "longness" of transport in a centre is more associated with the importance of rail transport and the share of long-distance trains than with the importance of bus transport and the share of long-distance buses. Certain specialisation of rail transport on long-distance transport is the cause of this result. Total long-distance transport is thus formed more significantly by express trains transport than long-distance bus transport. This affirmation is supported by further values of correlation coefficients: it is proved that the share of long-distance trains in a centre is increasing with the importance of rail transport rather than in case of bus transport and long-distance bus connections. Then long-distance transport takes more important positon in rail transport services.
2) Another evidence of certain specialisation of centres on long-distance type of transport is the fact that the share of long-distance trains and long-distance buses is in negative correlation.
3) The share of rail connections on total transport in a centre naturally closely relates with the importance of rail transport in a centre and indicates that centres with a high number of rail connections also specialise in rail transport. For that reason, slightly negative or rather neutral relation of "railness" of a centre and the importance of bus transport in a centre is not surprising, which indirectly confirms the complementariness of both transport modes.
4) The correlation values between the quotient of rail connections and *FASTTRAIN SHARE* or *LONGBUS SHARE* characteristic illustrate again that "rail" centres use railways also for long-distance transport; long-distance bus transport of these centres is, considering lower correlation, more varied.

5) The fact that "longness" and "railness" of transport in centres are mutually relatively less closely related and could be accepted as typology criteria sufficiently differentiating the characteristics of the observed centres, follows from the previous point.

Tab. 1 Pair correlation of selected characteristics

Characteristic	KFV 1991	TRAIN	BUS	TRANS-PORT	FAST-TRAIN SHARE	LONG-BUS SHARE	LONG-LINE SHARE	TRAIN SHARE
KFV 1991	1.000	0.656	0.929	0.899	0.092	0.090	0.156	–0.028
TRAIN	0.656	1.000	0.648	0.866	0.672	–0.160	0.531	0.537
BUS	0.929	0.648	1.000	0.942	0.062	0.272	0.263	–0.162
TRANSPORT	0.899	0.866	0.942	1.000	0.337	0.108	0.407	0.131
FASTTRAIN SHARE	0.092	0.672	0.062	0.337	1.000	–0.342	0.713	0.799
LONGBUS SHARE	0.090	–0.160	0.272	0.108	–0.342	1.000	0.415	–0.592
LONGLINE SHARE	0.156	0.531	0.263	0.407	0.713	0.415	1.000	0.332
TRAIN SHARE	–0.028	0.537	–0.162	0.131	0.799	–0.592	0.332	1.000

Note 1: Pearson correlation coefficient
Note 2: Definition of characteristics used see pp. 260–261

The main methodical issue in the process of typology has been to set a boundary values in the frame of two selected criteria. Both characteristics, the share of rail links (*TRAIN SHARE*) and the share of long-distance connections (*LONGLINE SHARE*) on the total transport of a centre, show deformed normal statistical division (Tab. 2). Considering statistical division of typology characteristics in both cases the inner intervals including majority of values close to the average have been set first (Fig. 1). Those are intervals 30.0%–54.9% in case of the share of rail links and 20.0%–49,9% in case of the share of long-distance connections. The centres belonging to an intersection of both intervals have been specified as transport centres of complex (or balanced) character (symbol C).

The centres with extreme values lying out of this intersection, it means those, which fulfil just one criterion set or fulfil none of both, have been further divided with help of rounded average of typology characteristics. It means by value 43.0% in case of the share of rail links and 35.0% in case of long-distance connections. Four created types of centres have been named as follows:
LD/R – centres with heightened specialization in long-distance or railway transport,
LD/B – centres with heightened specialization in long-distance or bus transport,
LO/R – centres with heightened specialization in local or railway transport and
LO/B – centres with heightened specialization in local or bus transport.

Tab. 2 Basic parameters of typology characteristics

	LONGLINE SHARE	TRAIN SHARE
Average	35,16	43,03
Median	36,41	40,83
Modus	–	37,50
Standard deviation	15,70	16,19
Coeff. of Variation	44,67	37,63
Range (max-min)	70,41	86,26
Maximum	70,41	86,26
Minimum	0	0

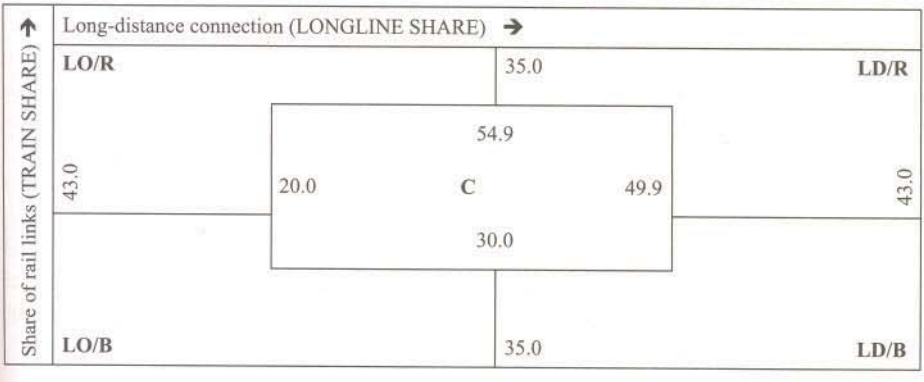

Fig. 1 Typology criteria
Note 1: Values in %
Note 2: Symbols and a construction of characteristics see text before

21 centres of *type LD/B*, 36 centres of *type LD/R*, 36 centres of *type LO/B*, 14 centres of *type LO/R* and 63 of *type C* have been delimited using the above described method. Categorization of particular centres into the five set groups is given in Table 3 and showed transparently in Figure 2. It is evident from the figure that the centre *type LD/R* is bond to main railroads of our network (specific Krnov is the only exception). Centres of *type LD/B* lie mainly in regions with less density or less quality of railroad network and with worse railway transport service. These are mostly peripheral regions of East and Northeast Bohemia and some regions of Bohemian-Moravian highland and then several Moravian cities. In spite of dot expression of the phenomena an axis of long-distance bus transport connecting North and East Bohemia with Middle and South Moravia is evident (Liberec/Trutnov–Jičín–Hradec Králové–Litomyšl–Svitavy–Brno/Olomouc). A corridor connecting South Bohemia and South Moravia is another noticeable axis of long-distance bus transport (Tábor/České Budějovice–Pelhřimov/Jindřichův Hradec–Jihlava/Telč–Brno). The above mentioned bus transport corridors supply intensive long-distance regional relations in case of absence of appropriate railway network. The case of Vyškov, which profits from good location in both road and

railway networks, is somewhat unusual. But, an influence of bus transport prevails because it enables better accessibility of main commute destination – Brno.

A peripheral border location (mostly resettled regions) attracts in case of centres of *type LO/R*. These are the regions of Krušnohoří and Podkrušnohoří (Ore Mountains), North-Bohemian borderland and Mikulov. There are several other small centres located in the central part of Czechia in this group, which have a favourable location at main railroads (e.g. Kutná Hora, Přelouč, Litovel) or at less important railroads, but busy due to intensive commuting by railway transport (e.g. Frýdlant nad Ostravicí, Neratovice). Rakovník lying in inner periphery is noticeably focused on railway service because of intersection of several rail tracks.

The centres of *type LO/B* lie, in all cases, at railways of local significance with low frequency of traffic and so they are focused on bus transport service. They often lie at fragmental railway and at the same time they have favourable location in road network (e.g. Dobříš, Hustopeče, Nový Jičín).

The most numerous group of complex transport centres (*type C*) is difficult to generalize owing to high variability on one hand and overall balance and thus absence of dominant conditioning factor on the other hand. Often these are centres with high regional significance, which is demonstrated in transport organization and in its complementarity. Good location of the centres in both transport networks also contribute to the representation of both transport modes. This is the case of majority of regional (province) cities and district cities from 1960–2002 (Česká Lípa, Hodonín, Klatovy, Litoměřice, Louny, Třebíč or Valašské Meziříčí and others). A number of smaller centres with totally lesser transport significance, which however correspond to their regional significance, is included. On the whole it is highly variable but "unpronounced" set of cities different by size and location but without subjective transport orientation.

Tab. 3 Centres in delimited types

LD/R – 36 centres Beroun, Bílina, Bohumín, Bučovice, Břeclav, Česká Třebová – Ústí nad Orlicí, Český Těšín, Děčín, Havlíčkův Brod, Horažďovice, Hořovice, Hranice, Cheb, Choceň, Chomutov, Kolín, Kralupy nad Vltavou, Krnov, Lovosice, Mariánské Lázně, Most, Nymburk, Olomouc, Ostrov, Pardubice, Plzeň, Přerov, Rokycany, Roudnice nad Labem, Soběslav, Stříbro, Tábor, Týniště nad Orlicí, Ústí nad Labem, Veselí nad Moravou, Zábřeh	**LD/B** – 21 centres Brno, Dvůr Králové nad Labem, Holešov, Holice, Hořice, Hradec Králové, Jičín, Jihlava, Litomyšl, Mladá Boleslav, Pelhřimov, Poděbrady, Slaný, Svitavy, Telč, Třeboň, Uherský Brod, Velké Meziříčí, Vrchlabí, Vyškov, Vysoké Mýto
C – 63 centres Benešov, Blansko, Brandýs nad Labem-Stará Boleslav, Bruntál, Bystřice pod Hostýnem, Čáslav, Česká Lípa, České Budějovice, Domažlice, Frenštát pod Radhoštěm, Frýdek-Místek, Hlinsko, Hodonín, Chotěboř, Chrudim, Jablonec nad Nisou, Jaroměř, Jeseník, Jilemnice, Jindřichův Hradec, Karlovy Vary, Karviná, Kladno, Klatovy, Kroměříž, Kyjov, Liberec, Litoměřice, Louny, Milevsko, Mohelnice, Moravské Budějovice, Moravský Krumlov, Náchod, Nová Paka, Nové Město nad Metují, Nový Bydžov, Opava, Ostrava, Pacov, Písek, Podbořany, Praha, Prostějov, Semily, Slavičín, Sokolov, Strakonice, Sušice, Šternberk, Teplice, Tišnov, Trutnov, Třebíč, Třinec, Turnov, Uherské Hradiště, Valašské Meziříčí, Vsetín, Zlín – Otrokovice, Znojmo, Žamberk – Letohrad, Žďár nad Sázavou	

LO/R – 14 centres Broumov, Frýdlant, Frýdlant nad Ostravicí, Kadaň, Kutná Hora, Litovel, Litvínov, Mikulov, Neratovice, Přelouč, Rakovník, Rumburk – Varnsdorf, Tanvald, Žatec	**LO/B** – 36 centres Aš, Boskovice, Blatná, Bystřice nad Pernštejnem, Český Krumlov, Dačice, Dobruška, Dobříš, Humpolec, Hustopeče, Ivančice, Jevíčko, Kaplice, Kopřivnice, Lanškroun, Ledeč nad Sázavou, Mělník, Moravská Třebová, Nové Město na Moravě, Nový Bor, Nový Jičín, Polička, Prachatice, Příbram, Rožnov pod Radhoštěm, Rychnov nad Kněžnou, Sedlčany, Skuteč, Šumperk, Tachov, Uničov, Valašské Klobouky, Velká Bíteš, Vimperk, Vítkov, Vlašim

Figure 2 shows not only type of the centres but also their association with transport significance. Table 4 presents the relation of individual types and total transport significance expressed simply by frequency. The results indicate that higher transport significance centres have higher long-distance transport share and lower centres have predominantly local bus transport service. Balanced centres of type C have different size category, but these are mostly cities of middle transport significance. A similar links are evident also from comparison with complex size of centres nevertheless there are more LD-centres present among small centres. These are certainly centres lying favourably in transport networks and thus centres with higher transport significance than complex significance.

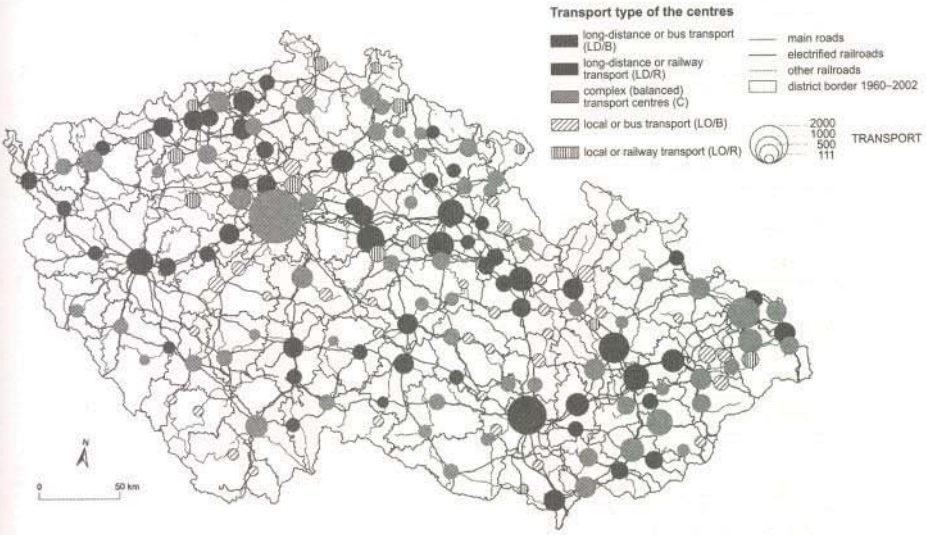

Fig. 2 Transport significance and typology of the centres

Tab. 4 Frequency distribution by size category and type of centres

Value of characteristic TRANSPORT	Transport type of centre					Value of characteristic KFV	Transport type of centre				
	LD/B	*LD/R*	*C*	*LO/B*	*LO/R*		*LD/B*	*LD/R*	*C*	*LO/B*	*LO/R*
<200	1	–	5	25	3	<10.0	4	7	10	17	4
200–399	10	13	32	10	11	10.0–19.9	9	8	17	14	4
400–599	6	14	15	1	–	20.0–39.9	4	11	18	3	6
600–799	2	4	8	–	–	40.0–99.9	2	6	13	2	–
>800	2	5	3	–	–	>100.0	2	4	5	–	–

Tables 5, 6, 7 and 8 presenting absolute and relative expressions of basic statistical indicators of characteristics *TRANSPORT* and *KFV*, support the above mentioned links more precisely. It is obvious that LD/R-centres really reach the highest value of characteristics *TRANSPORT* and *KFV*, LO/R-centres and LO/B-centres the smallest value. The level of variability has an analogous tendency: the highest variability can be observed in *type C* and then in both *types LD/R* and *LD/B*. Understandably, the variability of *KFV* characteristic is generally higher in comparison with *TRANSPORT* characteristic or other previously studied indicators.

Tab. 5 Indicators of TRANSPORT characteristic according to centre's type

	LD/B	LD/R	C	LO/B	LO/R	Whole set
Average	501.2	532.1	460.8	201.0	282.3	411.2
Median	374	482	354	171	307	327
Standard deviation	407.6	246.6	503.0	83.9	94.8	378.2
Coeff. of Variation	81.3	46.3	109.2	41.7	33.6	92.0
Range (max-min)	1893	1043	3907	292	268	3924
Maximum	2075	1254	4035	403	395	4035
Minimum	182	211	128	111	127	111
Number	21	36	63	36	14	170

Tab. 6 Indicators of KFV characteristic according to centre's type

	LD/B	LD/R	C	LO/B	LO/R	Whole set
Average	45.8	38.0	63.1	13.5	16.4	41.3
Median	17.1	23.1	24.9	10.7	13.2	16.7
Standard deviation	100.2	41.4	200.7	9.7	7.5	129.4
Coeff. of Variation	218.5	108.8	318.2	72.1	46.1	3.13
Range (max-min)	461.5	193.5	1552.5	42.3	21.0	1554.0
Maximum	467.6	199.6	1557.5	45.8	29.0	1557.5
Minimum	6.1	6.1	5.0	3.5	8.0	3.5
Number	21	36	63	36	14	170

Tab. 7 Relativised indicators of TRANSPORT characteristic according to centre's type

	LD/B	LD/R	C	LO/B	LO/R	Whole set
Average	121.9	129.4	112.1	48.9	68.6	100.0
Median	114.4	147.4	108.3	52.3	93.9	100.0
Standard deviation	107.8	65.2	133.0	22.2	25.1	100.0
Coeff. of Variation	88.4	50.4	118.7	45.4	36.5	100.0
Range (max-min)	48.2	26.6	99.6	7.4	6.8	100.0
Maximum	51.4	31.1	100.0	10.0	9.8	100.0
Minimum	164.0	190.1	115.3	100.0	114.4	100.0
Number	12.4	21.2	37.1	21.2	8.2	100.0

Tab. 8 Relativised indicators of KFV characteristic according to centre's type

	LD/B	LD/R	C	LO/B	LO/R	Whole set
Average	111.0	92.0	152.7	32.7	39.6	100.0
Median	102.7	138.7	149.5	64.0	79.3	100.0
Standard deviation	77.4	32.0	155.1	7.5	5.8	100.0
Coeff. of Variation	6974.7	3473.9	10157.5	2300.0	1471.3	100.0
Range (max-min)	29.7	12.5	99.9	2.7	1.4	100.0
Maximum	30.0	12.8	100.0	2.9	1.9	100.0
Minimum	174.3	174.3	142.9	100.0	228.6	100.0
Number	12.4	21.2	37.1	21.2	8.2	100.0

Conclusions

Several principal conclusions can be drawn from the above analyses:

1. Transport type and significance of centres as well are influenced by centre's location in transport/line network (particularly in railway one) on one hand and by complex settlement hierarchy of higher scale on the other hand (conditioning focus on long-distance and local transport). Bus transport is characterized rather by nodal concentration and by focus on local transportation; the feature of railway transport is rather an axis concentration and specialization on long-distance transportation.
2. Centres of *types LD/R* and *LD/B*. thus centres with high share of long-distance. rail or bus lines. belong to the most important centres from transport and complex point of view. On the contrary, centres specialized in local transport (*types LO/R* and *LO/B*) rank among the least transport and complex important. The balanced centres of type C have the highest variability from transport and complex points of view. It implies that transport network selectivity is especially markedly shown in case of the largest and the smallest settlements, which results into their high transport specialization.

3. The relationship between relatively autonomous development of bus and railway transport service of the centres is possible to see in their certain complementarity and specialization in long-distance or local transport. This cooperation is necessary from the perspective of economic effectiveness of subsidized public transport service. These tendencies could be strengthened by the transfer of planning and financing public passenger transport under the authority of regional self-administration. The complemetarity of long-distance bus and railway transport is documented (except quantified correlation links) also by "occupation" of major transport axis of Czechia when interregional relations, unsupported by appropriate railway network quality, are realized by bus service (corridors North Bohemia–East Bohemia–Middle/South Moravia and South Bohemia–South Moravia). Podkrušnohoří corridor (below Ore Mountains) and international transport axis Saxon–Děčín–Praha–Břeclav–Austria/ Ostrava–Poland and Austria–Břeclav–Přerov–Ostrava–Poland are served predominantly by railway.
4. Of course, whole survey induced a round of further questions, that call for additional detailed analyses. Understanding of relationship of centre's transport significance and of its connection into regional system, it means the research of inter-centre relations and relations of centre–hinterland as well. These surveys can, for example, contribute to optimalization of centre's transport service. Questions of association between transport location and total exposure of a region, which are often in accord nevertheless sometimes do not correspond, are interesting as well. Cognition of the above mentioned relations could help answer the question of transport infrastructure effects on regional development and would result in recommendations for regional policy.

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