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IV

TREND SURFACL ANALYSIS: STUDY OF EMPLOYEMENT RATE IN MAIN BRANCHES OF NATIONAL ECONOMY IN SLOVAKIA IN 1961 AND 1976

(The paper was presented briefly first time at the XIV-th Congress of Czechoslovak Geographers in Levice in duly 3-8,1978, (Š. Poláčik, ,1978))

IV-1 INTRODUCTION

The trend surface analysis is a suitable method for generalisation of the space distribution of a certain phenomenon. The method is suitable mainly for geosciences. The general form of the n-th grade trend function is for <0, U, V>:

$$F(U,V) = A_0 + A_1 U + A_2 V + A_3 U^2 + \cdots + A_{\left[(n+1), \frac{n+2}{2} - 2\right]} UV^{n-1} + A_{\left[(n+1), \frac{n+2}{2} - 1\right]} V^n$$

The number of independent parameters describing a space can be further increased. In a case when the above the sea altitude is also an independent variable we obtain trend functions Y=F(U,V,Z). The Y variable can be for instance stand for a certain property of substrate. Such a Y function is called hyperplane.

The trend surface analysis can be utilized for reproduction of a certain actual relief (landscape) or at either physically geographic analyses or also economic geography. The problem lies only in suitable substitution of variables. We have chosen as dependent variables in our study the following: 1.the industry employement rate from the total number of economically active population 2.the agriculture employement rate form the total number of economically active population 3.the rate of employement in other branches of the national economy from the total number of economically active population.

IV – 2 DIGITAL INPUT MATERIAL

For the trend surface analysis (TSA) it is necessary to know the carthesian coordinates of every point (in our case of every communities) which we do wosh to contain in an analysis. Though, the way of coordinate reading is very redious. The more acceddible way in a quick and automatised coordinate ascribing to points by placing a grid over the fundamental map. We have used the map of Slovakia gauged 1:400 000. Coordinates of a certain point from the grid were ascribed to that sommunities district where the point was placed at the map. The grid shape was influenced also by the type of computer output device by which was the task drawn (DZM 180). We wanted to have the output least distorted. The borders of Slovakia contain 792 points from the chosen grid. We did delete some of them. Those were such points which did not represent any population in respective districts. In order to obtain an equally valuable digital material for the years of 1961 and 1970 we did unify data in such a way as choosing for the basis the administrative division dated January 1, 1974.

IV-3 THE MAINSPATIAL TRENDS OF EMPLOYEMENT IN SLOVAKIA FOR THE YEARS OF 1961, 1970.

Trend function coefficients of the 1st - 5th grade for all the three parameters and both the years are shown in tables IV-1A, B, IV-2A, B, IV-3A, B. The discrete values of the trend surface are calculated

from them and through aplhanumeric variables the individual trend maps are being drawn. It is evident from the survey table (Table IV-4), which describes the quality of obtained trend functions, that generally with increase of the trend function degree increases also the percent of described of dependend variables.

Lets take a closer look to the spatial trends of the employement rate in industry from the overall number of economically active population. It will interest us how the spatial differentiation of this parameter appears through the trend surface analysis.

Tab. IV - 1 A KOEFICIENTY TRENDU 1, - 5. STUPNA ZAMESTNANOSŤ V P R I E H Y S L E ROK 1961

	1. STUPŇA	2. STUPŇA	3. STUPŇA	4. STUPŇA	5. STUPŇA
	19,753	-4,034	7,465	73,741	53,935
U	-1,926	2,283	2,731	-33,470	-36,167
V	5,346	20,173	-0,137	-80,697	-20,273
U*V		-0,408	1,752	20,991	-0,698
U^2		-0,303	-0,865	6,481	12,324
V^2			4,564	48,028	11,316
$U^2 * V$			0,329	-3,140	-5,789
$\mathbf{U} * \mathbf{V}^2$			-1,025	-2,230	18,434
U^3			-0,020	-0,442	-1,247
V^3			-0,374	-12,423	-9,207
$U^3 * V$				0,043	0,057
$\mathrm{U}^2 * \mathrm{V}^2$				0,501	1,505
$U * V^3$				-0,407	-7,280
U^4				0,015	0,088
V^4				1,312	3,535
$U^4 * V$					-0,015
$U^{3} * V^{2}$					0,047
$U^{2} * V^{3}$					-0,185
$U * V^4$					0,776
U^5					-0,001
V ⁵					-0,393

Tab. IV - 1 B KOEFICIENTY TRENDU 1. - 5. STUPŇA Z A M E S T N A H O S T V PRIEMYSLE ROK 1970

	KOK 1970						
	1. STUPŇA	2. STUPŇA	3. STUPŇA	4. STUPŇA	5. STUPŇA		
	24,018	2,704	3,929	52,495	9,599		
U	-1,752	1,468	6,652	-16,044	5,989		
V	5,797	20,075	8,546	-60,699	9,877		
U*V		-0,386	1,733	15,338	-21,477		
U^2		-0,217	-1,857	2,063	-0,688		
V^2		-2,424	0,832	42,314	15,659		
$U^2 * V$			0,379	-2,488	-2,542		
$\mathrm{U} * \mathrm{V}^2$			-1,074	-1,362	25,337		
U^3			0,038	0,013	0,568		
V^3			0,118	-11,900	-18,876		
$U^3 * V$				0,076	-0,490		
$U^2 * V^2$				0,284	1,832		
$U * V^3$				-0,241	-9,364		
U^4				-0,007	0,010		
V^4				1,238	6,692		
$U^4 * V$					0,008		
$U^3 * V^2$					0,058		
$U^2 * V^3$					-0,254		
$U * V^4$					1,022		
U^5					-0,001		
V^5					-0,714		

Tab IV - 2 A KOEFICIENTY TRENDU 1, - 5, STUPŇA ZAMESTNANOSŤ V POĽNOHOSPODÁRSTVE ROK 1 9 6 1

	1. STUPŇA	2. STUPŇA	3. STUPŇA	4. STUPŇA	5. STUPŇA
	49,323	76,595	27,105	-22,200	63,660
U	1,645	-1,920	17,675	49,241	-4,436
V	-6,681	27,102	11,181	71,645	-54,791
U*V		-0,545	-8,889	-15,164	51,295
U^2		0,501	-1,445	-10,548	-0,261
V^2		4,403	-5,318	-48,670	6,550
$U^2 * V$			0,358	4,180	-2,059
$\mathbf{U} * \mathbf{V}^2$			0,820	-3,940	-37,694
U^3			0,065	0,680	-0,452
V^3			0,876	16,443	14,311
$U^3 * V$				0,011	0,855
$U^2 * V^2$				-0,697	-0,387
$\mathbf{U} * \mathbf{V}^3$				1,334	9,896
U^4				-0,032	-0,032
V^4				-1,987	-5,241
$U^4 * V$					-0,043
$U^3 * V^2$					0,021
$U^2 * V^3$					-0,121
$U * V^4$					-0,644
U^5					0,004
V^5					0,428

Tab IV - 2 B

KOEFICIENTY TRENDU 1, - 5, STUPŇA ZAMESTNANOSŤ V POLNOHOHOSPODARSTVE ROK 1970

	1. STUPŇA	2. STUPŇA	3. STUPŇA	4. STUPŇA	5. STUPŇA
	38,959	59,883	18,352	-24,577	85,150
U	0,985	-0,399	13,536	41,139	-30,160
V	-6,515	-24,470	10,312	60,790	-101,440
U*V		-0,237	-9,663	-16,065	64,340
U^2		0,217	-0,205	-7,690	8,595
V^2		3,628	-3,503	-38,901	38,034
$U^2 * V$			0,106	3,960	-2,997
$U * V^2$			1,448	-3,258	-45,069
U^3			0,014	0,380	-2,031
V^3			0,241	13,406	6,480
$U^3 * V$				-0,003	0,993
$U^2 * V^2$				-0,662	-0,434
$U * V^3$				1,285	12,054
U^4				-0,018	0,092
V^4				-1,732	-4,886
$U^4 * V$					-0,049
$U^3 * V^2$					0,019
$U^{2} * V^{3}$					-0,117
$U * V^4$					-0,841
U^5					0,000
V ⁵					0,473

Tab IV - 3 A KOEFICIENTY TRENDU 1, - 5, STUPŇA ZAMESTNANOSŤ V OSTATNYCH ODVETVIACH ROK 1961

	1. STUPŇA	2. STUPŇA	3. STUPŇA	4. STUPŇA	5. STUPŇA
	30,925	27,439	65,430	48,459	-17,596
U	0,281	-0,363	-20,406	-15,771	40,603
V	1,335	6,929	-11,043	9,052	75,064
U*V		0,953	7,138	-5,827	-50,597
U^2		-0,198	2,310	4,067	-12,063
V^2		-1,877	0,754	0,642	-17,866
$U^2 * V$			-0,687	-1,040	7,848
$U * V^2$			0,206	6,170	19,259
U^3			-0,045	-0,238	1,699
V^3			-0,502	-4,020	-5,105
$U^3 * V$				-0,054	-0,912
$U^2 * V^2$				0,197	-1,118
$U * V^3$				-0,928	-2,615
U^4				0,016	-0,056
V^4				0,675	1,706
$U^4 * V$					0,058
$U^3 * V^2$					-0,068
$U^2 * V^3$					0,307
$U * V^4$					-0,132
U^5					-0,003
V^5					-0,035

Tab IV - 3 B

KOEFICIENTY TRENDU 1, - 5, STUPŇA ZAMESTNANOSŤ V OSTATNYCH ODVETVIACH ROK 1970

	1. STUPŇA	2. STUPŇA	3. STUPŇA	4. STUPŇA	5. STUPŇA
	37,023	37,413	77,719	72,081	5,251
U	0,768	-1,069	20,188	-25,096	24,171
V	0,718	4,395	18,859	-0,090	91,563
U*V		0,623	7,930	0,727	-42,863
U^2		0,000	2,062	5,627	-7,907
V^2		-1,204	2,671	-3,413	-53,693
$U^2 * V$			-0,485	-1,472	5,539
$U * V^2$			-0,374	4,619	19,732
U^3			-0,052	-0,393	1,463
V^3			-0,359	-1,507	12,396
$U^3 * V$				-0,073	-0,503
$\mathrm{U}^2 * \mathrm{V}^2$				0,378	-1,399
$U * V^3$				-1,044	-2,689
U^4				0,025	-0,103
V^4				0,494	-1,806
$U^4 * V$					0,040
$U^3 * V^2$					-0,076
$U^{2} * V^{3}$					0,371
$U * V^4$					-0,182
U^5					0,001
V ⁵					0,241















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ß OBR. IV - 10

学生也是这些这些这些这些这些这些实在,这些这些这些这些这些这些这些这些的,我们就是这些这些,我们就是这些这些的,我们就是这些这些,我们就是这些这些,我们就是一些 - TEORETICKA HODNOTA × BTCE H R E Z I D ZAMESTNANOS :::::: UPEN TRENDU - 6(=(8-T)/8((6-T)/8(.2((8-T)/8(-.2(=(8-7)/8(R E Z

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TAB. IV - 4 KOEFICIENTY MNOHONÁSOBNEJ DETERMINÁCIE FUNKCII PRIESTOROVÉHO TRENDU V ROK 1961 ROK 1970

ROK			1961			1970				
STUPEŇ TRENDU	1	2	3	4	5	1	2	3	4	5
ZAMEST. V PRIEMYSLE	21,6	39,2	44,8	54,2	56,4I	25,4	41,2	47,6	54,8	58,4
ZAMEST, V POĽNOHOSPODÁRSTVE	16,2	36	46,2	54,4	57,6I	20	36	47,1	55,1	60,8
ZAMEST, V OST, ODVETVIACH	4	10	27,8	31,4	34,4I	6,6	9,4	24,6	28,4	31,2

Linear trend (1st grade, year 1961). The employement rate in industry of Slovakia grows in the south to east and north to west directions. The spatial trend determines as counties with the highest industry employement share: Senica, Trenčín, Považskái Bystrica, Žilina, Čadca and Dolný Kubín. Counties with theoretically the smallest: industry employement rate are in accordance with the linear trend (T-l) the following: Komárno, Veľký Krtíš, Košice, Trebišov, and Michalovce. T-l reproduces only 21.6 % of variance pertaining to the dependent variable (Fig. IV-2A).

Square trend (2nd grade, year 1961). Importance of middle Slovakia counties from the investigated variable point of view shows in this trend already. The parabole encompassing the territory with the highest industry employement rate takes in also the counties Martin, Banská Bystrica and Prievidza (Fig. IV-3A).

Cubic trend (3rd grade, year 1961). When compared to previous trends, this one does better describe the spatial differentiation, especially within the region of eastern Slovakia where the weakly industrialised part - north of eastslovak country is starting to separate (Fig. IV-4A).

Quartan trend (4th grade, year 1961). The industry rate of employement within the villages of Rožňava county and northern part of the county of Zvolen "breaks down" the direction of trend function and the isolinie valued 3 (represente theoretically higher share of industry employement than 30 % of economically active population) extends more to southeast. Southwards form this isoline is this distance amongst isolines decreasing. At southern Slovakia there did occure a "depression" of industrial employement which takes in parts of the counties Nové Zámky and Levice (Fig, IV- 5A). **Quintan trend** (5th grade, year 1961). When comparing to the previous trend grade it describes only a little bigger variance percent of the dependent variable (only 2,2%). This is why this trend exhibits small differences only when compared to the 4th grade trend (Fig.IV-6A).

Trend functions of the agriculture employement share from the total number of economically active population for the year 1901 are the reverse picture of trend calculated for industrial employement. In order to illustrate it we do submit the 5th grade trend Map (Fig.IV-7A).

The trend function of the parameter showing the employement share in rest of the branches from the total number of economically active exhibits a lesser ability to reproduce variance of the dependent variable when compared to the case of employement in industry 3nd agriculture. This is because Slovakia has a small spatial differentiation of this kind of employement. Only the fifth trend grade described the two main regions where the rate of employement in other branches is higher. Those are the regions: Bratislava and its hinterland (county of rural Bratislava) or else the High + Low Tatras with the adjoining regions.

The trends for the year of 1970 have similar directions, though their functional values did change. The industrial employement share and that of other branches did increase. The functional trend values are in both cases bigger in the year of 1970 than in 1961. Surely, agriculture represents the main source of work power for industry but mainly for other branches of the national economy.

IV-4 ANALYSIS OF RESIDUES

With regard that the 5th grade trends express the best, the spatial differentiation of the investigated parameters we sill pay attention to them only. Residues tell about to what degree it happened to describe not only the characteristic signs of the whole territory but also of its smaller subregions. The symbols + and in the map mean again that the trend function describes the mentioned place by a lower value than in reality.

The symbols - and = mean again that the function does not evaluate mentioned place. The point symbol is found at places where the theoretical and actual values are very close to each other.

Quintan industrial employement trend well describe the main industrial axis of Slovakia - Považie. Though, in both years it is possible to delineate smaller regional units which the trend functions could not describe well enough with regard to their localization. These are: middle part of the Žiar nad Hronom county, northeastern part of the Dolný Kubín county (influence of Nižna na Orave), middle part of the Banská Bystrica county (influence of Podbrezová and Brezno), south part of the Lučenec county (influence of Lučenec and Fil'akovo), part of the Ržňava county (between Rožňava and Jelšava), in counties Vranov and Humenné (influence of Hencovce, Snina nad since the year of 1970 already the influence of Humenné).

Differences between the actual and theoretical values of the agricultural employement parameters exhibit a regional character at many places of Slovakia. Bigger agricultural employement than shown in the fifth grade trend is for example in the Martin county, in the northern part of Liptovský Mikulaš county, in the northeastern part of Spišská Nová Ves county, eventually in part of the Rimavská Sobota county.

Residues of the quintane employement trend in other branches have regional charakter only with respect to hinterland of Nové Zámky and Zvolen (we do assume that this in under the influence of transportation function of these cities). An interesting picture concerning employement rate in other branches provide residues within the region of the High latras where there does exists substantially higher employement rate in villages of the Poprad county regarding other branches than in villages of the Liptovský Mikuláš county. This is probably the consequence of higher concentration of touristis and health care establishements within the county of Poprad than in the neighbouring county of Mikuláš.

IV-5 POPULATION EMPLOYEMENT RATE SPECIALISATION

When solving the problem there were calculated simultaneously all the three quintane trends using computer. According with attaining the maximum value by the trend function in a certain point there was ascribed to this point a certain specialization. Pictures IV-12A,12B contain symbols "I", "A", "O". I - means that the population of a given village orients itself in the rate of employement to industry. A - orientation of population towards agriculture

and "O" other branches.

This calculation was done for the year 1961 and also for 1970. However, it is necessary to stress the specialization is theoretical - such as set by the fundamental spatial trends.

When comparing both maps we find that the biggest changes did concern the originally agricultural regions. In the year 1961 spatial trends determined as largely agricultural counties: Senica, Galanta, Dunajská Streda, Komárno, Nové Zámky, Nitra, Levice, Velký Krtís, Trebišov, Michalvce, Vranov, Svidník and Bardejov. In the year 1970 there remained only parts of counties Komárno, Nové Zámky, Levice and Velký Krtíš. The population specialization areal did somewhat widen towards the industrial employement, though the more substantial changes resulted in "benefiting" the employement in other branches.

Tables and figures for papaers 2,3,4.

Table II-1: Exponential interaction model (work commuting intensity)

The first 3 columns - actual values

4-6 column - theoretical values

7-9 column - residues

10 - 12 column - distances

Table II-2: Exponential interaction model (absolute number of commuting workers)

Table II-3: Power interaction model (work commuting intensity)

Table II-4: Power interaction model (absolute number of commuting workers)

 Table II-5:
 Review table of geodnees-of-fit statistics of the interaction model

F - number of communities

R - correlation coefficient between T_{ij}^+ and T_{ij}

 $(T_{ij}^+ = \text{observed values}, T_{ij} = \text{theoretical values})$

REGR A, REGR B - Linear regression coefficients (T=REGR A + REGR B . T⁺) NR - Nitra

VR - Vrable

ZM - Zlaté Moravce

- Table III-1: Correlation matrix (year 1961)
- Table III-2: Correlation matrix (year 1976)

Table III-3: Principal components matrix (year 1961)

Table III-4: Principal components matrix (year 1976)

Table III-5: Interpretation scheme of rotated principal components (year 1961)

Table III-6: Interpretation scheme of rotated principal components (year 1976)

Table III-7: Grouping index

Table III-8: Main region signs in the year of 1961 (numerical description)

Table III-9: Main region signs in the year of 1976 (numerical desription)

Table III-10:Main region signs in the years 1961 and 1976 (verbal desription)

Figure III-1:Review map of the model territory

Figure III-2 to III-ll : Component score depiction for the year 1961 (principal components 1 - 10)

Figure 111-12 to 111-20 : Component score depiction for the year 1976 (principal components 1-9)

Figure 111-21: Regional grouping dendrograms

Figure 111-22: Region dynamics and development direction diagram.

Table IV - 1A: Trend function coefficients of the 1 -5degree, industrial employement in the year of 1961

Table IV - 1B: Trend function coefficients of the 1-5 degree, industrial employement in the year of 1970

Table IV - 2A: Trend function coefficients of the 1 - 5 degree, agricultural employement in the year 1961

Table IV - 2B: Trend function coefficients of the 1-5 degree, agricultural employement in the year of 1970

Table IV - 3A: Trend function coefficients of the 1-5 degree, employement in other branches in the year of 1961

Table IV - 3B: Trend function coefficients of the 1-5 degree, employement in other branches in the year of 1970

Table IV – 4: Coefficients of the multiple spatial trend function determination Degree of trend Industrial employement Agricultural employement Employement in other branches

Figure IV - 1 : Profile and relief reproduction using trend functions

Figure IV - 2A: 1 st degree trend surface, year 1961, industrial employement

Figure IV - 2B : 1 st degree trend surface, year 1970, industrial employement

Figure IV - 9A: Spatial trend residues of the 5th degree, year 1961, industrial employement

Map legends
Map legends pertaining to Figures IV - 2A through IV - 8B :
0- employement share in a branch from the total number of economically active population is up to 9,9%
1- employement share in a branch is 10 - 19,9%
2- employement share in a branch is 20 - 29,9%
6- employement share ... is 60 - 69,9%

Figure IV - 12A: Population employement specialisation in the year of 1961 Figure IV - 12B: Population employement specialisation in the year of 1970 Map legende pertaining to Figures IV - 12A, 12B:

I - population employement specialisation to industry

A - population employement specialisation to agriculture

O - population employement specialisation to other branches