REGIONAL DISAGGREGATION OF INDUSTRIAL INVESTMENT: THE CASE OF CZECH REGIONS

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Abstract: *Properly structuring of industrial investment can increase the competitiveness and innovation potential of each region markedly; and results in welfare increasing. The intention of this study wasn't evaluating the allocation of investment but develops the method of gaining the regional disaggregated data of industrial investment. Such data are valuable for further regional development analysis, nevertheless the two dimensional matrix of regional investment in industrial structure for many regions, i.e. Czech NUTS III regions is not available at the moment. The aim of this paper is to present the developed methodology of values estimation within the industrial structure at regional level; to verify this principle on the sample of Slovak regions and to apply the methodology on Czech regions over sixteen years period between 1995 and 2010. Due to many limitations and accuracy requirements of such an approach, the presented method cannot be applied to reliably disaggregation of whole regional industrial investment structure. Still we found an evidence to believe, that the method is applicable on the industries and industrial groups of construction; financial and insurance activities; trade, transportation, accommodation and food services; and public sector services.*

Keywords: *Industrial structure, Czech NUTS III regions, Slovak NUTS III regions, Investment allocation, Regional disaggregation, Employment.*

JEL Classification: *E22, R11.*

Introduction

Regional development is dependent on the effective use of resources, which is the basis for the ability of a region to compete with its surroundings in terms of the attractiveness which the region potentially has but also which it is able to transform into the real allocation of capital investment, as well as its human factor. [1], [2] Economic potential is determined by the quantity and quality (including structures) of fixed (tangible, intangible, financial) as well as human capital, so when assessing the competitiveness of a region it is relevant to pay attention to the development (growth) of capital, which in the case of fixed capital is represented by investment.

Empirical studies show a strong correlation between investment and product. Countries which allocate a high share of their GDP to investment also show a high level of growth and vice versa. [11] Considering the fact that fixed capital figures both on the input and the output side of the production process, it not only influences the volume of production but also the accumulation of fixed capital as separate entities. A targeted accumulation of fixed capital logically requires an appropriate response in consumption. The existence of investment must sacrifice part of the current consumption in favor of an increase in future consumption. [13] Nevertheless, the allocation of investment is a crucial element in addressing the industrial structure of the economy and its competitiveness, since investors knowing well, that: "Investment should be optimally distributed so as be channeled into a region with a higher capital return," as Pražák noted. [12, p. 19] Properly structured industrial investment in a region can significantly increase its competitiveness

and innovation potential and ultimately increase its prosperity. This issue was addressed in 2000 in a study of experts from the European Commission who compared the development of European competitiveness - especially in relation to the USA and Japan - with structural (sectoral and industrial) changes in the European economy. [6]

1 Statement of a problem

Information on the development of the industrial structure of a regional economy - not only performance and employment but also investment as indicators of the further development of the industrial structure of a region, is very important for analyzing and managing the region's economy. The availability of the necessary data is also a prerequisite even though without that analysing of industrial structures many complications reveals. Dobrescu [5] showed some of them in his study of macroeconomic relationships interactions with structural variables. The aim of this study is to propose a methodology for obtaining industrial-allocated data on regional investment for further analysis of regional development. The issue of GDP components regionalization have been already opened by some Czech authors, for example Kramulová and Musil [9] approached to such an issue via experimental estimates of components of GDP by expenditure, while Krejčí and Sixta [10] used alternative methods for estimating the values of stock and consumption of fixed capital. Currently, in the framework of the data reported on the Czech economy .there are statistical data showing the industrial structure of investments on the one hand and their regional values on the other hand. A two-dimensional matrix that would capture the industrial-regional distribution of investments at the level of NUTS III - usually for relatively small countries the rating level of regional development is used because it has a certain degree of legitimate power, especially if it is bound to the definition of higher self-governing terrestrial units - is however not available. The absence of any reporting of industrial-regional investment is not limited exclusively to the Czech Republic. Statistical offices in Austria, Hungary, Poland and many other countries also do not disclose these elementary data. In contrast, for example, the statistical office of the Slovak Republic publicly reports these data. This fact gave the authors the idea that the availability of data on Slovak regions and the similarity of the Czech and Slovak environments, not only in economic aspects, underlined by the high level of synergy following their long-standing integrity within a single state, could be used to regionally distribute sectoral investment in Czech NUTS III regions.

The objective of this paper is to present a methodology for the regional determination of industrial investment and apply it to the level of Czech regions for a sixteen year period from 1995 to 2010. In order to verify the methodology it was first applied to Slovak regions and subsequently Czech regions at the level of NUTS III. Slovak NUTS III regions represent a comparable sample, which can be used to determine the differences between officially published results of the Statistical Office of the Slovak Republic on the regional-industrial distribution of investment [14] and the results of the application of the methodology created by the authors. A high level of conformity between the two results reflects the correctness of the methodology and its applicability to the Czech (and possibly other national) economic reality. The outputs of the application of the methodology can subsequently be used for a detailed evaluation of the distribution and development of industrial investment in each region on a lower regional level than the existing published data allow.

2 Methods for determining the industrial structure of regional investment

We may ask, of course, if there is any scientific reason to assume that formulas learned on the Slovak regions, are well enough established to use them on the Czech regional disaggregation; or, to believe that the main components and relationships in booth economies are pretty similar and work pretty similar. There is no single unambiguous argument to assume the outlined hypothesis is true; however there are many rational arguments to adopt and follow it, especially in the situation, when we face the lag of data that are very desirable for any deep intentional analysis of Czech regions. We can mention some of the most significant facts for our further research:

a) booth countries constituted one before 1993 – many cornerstones and conditions for further development were (and still are) pretty similar to booth;

b) the regional patterns of booth countries involve some similar signs – the region of capital city can be regard as the heavy outlier within the terms of economic performance and employment, while the other regions show pretty balanced development of the main economic indicators (see [7]);

c) there are no principal differences in the employment structures between the Czech and Slovak regions (see [3], [14]);

d) regional industrial structures of booth countries are shaped under the influence of similar factors – booth can be labelled to be the small open industrial economies, where manufacturing plays the leading role (see [3], [7], [14]);

e) regions across booth countries converge in many key economic indicators [15];

f) there are no principal differences in the effects of creativity and innovations involvement between the Czech and Slovak regions [8].

The first step in creating the methodology was to check the availability of the data. The authors not only wanted to develop the methodology but to apply it to real data of the Czech economy for a sufficiently long period of time, which in this case was the longest available period from 1995 and 2010. Should they be reasonably acceptable the obtained values would potentially be useful in a range of subsequent empirical studies. Relevant statistical data available in the Czech Republic include time series of the state of fixed assets at current prices per industry (19 industries of CZ-NACE), employment per capita in the individual region (14 regions) and per industry (11 industries or industrial groups), and gross fixed capital formation (GFCF) at current prices per region and per industry or industrial group. A major limitation is the high degree of industrial aggregation of data on fixed assets and especially investment and employment, which is justified by the need to protect "... individual data, especially within small regions and industries" ... which "... allows the publication of industrial breakdowns only to a certain degree of aggregation according to the letters, at the same level of detail as it is required by the statistical office of the EU (Eurostat)." [4]

As we have already mentioned, in terms of the required data the comparative sample of Slovak regions is saturated at the NUTS III level in the form of a two dimensional matrix showing the industrial allocation of GFCF. Therefore, its use in the evaluation of the proposed methodology seems to be wholly appropriate.

Development of the methodology for determining regional sectoral investment takes into account the following grounds and assumptions:

α) economic sectors are represented by 11 separate industries or industrial groups based on the valid CZ-NACE classification;

β) the methodology of the labor force sample survey used by the Czech Statistical Office (CZSO) and Slovak Statistical Office (SOSR) and the application of workplace methods for the regionalization of indicators of the GFCF, when the investment data are classified according to the place of execution [3, 14] are accepted;

ϰ) investment is represented by the GFCF as the decisive representative of the gross capital formation;

δ) the structure of industrial-regional employment reflects the allocation of industrial -regional investment;

ε) coefficients of industrial and regional investment do not significantly differentiate between the NUTS III regions within a single NUTS II at a given time;

ζ) price changes are not taken into account, the indicators are in current prices;

η) the diversity of the impact of cyclical developments in the individual regions is not taken into account;

θ) extra-regional or territorial enclaves etc. are not taken into account;

ι) there is no fundamental difference between Czech and Slovak regions, or the methodology applicable to the disaggregation of investment for the Slovak regions is also applicable to the Czech regions.

The capital intensity indicator, usually considered to be significant in the evaluation of the industrial allocation of investment, was not considered taking into account the prospective purpose of the proposed methodology, i.e. to assess the performance of a region in relation to the development of the size industrial investment, because the status values with which this indicator works, do not correspond to incremental values in the form of investment.

In summary, the outcome of the regional distribution industrial investment is considered to be: the size of investments in the given region as a whole, the size of investment in the given industry, employment in the given industry in total and regionally recognized. The presented methodology is based on the top-down principle of regionalization, or more precisely disaggregation of values reported for higher territorial units (in this case NUTS II) on lower level regions (here NUTS III). NUTS II regions, which are also delimited as the NUTS III regions, are not considered in this analysis and will therefore not further artificially distort the proposed methodology. Taking into account the method of collection and subsequent reporting of data that can be used as the initial inputs of the presented methodology by the official statistical authorities, the methodology can be considered more of a mixed method pursuant to the methodology of the European System of National and Regional Accounts ESA. The above-mentioned “disaggregation key” can be illustrated as follows.

To determine regional industrial investment the following input data are required:

I_t^R - the total value of investment in region *R* at time *t* in current prices;

I_t^S - the total value of investment in industry[9] *S* at time *t* in current prices;
$E_t^{R,S}$ - employment in industry *S* in region *R* at time *t* in number of persons;

where *R = 1, 2, ..., n; S = 1, 2, ..., m*; *and t = 1, 2, ..., k*. These conditions are valid in equations below - from (1) to (5) - as well. The procedure for calculating industrial regional investment can be represented by the following four basic steps:

I. Calculation of the relevant weight of industrial-regional employment $wE_t^{R,S}$ in individual years

$$wE_t^{R,S} = \frac{E_t^{R,S}}{\sum_{R=1}^{n} E_t^{R,S}} \tag{1}$$

The weight reflects the "range" of industry *S* in region *R* at time *t* using the parameter of employment. It is a classic weight indicator whereby the sum of the values of all industries for each region equals *1*.

II. Calculation of the coefficient of the relationship between the total investment of a region and the total investment of a industry $rI_t^{R,S}$ in individual years

$$rI_t^{R,S} = \frac{I_t^S}{I_t^R} \tag{2}$$

The relation coefficient can be seen as a certain form of weight which is specific for each territorial unit. It is not a weight in the true sense; it represents the relation between investment in the industry *S* in the economy of a higher reporting unit and the investment that was made in region *R* at time *t*.

III. Calculation of the coefficient of the industrial structure of investment $cI_t^{R,S}$ as the product of the relative weight of the industrial and regional employment and the relation coefficient between industrial and regional investment in individual years.

$$cI_t^{R,S} = \frac{wE_t^{R,S} \cdot rI_t^{R,S}}{\sum_{S=1}^{m}\left(wE_t^{R,S} \cdot rI_t^{R,S}\right)} \tag{3}$$

This indicator expresses how much industrial investment of industry *S* is bound to a unit of regional investment in region *R* at time *t*. Balancing the coefficient eliminates the inter-industrial reallocation of the next step.

IV. And finally, **calculation** of the industrial value of investment in each region $I_t^{R,S}$, using the product of the above coefficient of the industrial structure of investment $cI_t^{R,S}$ and the value of the total investment in the monitored region I_t^R.

$$I_t^{R,S} = cI_t^{R,S} \cdot I_t^R \tag{4}$$

The logical question is "Why was an employment indicator used in the key of the calculation of the regional distribution?" We can answer as follows: Other relevant data in the related industrial breakdown at the monitored level showing at least a certain degree of positive correlation are not publicly available (for Czech regions).

3 Problem solving and discussion

3.1 Verification of the proposed methodology

Based on the correlation analysis, which was applied to a comparative sample of Slovak regions, the correlation between regional-industrial employment and the regional-industrial distribution of investment was demonstrated only in certain industries. A nonparametric

[9] The term "industry" here also refers to statistically reported industrial groups.

approach to the measurement was applied due to the fact that most of the input data lacked normality. A summary of the results of the analysis is shown in Table 1: The top part of the table shows the frequency of occurrence, where Spearman's rank correlation (ρ) for a defined level of significance (α) was significant during the period 1995 to 2010. Relevant levels of significance in this analysis are 0.05 and 0.10. The highest reliability is naturally desirable but taking into account the method of reporting the regional-industrial investment or its estimation the authors consider a significance level of 0.10 as being sufficient. Nevertheless, due to the fact that a large number of values fall outside the desired significance, we have used for "illustration purposes" a less common level of significance of 0.15. The lower part of table shows the minimum and maximum values of correlation coefficient (ρ) at a significance level of 0.10 of the entire sample for the monitored period.

Tab. 1: Summary of the analysis of the relation of investment to employment

α	A	BDE	C	F	GHI	J	K	L	MN	OPQ	RSTU
0.05	43.8	31.3	0.0	43.8	50.0	18.8	93.8	12.5	0.0	87.5	0.0
0.10	68.8	31.3	6.3	56.3	62.5	31.3	100.0	25.0	6.3	87.5	0.0
0.15	87.5	50.0	12.5	68.8	75.0	37.5	100.0	37.5	18.8	93.8	6.3
ρ min	0.68	0.86	0.71*	0.71	0.71	0.68	0.71	0.71	0,71*	0.79	x*
ρ max	1.00	0.96		0.96	0.96	0.93	1.00	0.96		1.00	

*Notes: * only one (or none - "x") case at a significance level of 0.10 has been found; Explanation of shortcuts (industries substituted) used as follows: A - agriculture, forestry and fishing; B - mining and quarrying; D - electricity, gas, steam and air conditioning supply; E - water supply, sewerage, waste management and remediation activities; C - manufacturing; F - construction;*
G - wholesale and retail trade, repair of motor vehicles and motorcycles; H - transportation and storage; I -accommodation and food service activities; J - information and communication;
K - financial and insurance activities; L - real estate activities; M - professional, scientific and technical activities; N - administrative and support service activities; O - public administration and defence, compulsory social security; P - education; Q - human health and social work activities;
R - arts, entertainment and recreation; S - other service activities; T - activities of households as employers, undifferentiated goods-and services-producing activities of households for own use;
U - activities of extraterritorial organizations and bodies.

Source: author's own work based on [14]

The high correlation coefficient values and the frequency of their significance at low levels of probability suggests that for industries K and OPQ there is a very strong link between regional-industrial employment and the allocation of investment, which is confirmed throughout the period. Hence, the use of employment for the allocation of regional investment in these industries appears to be a step in the right direction. For the industries GHI, A, and with a greater level of benevolence also industry F, the results of the strength of ties are less convincing but there is still a sizeable degree of dependence and their significance does not completely exclude for these segments employment from a further "round of balancing" in the framework of the overall "disaggregation key" – by this one is no single factor used to determine industrial-regional investment. A major turning point in the development of interdependence was also identified for these industries, which occurred approximately in the middle of the monitored period. While for industry A the strength and significance of the dependence of investment and employment is clearly recognizable after 2002 - correlation coefficients in the range of <0.9; 1> and on the level of significance 0.05, often 0.01 (similar to industries K and OPQ), before the turning point in 2002 the significance level was around 0.10, with coefficients fluctuating at around 0.65. For industries F and GHI this development was the opposite - a statistically demonstrable dependence until 2002 (2004 for GHI) - and in subsequent years the dependence was not

observed. With this in mind, however, industries K, OPQ, GHI, F and A are perceived as being "preferred" for the application of the methodology. Values indicating a low correlation, found in industries BDE, C, J, L, MN, and RSTU prevent employment for being further considered as one of the determinants of the industrial determination of regional investment in these segments.

3.2 Comparison with actual values

Another step towards assessing the correctness of the proposed methodology was to apply the "disaggregation key" to input data on Slovak NUTS II and NUTS III regions which are also available for Czech regions from the database of the Statistical Office of the European Union - Eurostat [8], and to compare the disaggregation values obtained by the methodology with actually reported values of regional-industrial investment in regions of Slovakia. This comparison was also made for the whole of the monitored period. Two years were selected for the presentation of the detailed results of the comparison – a year in the middle of the interval, which can be described as being relatively "boring" or unaffected by any extraordinary events which could have the potential to significantly impede the methodology (2002), and vice versa a "turbulent" year in which the strongest impact of the economic crisis was recorded (2009). The time of the impact of the crisis can be connected with the potential occurrence of an extraordinary event and can thus be regarded as a convenient test of the methodology's elemental resistance to external influences. A comparison of the two years is expressed by relative deviations included in Table 2. The deviations were determined based on the formula (5)

$$\sigma = \left| \frac{I_t^{R,S} - V_t^{R,S}}{V_t^{R,S}} \right| \cdot 100\ \% \tag{5}$$

where $I_t^{R,S}$ means calculated values of regional-industrial investment at time *t*; and $V_t^{R,S}$ are reported values of regional-industrial investment at time *t*.

The industries and industrial groups previously excluded from the methodology were included in the comparison in an attempt to repeat the complex verification, which would in finding analogies of the resulting values with the previous correlation analysis or the measurement of low deviations for the sectors, for which significant correlation relationships with high coefficient values were recorded, continue to support the accuracy of the considerations on the basis of which the "disaggregation key" was developed.

The values of "disaggregation error" indicate the rate of error measured when comparing the cumulative values (outputs of the disaggregation) for industries and officially reported values. Based on the balance of the "disaggregation key" let us say the coefficient $cI_t^{R,S}$, the rate of error did not reach values that would cause a substantial distortion of the whole sector. During the entire period the disaggregation error of the individual industries in most cases ranged in the interval <0.5%; 0.5%>, with the highest measured value being -1.72%. The size of the resulting errors can largely be attributed to the officially reported values being rounding off. Only a very small part of the errors can be attributed to the disaggregation method used.

Tab. 2: Measured deviations for years 2002 and 2009 (in %)

2002	A	BDE	C	F	GHI	J	K	L	MN	OPQ	RSTU
Trnava	0	4	5	0	1	10	4	4	8	5	32
Trencin	23	23	0	7	5	7	4	16	8	2	13
Nitra	18	20	4	6	3	3	6	13	11	3	37
Zilina	11	12	5	1	5	0	1	46	21	8	26
Banska Bystrica	10	16	7	0	6	0	1	27	16	9	45
Presov	6	17	12	4	3	3	7	35	3	5	8
Kosice	8	6	10	4	2	2	6	35	3	5	8
Disaggregation error	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

2009	A	BDE	C	F	GHI	J	K	L	MN	OPQ	RSTU
Trnava	10	12	21	16	13	14	18	16	53	14	15
Trencin	14	21	3	14	8	8	2	6	0	12	19
Nitra	0	8	26	0	4	5	12	8	30	2	5
Zilina	2	25	0	6	14	12	0	5	17	19	12
Banska Bystrica	4	61	2	18	13	12	1	4	14	16	20
Presov	6	26	1	4	3	4	0	13	9	2	18
Kosice	6	11	0	7	3	2	0	10	7	2	19
Disaggregation error	**-1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Notes: interval borders applied for the visualisation have been set as follows:

<0; 5>	(5; 10>	(10; 25>	(25; ∞)

Source: author's own work based on [14]

Table 2 clearly shows that in 2002 the rate of error of the preferred industries K, OPQ, GHI and F ranged below 10% in all cases, and in most cases (20 of 28) it was below 5%. The last of the preferred industry - A has a higher rate of error; however, these deviations were expected due to the aforementioned weak correlation in the first half of the period. We also confirmed the expected high rate of error for the industries BDE, L, MN and RSTU. In contrast, the low rate of error for industries C and J was unexpected. Low deviations were measured for these industries in several of the other years of the monitored period; however, the measured rate of error and its volatility are higher than for the preferred industries.

The year 2009 confirms the low reliability of the disaggregation, which can be attributed to sudden unsystematic changes due to increased volatility on the labor market and a higher degree of caution of potential investors. These factors are significantly reflected in the development of employment and volume of investment during an economic crisis. Nevertheless, industry K within Slovak NUTS III regions shows a low rate of error although, paradoxically, the previous and the following years have a higher rate of error. A relatively lower rate of error was also found in industry A, which could be expected in relation to the above-mentioned turning point. Similarly, the higher deviations in industries GHI and F are not surprising. In contrast, the higher error for industry OPQ in 2009 may at first glance seem like an utter failure of the methodology. However, due to the fact that adverse developments in times of economic crisis are controlled by saturating part of private investment through higher public sector spending and favoring training activities, a higher rate of error for industry OPQ is rationally justified. A rate of error comparable to the preferred segments was found even for industry L – when comparing other years, however, it is an exceptional phenomenon - and again for industries C and J.

A summary of the results of the comparison of the calculated and actual values is included in Table 3. Table 3 shows the average absolute value of annual industrial

deviations for all of the regions. The lower part of the table shows the average deviation value for the entire period. The median value is also given in addition to the classical (arithmetic) average, which is related to the cumulative values of the deviations - top of the table.

Tab. 3: Comparison of deviations of calculated and actual values - summary (in %)

	A	BDE	C	F	GHI	J	K	L	MN	OPQ	RSTU
1995	13	18	9	10	5	10	6	11	14	10	17
1996	15	15	11	7	5	15	5	14	16	7	21
1997	17	14	6	8	4	7	3	10	11	5	16
1998	15	12	9	5	5	12	7	12	5	4	26
1999	17	14	8	6	5	16	3	9	5	3	18
2000	20	9	14	7	7	6	3	6	9	4	26
2001	10	11	9	5	3	5	8	14	16	7	23
2002	11	14	6	3	4	4	4	25	10	5	24
2003	7	8	8	20	3	5	6	20	16	5	19
2004	3	4	8	18	3	4	7	15	15	9	23
2005	7	9	16	15	10	12	8	18	16	17	22
2006	21	5	17	11	9	10	13	10	12	15	21
2007	13	24	16	11	12	10	12	15	18	11	12
2008	12	19	20	15	10	14	6	10	10	9	21
2009	6	23	8	9	8	8	5	9	19	10	15
2010	10	19	10	11	11	15	99	8	15	8	28
Average	12	14	11	10	7	9	12	13	13	8	21
Median	12	14	9	10	5	10	6	12	14	8	21

Notes: see notes below Table 2

Source: author's own work based on [14]

Table 3 confirms the relatively low rate of error of disaggregation for industries K[10] and OPQ, and to a limited extent also industries GHI and F i.e. for the period of the proven dependencies between employment and investment. On the contrary, for industry A the correlation relationship in the reduction of error was not strong enough for the disaggregation of investment to be acceptable based on the methodology, although at first glance a certain amount of reduction in the rate of error is definitely present. The certain but not entirely accepted suitability of the proposed methodology for industries C and J is probably due more to the higher impact of the relation between the total investment in the region and the total investment in these segments than the links between investment and employment, which is offered as a possible way of modifying the methodology for industries C and J.

3.3 Application of the created methodology on Czech regions

After verifying the methodology of industrial allocation of regional investment on Slovak regions it is possible to proceed to the final stage, i.e. the disaggregation of industrial investment in Czech regions. Since it is not possible to unambiguously verify the applicability of the methodology on a sample of Czech regions, it is necessary to recall the basic principle on which the methodology is based, i.e. suitable for Slovak regions,

[10] The value for 2010 can be considered an excess caused by the Trencin Region, which a 91% decrease from the previous year. This radical change, which is not reflected in employment, caused a large distortion in the disaggregation of the whole NUTS II region - Western Slovakia; the error for the Trencin Region reached 621%, which hugely distorted the following average value for 2010 and the whole of the period. If we omit 2010, the average value of the industry K, presented in Table 3, would be 6% and the median would remain unchanged.

applicable to Czech regions. The value the industrial-regional allocation of investment was calculated for so-called preferred industries for which a low rate of error was confirmed on a comparative sample and for which there are no reservations about the credibility of the values for – industries F, GHI, K and OPQ. The most accurate values can be considered those for investment disaggregated in industries K and OPQ. Values were calculated for each year of the monitored period (1995 - 2010), for each of the 11 Czech regions (NUTS III regions) that are not currently recognized as NUTS II regions, and the disaggregated values for some years are shown in Table 4. Disaggregation error indicates the rate of error measured by comparing the cumulative values (outputs of disaggregation) for the industries and officially reported values per industry.

Tab. 4: Regional-industrial allocation of investment in Czech regions (in mil. CZK)

1995	**F**	**GHI**	**K**	**OPQ**	**2000**	**F**	**GHI**	**K**	**OPQ**
South Bohemia	1707	6309	986	3397		1517	6566	157	2747
Plzen	899	3549	503	1882		1167	6108	150	2841
Karlovy Vary	312	1601	96	1708		282	1922	34	966
Usti	921	4181	391	3932		1273	6191	117	2968
Liberec	485	3125	457	2031		1179	3718	156	1886
Hradec Kralove	577	3567	908	2783		1157	6205	287	3748
Pardubice	540	3608	725	2309		835	4438	223	2271
Vysocina	692	2495	519	2228		1155	5555	182	2496
South Moravia	1888	7014	1921	7123		2487	12476	578	5614
Olomouc	663	2726	782	2601		1362	7117	173	3614
Zlin	749	2709	1082	2185		1165	6051	158	2509
Disaggr. error	**-0.04%**	**-0.19%**	**0.70%**	**-0.13%**		**0.08%**	**-0.17%**	**-0.47%**	**0.06%**
2005	F	GHI	K	OPQ	**2010**	F	GHI	K	OPQ
South Bohemia	2233	8231	579	4900		2336	12326	661	5570
Plzen	1391	5217	432	2900		1744	9360	555	4997
Karlovy Vary	515	4019	43	2003		549	3346	62	3061
Usti	1434	10260	121	4281		2586	10831	123	8429
Liberec	937	4434	174	2707		1037	3382	110	4360
Hradec Kralove	979	5525	314	3246		1025	4665	156	5621
Pardubice	831	4975	192	2952		1271	5066	261	5851
Vysocina	1209	7617	187	3740		1433	8555	369	4102
South Moravia	3157	23173	641	10457		3676	21792	1513	11978
Olomouc	1410	9559	104	5135		1738	10427	321	9974
Zlin	1355	7910	96	3844		1169	7492	225	6975
Disaggr. error	**0.16%**	**-0.04%**	**-0.40%**	**0.13%**		**0.67%**	**0.16%**	**0.37%**	**-0.06%**

Source: author's own work based on [7]

The presented summary table indicates very low disaggregation error, whose variation ranges around one percent during the period (0.80% for industry GHI, 1.02% for industry F, and 1.07% for industry OPQ). The highest value of variation was reached by industry K (1.29%). This low level of deviation can be regarded as being acceptable and not preventing the application of the developed methodology on the preferred industries.

Conclusion

By demonstrating the correlation between employment and investment in the industries and industrial groups F (construction), GHI (wholesale and retail trade; repair of motor vehicles and motorcycles wholesale, transportation and storage, and accommodation

and food service activities), K (financial and insurance activities) and OPQ (public administration and defense; compulsory social security, education, and human health and social work activities), and also by considering the relationships between industrial and regional allocations of investment, a methodology was developed for the regional disaggregation of industrial investment in these industries. The application of disaggregation was primarily targeted to Czech regions. The principle of the methodology is to use NUTS II regions for which regional-industrial investment is reported in a two-dimensional matrix, and at the NUTS III level, where only one-dimensional values are reported for industrial and regional investment separately. A two-dimensional matrix of region-industrial employment which is reported for NUTS III regions was also used.

The developed methodology was evaluated by applying it to a sample of Slovak NUTS III regions for which the required data are publicly reported. Based on the analysis of the correlation between employment and investment, followed by an analysis of deviations between the values from the methodology and officially reported values, the applicability of the developed methodology to determine industrial-regional investment in industries F, GHI, K and OPQ was recognized as being acceptable. For industry A (agriculture, forestry and fishing) a low rate of error was also not confirmed even though the existence of dependencies between industrial-regional employment and investment was demonstrated. On the contrary, industries C (manufacturing) and J (information and communication) showed relatively low deviation despite the apparently weak link between investment and employment. The anomaly found for industries C and J can either be attributed to chance, which due to the relatively stable rate of error does not seem likely, or possibly a greater effect of the relationship between total investment in the industrial and total investment in the region which may exist in these industries. This can also be considered for industry A; however, these possibilities have not been further investigated but are encouraged to be verified in their future. The resulting findings could also contribute to the development of a new methodology for regional disaggregation of industrial investment in these segments.

The structure of investment in industries and industrial groups F, GHI, the OPQ in Czech regions between 1995 and 2010 was subsequently determined through the application of the methodology developed for the allocation of industrial-regional investment in a two dimensional matrix based on one-dimensional values of industrial and regional investment, and the expected relationship between employment and investment. The obtained values could be used as input data for further analysis of the economic reality, creating significant potential to complement an area of regional development that has yet to be scientifically described.

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References

[1] ANNONI, P., DIJKSTRA, L. *EU Regional Competitiveness Index RCI 2013*. Luxembourg: Publication Office of the European Union, 2013. ISBN 978-92-79-32370-6.

[2] CAPELLO, R., FRATESI, U., et al. *Globalization and Regional Growth in Europe: Past Trends and Future Scenarios*. Berlin: Springer, 2011. ISBN 978-3-642-19250-0.

[3] CZSO (Czech Statistical Office). *Mimořádné revize národních účtů 2011 a 2014*. 2013. [cit. 2014-12-13]. Available from WWW: <http://apl.czso.cz/pll/rocenka/rocenka.avizo_revize?id=REGIONAL>.

[4] CZSO (Czech Statistical Office). *Roční národní účty: Regionální účty HDP, THFK, Zaměstnanost*. 2015. [cit. 2015-03-28]. Available from WWW: <http://apl.czso.cz/pll/rocenka/rocenka.indexnu_reg>.

[5] DOBRESCU, E. Modeling the Sectoral Structure of the Final Output. *In Romanian Journal of Economic Forecasting*, 2013, Vol. 16, Iss. 3, pp. 59-89. ISSN: 1582-6163.

[6] EC. *European Competitiveness Report - 2000*. Luxembourg: Office for Official Publications of the European Union, 2000. ISBN 978-92-829-0523-3.

[7] EUROSTAT. *Statistics*. 2015 [cit. 2015-03-16]. Available from WWW: <http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database>.

[8] KLOUDOVÁ, J., SCHWASZCZ, O. Komparace kreativního potenciálu regionů v České a Slovenské republice ve vztahu k vybraným makroekonomickým indikátorům. *In Regionální studia,* 2013, Vol. 6, Iss. 2, pp. 13-23. ISSN: 1804-1280.

[9] KRAMULOVÁ, J. MUSIL, P. Experimentální odhad složek výdajové metody regionálního HDP v ČR. *In Politická ekonomie,* 2013, Vol. 61, Iss. 6, pp. 814-833. ISSN: 0032-3233.

[10] KREJČÍ, I., SIXTA, J. Využití alternativních metod při odhadech stavů a spotřeby fixního kapitálu. *In Politická ekonomie*. 2012, Vol. 60, Iss. 6, pp. 780-800. ISSN: 0032-3233.

[11] MANKIW, G. *Principles of Macroeconomics*. London: Cengage Learning, 2003. 464 p. ISBN 0-324-17189-7.

[12] PRAŽÁK, P. Modely vzniku a eliminace ekonomických regionálních disparit jako úlohy optimálního řízení. *In E+M Ekonomie a Management*, 2012, Vol. 15, Iss. 2, pp. 15-25. ISSN: 1212-3609.

[13] SAMUELSON, P., NORDHAUS, W. Economics. New York: McGraw-Hill Companies, 1998. ISBN 0-070-57947-7.

[14] SOSR (Statistical Office of the Slovak Republic). *RegDat – databáza regionálnej štatistiky*. 2015. [cit. 2015-04-10]. Available from WWW: <http://px-web.statistics.sk/PXWebSlovak>.

[15] ZDRAŽIL, P., KRAFTOVÁ, I. Do the V4 Regions Converge?. *In 15th International Colloquium on Regional Sciences. Conference Proceedings*. Brno: Masarykova univerzita, 2012. pp. 48-58. ISBN 978-80-210-5875-0.

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