

Jan OSTOJ*

INTELLECTUAL CAPITAL OF SOCIOECONOMIC AREA: MEASURE AND STRUCTURE

Part III. Intellectual Capital of a Region – Estimate on the Example of Polish Voivodships

Summary

This paper is the last in the series of three papers devoted to the estimated value of intellectual capital belonging to any socioeconomic area: voivodship (province), municipality, country, region etc. An idea of the estimated value is based on the assumption that the value of a given socioeconomic area for its residents is determined by income generated due to the presence of a business activity in a given area. The structure of the presented method allows for covering all components of intellectual capital within estimated value regardless whether their existence is realized or not. The paper, the third in the series, makes an approximate estimate of intellectual capital in individual voivodships in Poland for the year 2013. Therefore, it is possible to disclose significant quantitative and qualitative relationships, inter alia between intellectual capital and population of individual provinces.

Key words: *intellectual capital, region, province, estimated value*

Introduction

The presented paper is the last in the series of papers devoted to the estimated value of intellectual capital of a given socioeconomic area. Its main objective, as reflected in a subtitle, is an estimate attempt of intellectual capital using a method demonstrated in the preceding two publications. From the data accessibility point of view, regarding Poland, provinces are the most promising research object. A lack of information concerning the value of net assets available in an investigated area, was the main difficulty in a formula. Hence, the value of fixed assets was

* Professor Jan Ostoj, Bielsko-Biała School of Finance and Law, Department of Finance and Information Technologies, Chair of Banking and Finance, janostoj@gmail.com

employed in the formula. Consequently, the obtained research results should be considered to be largely approximate. Obtained estimated values of intellectual capital belonging to individual voivodships were compared to both population, as well as property value. The gained results were presented in the form of graphs.

1. Output formulas

In order to estimate intellectual capital of individual voivodships in Poland, a formula derived in a previous chapter has been employed, as follows (1):

$$VIC_{reg} = VI_{reg} - A_{nreg} = \frac{GDP_1^R}{r \cdot av.rat_{inc} + av.rat_{inc} \cdot av.rat_{in} + av.rat_{in}} - A_{nreg} \quad (1)$$

where:

VIC_{reg} – intellectual capital value belonging to a given socioeconomic area (e.g. a region)

VI_{reg} – value represented by a given socioeconomic area (e.g. a region) for residents locating their activities in the area from the point of view of their income.

A_{nreg} – net assets of a given socioeconomic area (e.g. a region), a subject to a standard book register equal to

$A_{ncc} + A_{nH} + A_{nPubl}$; (that is A_{ncc} – net assets of companies (book value) in a region R; A_{nH} – households' net assets (book value) in a region R; A_{nPubl} – public institutions' net assets (book value) in a region R)

GDP_1^R – GDP created in the first year from a date, when intellectual capital valuation, belonging to a given socioeconomic area (e.g. a region R) is performed

$av.rat_{inc}$ – an average real GDP growth rate in a region R

$av.rat_{in}$ – an average investment rate in a region R

r – discount rate including the risk premium of total income loss in a region

If one accepts that:

$$av.rat_{inc} - av.rat_{inc} \cdot av.rat_{in} - av.rat_{in} = g \quad (2)$$

where:

g – a modified factor of an average growth rate and average investment rate

$av.rat_{inc}$ – an average real GDP growth rate in a province R

$av.rat_{in}$ – an average investment rate in a province R

then, the formula (1) will be the same as in Gordon's¹ model. The final form of formula regarding the intellectual capital value of a region may be obtained, based on the original assumptions (formula 3):

$$IC_{reg} = \frac{GDP_1^R}{r-g} - A_{reg} \quad (3)$$

where:

A_{reg} – net assets of a given socioeconomic area (e.g. region, province), a subject to a standard book register equal to $Acc + AH + APubl$; (i.e. Acc – companies' net assets (book value) in a province R; AH – households' net assets (book value) in a province R; $APubl$ – public institutions' net assets (book value) in a province R)

GDP_1^R – GDP created in the first year from a date, when intellectual capital valuation, belonging to a given socioeconomic area (e.g. a region, a province R) is performed

r – discount rate

g – a modified factor of an average growth rate and average investment rate

other signs as above.

The above obtained formula (3) was used to value an intellectual capital of a region, carried out below.

2. Intellectual capital – estimate attempt on the example of voivodships in Poland

At present, there is no data initially collected in assessing intellectual capital of any socioeconomic area. It is quite normal, as such estimates based on the method proposed in the preceding articles were not attempted. Therefore, available secondary data was employed - using formula (1) to value intellectual capital of individual voivodships in Poland, which have been selected as administratively enclosed national socioeconomic areas. The analysis used data available in Statistical Yearbook of the Republic of Poland 2014² informing about an amount of gross domestic product (GDP_1^i) created in i-this province in 2013. As the interest rate r an average real amount of interest rate in recent years was adopted, determining it as a difference between the average nominal

¹ Cf. : A. Rutkowski, *Zarządzanie finansami*, Warsaw 2007, p. 195.

² Statistical Yearbook of the Republic of Poland 2014, GUS, Central Statistical Office of Poland p. 70-81.

interest rate and an average price increase index of 3,6% , plus the risk premium equal to 6,05 percentage points³. (table 1).

Table 7. Specifying a discount rate r (decimal figures).

Average nominal interest rate in years 2005-2014*	Average price growth rate in years 2000-2014**	A risk premium	A discount rate
$r_{nav.}$	$Rat.p_{av.}$	r_r	r
a	b	c	a – b+c
0,045	0,03057143	0,0605	0,07492857

*Source: calculated on the basis of data of Statistical Yearbook GUS 2015: *p. 619, **p. 448. A discount rate was determined based on data – see http://bossafx.pl/index.jsp?layout=fx_2a&page=0&news_cat_id=3799&news_id=39295 (access 04-04-2017).*

As an average investment rate $av.rat_{in}$, an investments share in GDP in 2013 was adopted, equal to 0,14305084⁴. Whereas an average growth rate $av.rat_{gr}$ was adopted based on real GDP growth rates in years 2008-2014 – see table 2⁵.

³ A risk premium estimate to cover a loss of income due to a closure of a business or job loss in a given voivodship (region) is a separate complex issue. Presented calculation results (due to a lack of detailed initial data) are for reference only. Therefore, a risk estimate of Polish capital market was employed, assuming that a risk of deterioration of shareholders' income in the long run corresponds to a risk of income loss by limited liability companies. The risk premium in Poland valued that way (for 12 months from June 2012) ranged from 5,4-6,7%. Cf.: *Premia za ryzyko na polskim rynku akcyjnym*. Magazyn Bossa. http://bossafx.pl/index.jsp?layout=fx_2a&page=0&news_cat_id=3799&news_id=39295 (access 04-04-2017).

⁴ Statistical Yearbook of the Republic of Poland 2014, GUS, p. 78.

⁵ Statistical Yearbook of the Republic of Poland 2015, GUS, p. 693.

Table 8. Real GDP growth RGR_{GDP} in subsequent years [%].

Subsequent years	RGR_{GDP}
2008	3,9
2009	2,6
2010	3,7
2011	5,0
2012	1,6
2013	1,3
2014	3,3
Average GDP growth rate 2008-2014 $av.rat_{gr}$	3,057143

Source: Statistical Yearbook GUS 2015, p. 693.

According to these data, the value of a modified factor of an average growth rate and average investment rate g could have been determined. (table 3).

Table 9. Determining the value of a modified factor of an average growth rate and average investment rate.

GDP Poland 2013 [PLN million]	GDP_1	a	1615894
Fixed assets investments Poland 2013 [PLN million]		b	231155
Average real GDP growth rate (2013-2015)	$av.rat_{gr}$	c	0,0305
Investment rate	$av.rat_{in}$	b/a	0,143051
Modified factor of an average growth rate and average investment rate	g	d	-0,11691
Difference between a discount rate r and a modified factor of an average growth rate and average investment rate	$r-g$	e	0,191842

Source: Own calculations based on data of Statistical Yearbook GUS 2014, p. 78.

Due to a lack of data regarding net assets A_{reg} available in a region, subject to a value inventory register, certain simplifications were made. As a surrogate of quantity, fixed assets value was adopted for December

31st in current prices available in individual voivodships. Hence, taking this into account, the obtained research results in the paper, should be regarded as initial estimation of intellectual capital value belonging to individual provinces in Poland: in general, they do not contradict the intuitively expected values.

Table 4 includes detailed data regarding estimate of provinces' intellectual capital.

Table 1. Intellectual capital estimate by provinces - voivodships for 2013.

Specification	Poland	Lower-Silesian	Kuyavian-Pomeranian	Lublin	Lubush	Łódź	Lesser Poland	Mazovian	Opole
Fixed assets value for 31st December , current prices PLN million	3064148	244399	135753	131743	84751	184189	228798	647092	74294
GDP current prices PLN million	1615894	138298	71526	63929	35667	98819	123832	353348	34305
r-g	0,19184247	0,19184247	0,19184247	0,19184247	0,19184247	0,19184247	0,19184247	0,191842	0,191842
Region income value for its residents , PLN million	8423025,6	720893,57	372837,159	333236,959	185918,169	515104,93	645487,95	1841865	178818,6
Investment outlays(current prices) in PLN million (According to investment location)	231155	20644	9286	9742	5283	16819	17561	47277	4779
Intellectual capital PLN million	5358877,6	476494,57	237084,159	201493,959	101167,169	330915,93	416689,95	1194773	104524,6
Population (as of 31st December) in thous.	38495,7	2910	2092,6	2156,2	1021,5	2513,1	3360,6	5316,8	1004,4
Population (as of 31st December) in dozens of people	3849570	291000	209260	215620	102150	251310	336060	531680	100440
Intellectual capital per capita kPLN/resident	139,207174	163,743838	113,296454	93,4486408	99,0378552	131,676388	123,992725	224,7166	104,0667
Intellectual capital per unit of fixed assets value [PLN/PLN]	174,889646	194,965843	174,643772	152,944718	119,369882	179,661071	182,121325	184,6373	140,6905

Source: Own calculations based on statistical data: Statistical Yearbook GUS 2014, p. 78-81.

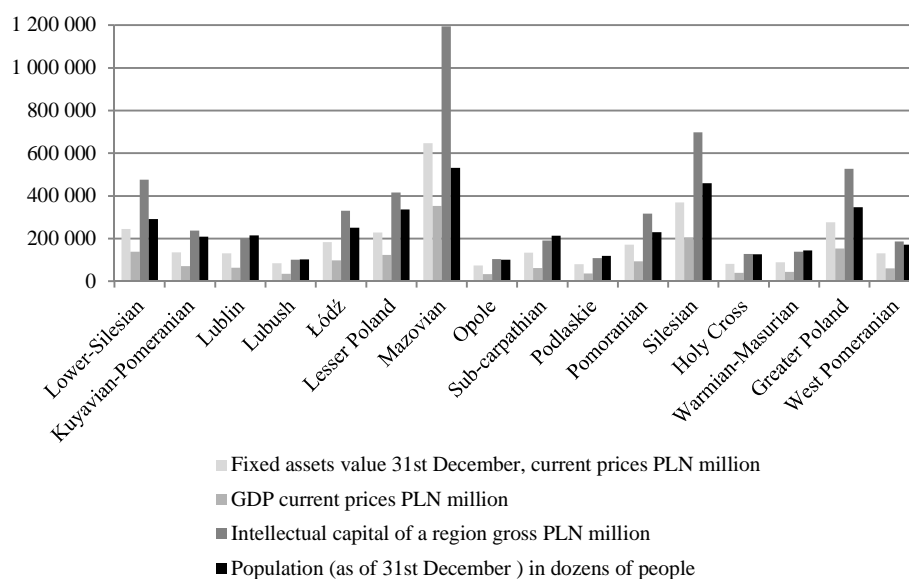
Table 2. Intellectual capital estimate by provinces-voivodships for 2013 cont.

2013	Poland	Sub-carpathian	Podlaskie	Pomoranian	Silesian	Holy Cross	Warmian-Masurian	Greater Poland	West Pomeranian
Fixed assets value 31st December current prices PLN million	3064148	134305	79626	171797	369978	81174	88768	276841	130640
GDP current prices PLN million	1615894	62448	36057	93859	205025	40126	43653	154153	60850
r-g	0,19184247	0,191842	0,191842	0,191842	0,191842	0,191842	0,191842	0,191842	0,191842
Region income value for its residents PLN million	8423025,6	325517,1	187951,1	489250,4	1068715	209161,2	227546,1	803539,5	317187,3
Investment outlays(current prices) in PLN million (According to investment location)	231155	12013	5515	13827	27649	4948	6192	18874	10746
Intellectual capital PLN million	5358877,6	191212,1	108325,1	317453,4	698737,4	127987,2	138778,1	526698,5	186547,3
Population (as of 31st December) in thous.	38495,7	2129,3	1195	2295,8	4599,4	1268,2	1446,9	3467	1718,9
Population (as of 31st December) in dozens of people	3849570	212930	119500	229580	459940	126820	144690	346700	171890
Intellectual capital per capita kPLN/resident	139,207174	89,80044	90,64861	138,2757	151,9193	100,9204	95,91407	151,9177	108,5272
Intellectual capital per unit of fixed assets value [PLN/PLN]	174,889646	142,3715	136,0424	184,784	188,8592	157,6702	156,338	190,2531	142,795

Source: Own calculations based on statistical data: Statistical Yearbook GUS 2014, p. 78-81.

Intellectual capital estimate by provinces was shown in Figure 4.

Fig. 4. Intellectual capital of a region (initial estimate).



Source: own calculations based on statistical data: *Statistical Yearbook of the Republic of Poland 2014*, GUS, p. 70-81. Note: a bar chart was calibrated for intellectual capital valuation, the remaining values were scaled according to the same ratio in order to obtain a correct graphic illustration effect.

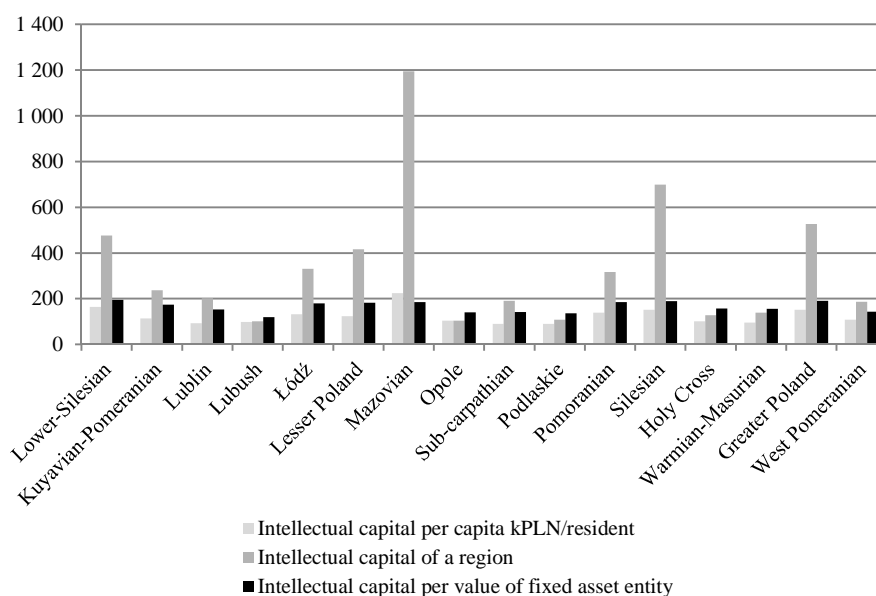
As Figure 4 shows, in Poland there are four dominant provinces: Mazovian (metropolitan), Silesian, Greater Poland, Lower-Silesian, as far as intellectual capital value is concerned. Figure 4 illustrates that there is a relationship among established and proposed method of intellectual capital valuation and a number of residents, and fixed assets value. In terms of quantity, both a human factor (linear correlation index of intellectual capital value and a number of residents $r_P = 0,95385$), as well as fixed assets value (linear correlation index of intellectual capital value and fixed assets value $r_{FA} = 0,997708$) are decisive regarding a value of human capital in a province.

The opposite relationship takes place in case of Mazovian voivodship. The exclusion of this province from correlation analysis increases r_P to a level of 0,974685 and decreases r_{FA} to a level of 0,99626.

Considering the above results, as well as the fact that Mazovian voivodship disposes of the largest intellectual capital and fixed assets values, one may initially formulate a hypotheses that in the capital province, it is not a quantity factor that determines human capital value ,but the quality of the resource. The City of Warsaw offering the best development opportunities and a high quality of life, attracts the best human capital from all over the country and abroad.

The hypothesis to a certain extent is confirmed by the following chart (Figure 5).

Fig. 1. Intellectual capital of a region per capita (initial estimate).



Source: own calculations based on statistical data: *Statistical Yearbook of the Republic of Poland 2014, GUS, p. 70-81*. Note: a bar chart was calibrated for intellectual capital valuation, the remaining values were scaled according to the same ratio in order to obtain a correct graphic illustration effect.

As Figure 5 shows, the highest human capital index per one capita and at the same time the highest, absolute level of intellectual capital belongs to Mazovian voivodship, with similar value of intellectual capital index per value of fixed asset entity, located in most of the remaining provinces. Therefore, fixed assets allocated in individual provinces in terms of value are characterised by similar influence on a level of available within intellectual capital. Otherwise, it is with intellectual

capital: not only a quantity factor is decisive in a form of population, but also a quality of human capital.

From an intellectual capital accumulated in a province point of view, a hypothesis may be formulated, stating that the greater its level, the greater the source of human capital. The example that supports this argument is Mazovian voivodship with the City of Warsaw. One may also assume that the high level of intellectual capital in a region attracts human capital of the greatest quality, which plays the most important role in determining the capital after exceeding a certain critical mass.

In the remaining provinces, physical capital seems to be of most importance, as a carrier of capital within, in the form of a modern technology; but still there is a positive dependency between human capital and intellectual capital.

Conclusions

In conclusion, these considerations may indicate that a suggested approach regarding intellectual capital estimate constitutes a prospective solution, because it includes all of its components regardless one realizes their existence, or not. This results from a substantial definition of intellectual capital underlying the proposed estimate method. The quality of the obtained results depends mainly on data accuracy one possesses, as well as the accuracy of investment growth rate estimate and economic growth rate (GDP growth rate) in a given region.

A key element of the suggested method of intellectual capital estimate is a claim that the market price of a given economic structure as an organised whole, for an entity that has an access to its resources, is constituted by a sequence of income that can be obtained by the entity, at a given risk level. Obviously, one may assume a market value if a given method of resources use is the best one of all known and possible solutions. The statement is true for both a business owner and a resident of a given economic area, for example a province. It is not an ownership that is decisive, but an access to resources. A company's owner does not own employees, and theoretically may lease all fixed assets. Moreover, it is a well known fact that an access to such and no other public goods, generally for each private company, constitutes a condition of lower or higher activity profitability (e.g. an access to better or worse road infrastructure network). In some cases, the mentioned access is a condition of proper functioning. It should suffice to have a look at

roadside restaurants, which lost an easy access to road, due to a conversion of communication artery, and thus lost customers. There is no doubt that in a such situation, intellectual capital of a given area *sensu stricte* was reduced in relation to these companies. However, it does not mean that such solution decreased intellectual capital of a given area at all: may be such solution, and not the other one, concerning a road construction has created *per saldo* a considerably greater than before development potential of a region for entities of a given area.

Suggested estimate method allows the hypothesis regarding a complex and triple structure of intellectual capital in a region, which is created not only by intellectual capital located in companies in a given region, but also available in a region human capital, and intellectual capital frozen in the infrastructure of a region; including a structure and organisation of self-government units functioning there, as well as in communication infrastructure, a structure of companies, public institutions, and so on. It is obviously true while assuming that a surrogate of region market value, estimated from the point of view of residents, is determined by income, which may be obtained by locating its activity in a given area.

It is hard to overestimate a disclosed relationship between GDP and intellectual capital. It is clear that in many cases intellectual capital constitutes 80% of a given economic structure value (e.g. a company). The increase of intellectual capital value e.g. in a province means the increase of GDP created in a given area at the same time. From the point of view of the analysis, which guarantees the completeness of all aspects of intellectual capital in the study, one should identify the factors which are responsible for net investment development in companies, as well as the increase of number of enterprises, which inter alia are defined by modern technologies, and for which resources available in a region hold great functionality (infrastructure, human resources, natural resources, etc.). The development of factors determining and attracting a highly qualified human capital is also essential, thus a consumer infrastructure, clean environment, learning opportunities, health care, leisure and recreation and many others. Investments which develop the infrastructure deciding about intellectual capital of a region *sensu stricte* are relevant for the mentioned above processes. All this indicates a necessity to a *complex* approach to a category of intellectual capital of a region, which is however possible only providing a completeness of factors

analysis that guarantees its value. Such completeness is guaranteed by a proposed criterion of its valuation in this article.

Due to such completeness, intellectual capital management in a region, is able to rely on finding, identifying of its existing components, filling missing elements, and next making them work, by using the resource by residents' activity. Therefore, an idea of 'conjugated residents' activity sites with public investments' seems to play an important role in investment in intellectual capital of a region *sensu stricte*. The development of the infrastructure, the expansion of properly profiled secondary schools, and a lot of other activities adjusted to obtained natural resources, geographical location, etc., all create an intellectual capital potential *sensu stricte* as places and new economic opportunity ventures potential, which should be constantly discovered and promote their ways of use. By investing in a region intellectual capital, one invests in development opportunities, inter alia creating a potential in the form of new investments in a given area. The opportunities are the result of a main investment goal e.g. a new motorway connecting specific points on the map, enabling a fast delivery with low fuel consumption, which may indicate at the same time an elimination of a critical organisational and economic barrier for other investments. Moreover, the remaining elements which increase intellectual capital of a region *sensu stricte* in a form of combined with a specific investment opportunities, which additionally guarantee development should be discovered and promoted (e.g. in a case of motorway construction, there are places to be petrol stations, travellers' inns and others, sometimes not perceived by potential investors and requiring additional analysis, may be additional investment and discovery). It is a problem of a newly created intellectual capital start-up, which if remains unnoticed, does not provide anything.

Finally, it should be noticed that from a point of view of calculations made which aimed at intellectual capital estimate regarding provinces, one should notice that even an approximate analysis suggests certain regularities responsible for the development. In case of the Metropolitan Mazovian voivodship, a human factor seems to be decisive as far as intellectual capital is concerned, however, it is quality rather than quantity of human capital available in this province. It is quite a reverse in case of tangible resource factor (it is a combined value of quantity and quality) which more precisely guarantees a level of intellectual capital in the remaining voivodship compared to the capital of the voivodship.

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