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The Relationship between Intellectual Capital and Development of Regions

INTRODUCTION

The objective of this paper is empirical verification of an opinion, with theoretical considerations origin, that intellectual capital is an accelerator of developmental processes in globalised and increasingly widespread knowledge-based world economy. Practical reference is in the form of Polish provinces in 1999–2009. The study assumes that intellectual capital within regions is disclosed as: human capital, social capital, structural capital and relation capital.

The first part of the paper features premises indicating the key role of intellectual capital in the social and economic development processes. Following parts feature study methodology and a commentary on the main findings.

INTELLECTUAL CAPITAL IN ECONOMICS DEBATE ON DEVELOPMENT CONDITIONS

In the face of demographic, ecological, axiology and values crisis, increasing development disproportions, we increasingly become aware of the need for development, including all the dimensions of human existence [Horx, 2002, pp. 48–51], sustainable in inter-generational as well as territorial aspect.

Adopting a holistic approach to development forced overcoming of reductionism of mainstream economy. First, in the 60s and 70s of the 20th century, as a result of falsification of neoclassical economics theories, human resources were included in the analyses. T. Schultz (1961), G. Becker (1975) showed that they are an equally significant production factor as physical and natural resources. An essential influence of human capital on the level of economic development finds confirmation in the research by R. Lucas (1988), G. Mankiw, D. Romer and D. Weil (1992), R.J. Barro (2001), R.J. Barro and X. Sala-i-Martina (2004). With respect to regional profile in the wake of this study we may mention the works of authors such as:

H. Badinger and G. Tondl (2002), A. de la Fuente (2002), J. Persson and B. Malmberg (1996) or M. Herbst [2007]¹.

Empirical study showed that still a large part of growth variation in time and between countries remains unexplained by main growth factors. A gap in mainstream economics considerations has created a space for a group of non-orthodox theories, evolutionary and institutional economics. Those works took into consideration the often non-material forms of capital, which are complementary to human capital.

The release of creative and pro-developmental features of human capital in the conditions of knowledge based economy requires a support of information society infrastructure to the sphere of education, R+D and intellectual property capital in the form of patents, licences, etc (structural capital). They form a technological and organisational pillar for the processes of development, exchange and the use of knowledge. Whereas considering the network dimension of information economics, it becomes necessary to equip human resources with attributes enabling cooperation (social capital) and benefiting from the affiliation with the network forms of cooperation (relation capital). Relation capital – expressed by territory attractiveness to investors, business partners, tourists, citizens – determines the capability of attracting alien savings and transforming them into long term capital increasing own productive powers; whereas social capital supports human capital on the mental side. It establishes goals and directions of human activity and the application of other productive factors. R. Putnam defines it as “features of society organisation, such as trust, norms and connections which may increase the efficiency of a society facilitating coordinated activity” [Putnam, 1995, p. 258]. Within the economic dimension social capital enables cooperation, coordinates individual and group activities, in a public domain – establishes current behavioural patterns, but most of all in problematic situations it may complete other capital insufficiencies. In this manner such capital influences the effectiveness of economic processes. It is productive as other forms of capital. However, until the 90s of the 20th century the main economic development theories interpreted social dependences as insignificant to economic wellbeing increase. The results of a new theory of economic growth study – S. Knack and P. Keefer [1997, pp. 1251–1288], P.J. Zak and S. Knack [2001, p. 308], R. Putnam [1995, pp. 233–240, 258–276]¹, J.J. Sztaudynger [2005, pp. 75–80] and others, as well as experiences of many countries do not seem to confirm observations formulated in such manner.

In the light of research, separately considered intellectual capital resources may be regarded as additional input into the standard function of production. Their coherent development additionally releases pro-developmental synergic effects. In other words, achieving the biggest economic effects requires human capital to find sufficient mental support in social capital, infrastructural, organisational and technological in structural capital and on the part of external environment, acting through the relation of capital dimension.

¹ The study results are described by M. Herbst [2007, pp. 118–122, 166–202].

Through transaction and operational costs channel the intellectual capital influences the proficiency and effectiveness of the economic processes. However, it mostly affects the behaviour and attitudes of economic entities, it brings forth activities directed at realisation of multithreaded economic goals. Multidimensional aspect of intellectual capital results in its transformation into economic effects – higher productivity, as well as social effects, which means higher wellbeing level.

Although intellectual capital was introduced in economic analyses by the business world representatives, numerous premises indicate that such concept may be useful also in order to explain socio-economic development. It allows a comprehensive capturing of the role of non-material forms of capital in developmental processes. Moreover, such analysis features holistic approach criteria and also is connected with endogenous theories of regional development.

STUDY METHODOLOGY

Empirical studies, verifying the thesis about the influence of intellectual capital on the achieved economic results of countries and regions, reduce its multithreaded influence to material aspects. Such studies mostly employ the analysis of correlation between intellectual capital level and GDP, GDP per capita or productivity. A conventional assumption is that material changes are primary in relation to the changes of qualitative and structural nature.

A positive interdependence between intellectual capital and the indicators depicting the economic condition of countries or regions is indicated in the results of empirical studies: A. Lerro, G. Schiuma and D. Carlucci [2008, pp. 294–298], D.G. Andriessen and C.D. Stam [2004, p. 23], D. Węziak-Białowolska [2010, pp. 124–125]. In the opinion of A. Bounfour and P. Stähle [2008, p. 168], in such reduced research space, one should consider at least four profiles of interdependence between intellectual capital (its level and dynamics) and the level and pace of development of the economy (see table 2):

- to what scope the level of intellectual capital sustains the GDP growth rate (sustaining effect) and to what scope it stimulates (boosting effect),
- whether the development of intellectual capital sustains the pace of GDP growth (linear growth potential) increase or whether it accelerates (exponential growth potential).

Constraints of analyses based on regression dependences are noteworthy. Coexistence of a high GDP level and a high intellectual capital level does not need to indicate causation and effect dependence between them. GDP changes are the result of concurrent effects of various factors². Whereas relations be-

² It is particularly visible in economies with development based on natural resources. In such countries (for instance in the Arab region) a high GDP per capita is accompanied by a low intellectual capital level [Bontis, 2004, p. 32].

tween particular dimensions of intellectual capital and GDP per capita may be additionally disturbed by internal connection between those components.

Furthermore, studies based on the correlation analysis do not display the dependence direction: whether intellectual capital determines GDP or whether it is quite the contrary. From the analysis of literature seems possible to assume that the two dimensions are interdependent. There are cases, where intellectual capital stimulates economic growth, and vice versa, economic growth drives the development of intellectual capital. The second dependency may be observed particularly in developing economies (such as China, India, Russia), where investment in intellectual capital (just to mention education or R+D) is a result of a booming economy [Stähle, Bounfor, 2008, p. 167].

Moreover, the assessment of intellectual capital alone is incredibly complicated and bears a multitude of methodological compromises. Practical requirements ‘impel’ towards quantitative methods expressing intellectual capital in the form of one synthetic index (on the bases of a range of partial variables) [such as Bontis, 2004, pp. 25–27; Lerro, Schiuma, Carlucci, 2008, p. 292; Węziak-Białowolska 2010, pp. 60–64; Edvinsson, Yeh-Yun Lin, 2011, 21–31]. In principle, such methods constitute the only possibility of an approximate reflection of the value of such capital in countries and regions. This forced manner of action does not allow full reflection of qualitative changes within this capital, which results in a limited conclusions range.

INTELLECTUAL CAPITAL IN THE DEVELOPMENT OF POLISH PROVINCES

During 2003–2009 Poland displayed a significant regional differentiation in the scope of intellectual capital supply (fig. 1).

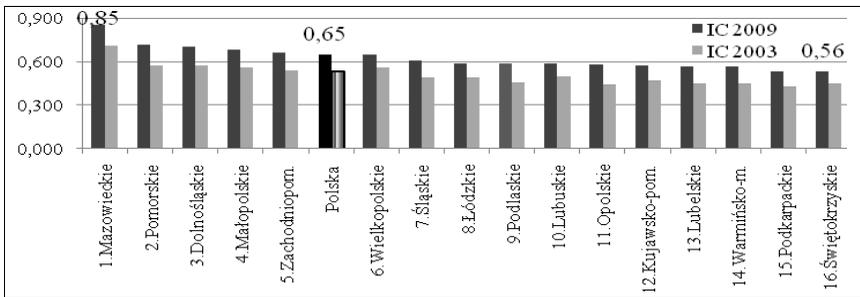


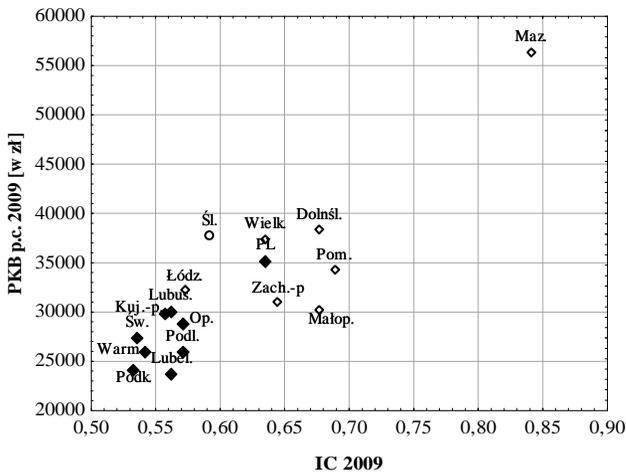
Figure 1. Rating of provinces with respect to the level of intellectual capital (IC)³

Source: [Wosiek, 2012, p. 62].

³ Synthetic index of intellectual capital is a mean average of the indexes of particular measurements of such capital, calculated with the use of Z-scores. 23 partial factors were used, the list is presented by [Wosiek, 2012, p. 56].

Notably, its average level (even that observed in the above assessed Mazowieckie province) differed significantly from the values achieved in developed countries [Yeh-Yun Lin, Edvinsson, 2011, pp. 23–26, 137–141].

Comparison of those results with a regional GDP distribution per citizen indicates obvious relation of the coexistence of a high GDP per capita and a high level of intellectual capital (fig. 2). In the period between 2003–2009 those Polish regions that have been traditionally considered less developed from economic point of view present also a lower level of intellectual capital (Podkarpackie, Podlaskie, Lubelskie, Świętokrzyskie, Warmińsko-mazurskie). Whereas, provinces considered to be on a higher level of development presented also a higher intellectual capital index (the highest – Mazowieckie).



Index of capital	Results of assessment of linear regression function: $GDPp.c._t = \alpha \cdot \text{component factor } KI_t + \beta$					
	α		β		Determinant coefficient (R^2)	
	2003	2009	2003	2009	2003	2009
Intellectual	56911	85 669	-8 3845	-20 193	0,76	0,76
Human	64022	80 024	-20 702	-24 161	0,76	0,63
Social	17446	-2 134	10 121	33 580	0,03	0,0001
Structural	45680	73304	-1 252	-13 466	0,79	0,77
Relation	26928	40 259	11 693	15 462	0,61	0,69

Figure 2. The links between intellectual capital and GDP per capita

Source: own study.

The assessed parameters of linear functions of regression allow to pose a statement that – with the *ceteris paribus* assumption – in 2003 intellectual capital explained interprovincial GDP differentiation per capita in 76%, in 2005

in 68.8%, in 2007 in 73.9%, and in 2009 – in 76%. The presented values of the determination factors constitute the measurement of fitting of linear regression function to empirical data. The growth of the value of the intellectual capital factor by 0.1 contributed to the increase of the value of GDP per capita (in a nominal aspect): in 2003 by about 5691.1 zł, in 2005 by about 6344.2 zł, in 2007 by about 7201.6 zł, and in 2009 – by about 8566.9 zł. Whereas, inverse regression functions calculated indicate that in the period 2003–2009, assuming *ceteris paribus*, growth of nominal GDP per capita by 1000 zł contributed to the growth of the synthetic intellectual capital factor by about 0.002 and clarified its variability in about 70%.

The presented dependences are a premise to consider intellectual capital an essential factor of socio-economic development of provinces. They are also a symptom of the existence of feedback between intellectual capital and the level of economic development. We may assume that in the regions considered to be problematic, low intellectual capital resources limit the opportunities of reducing the developmental distance. And vice versa, backwards development of those regions generates barriers – material and mental – for the development and application of such capital. We may also assume that in Poland the intellectual capital gap overlaps with the current territorial division lines (mainly in the east–west profile) and it constitutes an additional form of their reinforcement.

Regression dependencies transferred to a lower level of intellectual assets aggregation indicate that relatively highest GDP per capita growth in provinces is achieved as a result of accumulation of human and structural capital (fig. 2). Slightly weaker effects accompanied the development of the relation capital. The weakest and less significant relations with GDP per capita were observed in the social capital profile. It does not undermine the pro-developmental effects of such capital and is rather the result of assessment methods defects. The nature of such capital is difficult to grasp and as a principle escapes quantitative assessments. Moreover, this capital is expressed via attitudes and behaviours, therefore its influence could be attributed to other intellectual assets (such as human capital).

The achieved results should be assessed with utmost care. First, they concern short periods of time⁴. Second, they are disturbed with other causes, non-related to intellectual capital, which have a parallel influence on the GDP level. Third, they do not consider the time delay aspect – the results observed today are a consequence of not current but past activity. Fourth – they reduce the intricate economic system to linear dependencies.

Interdependencies between the dynamics of developmental processes and intellectual capital may be presented at the lowest level of aggregation, calling upon the indicators assessing this capital. The achieved results indicate that during 2001–2009 (table 1):

– among the variables assessing human capital, the society readiness for continuous development and initiative are praiseworthy. Such attributes of hu-

⁴ Due to the availability of statistical data.

- man capital did not only support the growth of GDP per capita but also could have intensified the changes dynamics,
- within the structural capital sphere, the variables assessing the actual permeation of modern solutions into economy featured stimulating influence (on the growth pace of GDP per capita) – the inventiveness level and high technological production processes,
 - the increase of the territory attractiveness to the investors, inhabitants and tourists was conducive to the increase of growth pace of GDP per capita.

Table 1. The results of linear correlation between intellectual capital (IC) and the GDP per capita growth rate in provinces 2001–2009

Indicator	Level of IC indicators		Trend of IC indicators*	
	annual growth rate	trend of annual growth rate	annual growth rate	trend of annual growth rate
	of GDP per capita			
	Sustaining effect	Boosting effect	Linear growth potential	Exponential growth potential
Human capital				
Post working-age population per 100 persons of working-age	0.531	-0.273	-0.132	0.085
Skilled labour	0.429	-0.208	0.359	-0.128
Higher education enrolment	0.123	0.079	-0.199	-0.371
Lifelong learning participation	0.230	0.079	-0.217	0.364
Businesses of individuals per 1000 of the working age popul.	-0.038	0.385	0.059	0.335
Structural capital				
R&D researchers	0.709	-0.024	-0.046	0.068
Patents per capita	0.517	0.237	-0.077	0.461
Students – academic teacher ratio	-0.209	-0.291	-0.510	-0.425
Computers in use per capita	-0.045	0.070	-0.024	-0.178
Computers for production processes management per enterprise	0.566	0.183	0.611	0.125
Relation capital				
Private sector investment per capita	0.587	0.010	0.384	0.113
Number of economic businesses with the participation of foreign capital per capita	0.302	0.105	0.406	-0.010
Foreign tourists per capita	-0.227	0.342	-0.016	0.330
Balance of external migration (for permanent stay) per capita	0.402	0.181	0.258	0.362

Social capital has been excluded from the analyses due to the weakest correlation with GDP per capita. * Directional parameter of the linear function of the trend.

Source: own calculations.

The results suggest that in Poland during the analysed years, the variation of the growth pace of GDP per capita in the province system relied mostly on the supply of intellectual capital (its level) in the provinces, and to a lower extent it was connected with the dynamics of its changes. Significant interregional disproportions, concerning a general level of socio-economic development as well as intellectual capital may lie at the heart of the observed dependence. They are compounded by the time stretch aspect – significant changes within intellectual capital, similarly to the socio-economic effects of those changes observable on a long time scale.

CONCLUSIONS

The fundamental problem concerning the analysis of intellectual capital influence on developmental processes is connected with its multidimensional and multilevel aspect – its resources are grounded in various functions, structures, technologies located at various levels of the system (citizens, organisations, regions, nation). The current developed models and assessment methods, based on regression and correlation analyses have some weaknesses – they reduce the intricate and dynamic system to linear dependencies. Consequently, the study carried out on the basis of those models features a limited opportunity to demonstrate a real influence of intellectual capital and its components on economical development.

A strong interdependence between the level of GDP per capita and intellectual capital endowment of Polish region exposes an important perspective of analyses and developmental processes programming. Pro-developmental influence of intellectual capital indicates that the development of these capital resources should gain more extensive recognition in planned territorial development strategies. The dimensions featuring stimulating influence on the GDP per capita changes (readiness for continuous education, initiative, inventiveness, implementation of modern solutions in economic practice, comprehensive territory attractiveness for internal and external stakeholders) should be of particular interest.

Influence of intellectual capital on the course and the dynamics of developmental processes is accomplished mainly through the formation of attitudes and behaviour of citizens. This aspect emphasises the necessity to adopt a subject orientation in this capital development scenarios. At the same time we must remember that qualitative factors stimulating activity and effectiveness activate when basic economics parameters are secured.

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Summary

The fundamental problem concerning the analysis of intellectual capital influence on developmental processes is connected with its multidimensional and multilevel aspect – its resources are grounded in various functions, structures, technologies located at various levels of the system (citizens, organisations, regions, nation). The current developed models and assessment methods, based on regression and correlation analyses reduce the intricate and dynamic system to linear dependencies. Consequently, the study carried out on the basis of those models features a limited opportunity to demonstrate a real influence of intellectual capital on economic development.

A strong interdependence between the level of GDP per capita and intellectual capital endowment of Polish region exposes an important perspective of analyses and developmental processes programming. Pro-developmental influence of intellectual capital indicates that the development of these capital resources should gain more extensive recognition in planned territorial development strategies. It becomes necessary to adopt a subject orientation in this capital development scenarios.

Zależności pomiędzy kapitałem intelektualnym a rozwojem regionów

Streszczenie

Zasadniczy problem dotyczący analizy oddziaływania kapitału intelektualnego na procesy rozwojowe związany jest z jego wielowymiarowością i wielopoziomowością – jego zasoby tkwią w różnych funkcjach, strukturach, technologiach, ulokowanych na różnych poziomach systemu (mieszkańcy, organizacje, regiony, kraj). Wypracowane dotychczas modele i metody pomiaru tych zależności, oparte

o analizy regresyjne i korelacyjne, redukują ten złożony i dynamiczny system do funkcji liniowych. W konsekwencji przeprowadzone w oparciu o te modele badania cechuje ograniczona zdolność do ukazania realnego wpływu kapitału intelektualnego i jego składowych na rozwój gospodarczy.

Stwierdzona jednak na ich podstawie silna współzależność między poziomem PKB *per capita* a wyposażeniem polskich województw w kapitał intelektualny odsłania istotną perspektywę analiz i programowania procesów rozwojowych. Prorozwojowe oddziaływanie kapitału intelektualnego wskazuje, że rozwój zasobów tego kapitału powinien znaleźć szersze uwzględnienie w projektowanych strategiach rozwoju terytorialnego. Szczególnie zainteresowanie powinny stanowić te wymiary, które wykazują stymulujące oddziaływanie na zmiany PKB *per capita* (gotowość do ustawicznego kształcenia się, przedsiębiorczość, wynalazczość, implementacja nowoczesnych rozwiązań do praktyki gospodarczej, kompleksowa atrakcyjność terytorium dla wewnętrznych i zewnętrznych interesariuszy).

Oddziaływanie kapitału intelektualnego na przebieg i dynamikę procesów rozwojowych dokonuje się przede wszystkim przez kształtowanie postaw i zachowań mieszkańców. Aspekt ten (notabene pomijany w analizach ilościowych) podkreśla konieczność przyjęcia podmiotowej orientacji w scenariuszach rozwoju tego kapitału. Jednocześnie należy pamiętać, że niezbywalnym czynnikiem uzyskania korzyści wynikających z efektów synergii kapitału intelektualnego jest jego kompatybilność z tradycyjnymi, podstawowymi czynnikami i warunkami rozwoju. Jakościowe czynniki, stymulujące aktywność oraz efektywność uaktywniają się, gdy zabezpieczone są podstawowe parametry gospodarowania.