European Research Studies Journal
Volume XXII, Issue 4, 2019

pp. 115-125

National Intellectual Capital in European Union Countries in 2013-2017

Submitted 14/07/19, 1st revision 20/08/19, 2nd revision 16/09/19, accepted 27/10/19

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Abstract:

Purpose: *The broadening of the concept of intellectual capital from the micro level to the macro level presents a challenge for contemporary researchers. No universal definition of national intellectual capital (NIC) or its taxonomy have been developed as yet. This hampers empirical research on measuring NIC resources, thus rendering it difficult to make cross-sectional and temporal comparisons. Therefore, methods are being sought to allow for estimating the volumes of intellectual capital on a macroeconomic level. The purpose of the article is to present an original concept of measuring NIC in the European Union (EU) countries, construct a synthetic measure of NIC on the basis of TOPSIS method, and create a ranking and classification of the EU countries in terms of their NIC resources.*
Design/Methodology/Approach: *The study uses TOPSIS, which is a multi-criteria decision-making method.*
Findings: *The obtained results reveal strong disparities between the EU countries as regards NIC resources. They confirm, moreover, the existence of high intellectual capital resources in the countries of Northern Europe.*
Practical Implications: *The outcomes of the conducted study and its conclusions can be used by decision-makers, both at the EU level and in particular countries. They can also serve as an instrument for bolstering the policies and practices promoting a holistic approach to socio-economic development.*
Originality/Value: *The article contains an original author's concept of measuring NIC resources, which can be applied to cross-sectional and temporal comparisons across EU countries.*

Keywords: *national intellectual capital, human capital, social capital, structural capital, relational capital, TOPSIS*

JEL codes: *C38, O15, O34.*

Paper type: *Research article.*

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1. Introduction

Based on the theory of economic development, new sources of value are continually being sought. For centuries, the wealth of economies used to be determined by material resources: land, buildings, machinery. For the past few decades though, this role has been taken over by intangible, knowledge-based resources. The recognition of knowledge as the main endogenous growth factor, one which can be acquired and developed through learning, has caused a shift in the approach to the notion of capital. Apart from material capital, a new concept – intellectual capital – is now taken into consideration. The economic significance of intellectual capital is emphasised in numerous studies i.a., Malhotra (2003), Bontis (2004), Andriessen and Stam (2005), Lin and Edvinsson (2012), Taranenko (2013), Labra and Sánchez (2013), Seleim and Bontis (2013), Tsouli and Elabbadi (2017). Estimating the resources of intellectual capital on a macro-economic level is ridden with difficulties. Lin and Edvinsson (2008), Navarro *et al.* (2011), Užienė (2014), Skrodzka (2018) have been among those who have indicated the problem of measurement. NIC is a complex, multi-dimensional category, impossible to observe directly. Since no widely accepted measurement method exists, various authors attempt to develop a synthetic measure of NIC that could be used as a universal gauge. The purpose of this article is, therefore, to present an original concept of measuring the NIC of EU countries, to construct a synthetic measure of NIC on the basis of the TOPSIS method, and to rank and classify the EU countries according to their NIC resources.

The article consists of six parts. Section two contains a review of the literature on the concept of NIC. Section three presents a description of the TOPSIS metohod used for constructing the synthetic measure of NIC. Section four offers a presentation of the author's concept of measuring NIC. Section five contains the results of empirical studies, and namely the calculated values of the synthetic measure of NIC, as well as the ranking and classification of the EU countries according to their NIC resources. The paper closes with a conclusion.

2. Literature Review

The development of the concept of intellectual capital dates back to the 1990s. Initially, research concerned companies (microeconomic level). Subsequently, it expanded into the macroeconomic areas. The publication, in 1999, of the first ever report on the intellectual capital of a country ('Invest in Sweden') had a great impact on the emergence of the concept of NIC (Michalczuk and Fiedorczuk, 2017). The authors of that innovative undertaking to report on the state of the national capital of a country were Rembe and Invest in Sweden Agency – ISA (Rembe 1999). The activity of Stenfelt and Edvinsson (Edvinsson, 2004) constituted a significant contribution to the report. Those attempts to gauge the intellectual capital of Sweden provided an impetus for extending the research into intellectual capital on a country level. Other contributors to the development of the NIC concept include, among

others: Pasher (1999), Malhotra (2003), Bounfour (2003), Bontis (2004), Pasher, Andriessen and Stam (2005), Sachar (2005 and 2007), Hervas-Oliver and Dalmau-Porta (2007), and Lin (2018).

A number of definitions of NIC have been proposed over the years. According to Bradley (1997), a country's intellectual capital is its ability to transform knowledge and intangible resources into wealth. Malhotra (2003) perceives it as the assets of knowledge possessed by individuals, enterprises, institutions, societies, and governments, which reflect the current and future potential source of generating and retaining wealth and the improvement of the standard of living. These assets are important for economic growth, maintaining the competitive advantage, but also for the development of society and improving life quality. Bontis (2004) defines NIC in a similar way, identifying it with the intangible values embedded in individuals, enterprises, institutions, societies, and regions which constitute current and potential sources of wealth. This type of definition focuses on the multi-level nature of the carriers of intellectual capital, i.e. people, formal groups (e.g. enterprises) and informal groups (e.g. society). Stam and Andriessen (2009) define NIC as all the intangible resources available to a country which ensure its relative advantage and which, in conjunction, can bring future benefits. Lin and Edvinsson (2011) regard NIC as information, knowledge, intellectual property, and experience that can be exploited for generating prosperity and that are at the core of the prospective capacity to increase wealth and gain an advantage over other states. Navarro *et al.* (2014), meanwhile, claim than NIC encompasses the non-material capital inherent in citizens , and the structural/socio-economic capital which enables a country to create future benefits.

NIC is a multi-dimensional category, directly unobservable, but possible to identify through the non-material resources which comprise it. For this reason, some authors supplement their definitions of NIC with taxonomies enumerating the components containing the intangible resources. As in the case of the definitions, there is no consensus about a uniform taxonomy (Table 1).

Table 1. *Review of selected approaches to NIC taxonomy*

Authors	**Components of NIC**
Malhotra (2003)	human capital, market capital, process capital, renewal and development capital
Bontis (2004), Lin and Edvinsson (2008), Užienė (2014)	human capital, market capital, process capital, renewal capital
Stam and Andriessen (2009), Seleim and Bontis (2013)	human capital, structural capital, relational capital
Węziak (2007)	human capital, structural capital, renewal capital, relational capital
Salonius and Lönnqvis (2012), Käpyla *et al.* (2012)	human capital, structural capital, relational capital, social capital
Phusavat *et al.* (2010)	human capital, market capital, process capital, innovation capital

Navarro *et al.* (2014)	human capital, process capital, research capital, development capital, innovation capital, relation and trade capital, marketing and image, social and environmental capital

Measuring NIC presents researchers with a number of difficulties. One of them is the above-discussed heterogeneity of approaches to defining NIC and the lack of homogeneity in the taxonomy of its components. Defining NIC and creating its taxonomy is only a preliminary step to measuring it. Another problem is the choice of a measurement method. Also the stage of indicator selection poses serious problems, as pointed out by Hervas-Oliver *et. al.* (2011). This stems from the fact that the measurement of NIC is usually based on diagnostic variables which describe the intangible assets comprising intellectual capital. The value of the synthetic measure of NIC is then a result of the specific manner in which the diagnostic variables are aggregated. It must be emphasised that there is no defined group of indicators which should be applied when measuring NIC. Researchers use different kinds of sets, often selecting indicators on the basis of their subjective assessment.

On the one hand, selection is determined by the availability of data (Bounfour, 2003; Käpylä *et. al.*, 2012) and, on the other hand, with the fact that measurement models are frequently adapted to a particular country or group of countries. Another issue is the assignment of weighting coefficients to the factors which identify NIC. Authors approach this problem in a variety of ways. Some apply equal weights (Andriessen and Stam, 2005; Hervas-Oliver and Dalmau-Porta, 2007; Stam and Andriessen, 2009; Lin and Edvinsson, 2012), others base their choices on the opinions of experts (Bontis, 2004, Užienė, 2014). In spite of all these constraints, research aimed at inventing a method to measure NIC is continually undertaken (Bontis, 2004; Hervas-Oliver and Dalmau-Porta, 2007; Stam and Andriessen, 2009; Lin and Edvinsson, 2011).

3. Research Methodology

In order to construct a synthetic measure of NIC for the EU countries, the authors used the TOPSIS (the Technique for Order of Preference by Similarity to Ideal Solution) procedure, which is a multi-criteria decision method. It was developed by C.L. Hwang and K. Yoon. The measurement of NIC was conducted in the following stages (Hwang and Yoon, 1981, pp. 130-132; Perło and Roszkowska, 2017, pp. 72-73).

Stage 1: Selection of diagnostic variables

In statistical terms, the level of variation of the diagnostic variables was examined as well as the level of their correlation with one another. A 10% value of the classical coefficient of variation was assumed as critical, and in order to eliminate excessively correlated variables, the inverse correlation matrix was used.

Stage 2: Division of diagnostic variables into stimulants and destimulants
Stimulants are variables whose higher values indicate a higher value of the studied phenomenon, whereas destimulants are variables whose lower values mean a higher value of the studied phenomenon.

Stage 3: Normalisation of the values of diagnostic variables (zero unitarisation procedure)
for stimulants $z_{ik} = \frac{x_{ik} - \min_i \{x_{ik}\}}{\max_i \{x_{ik}\} - \min_i \{x_{ik}\}}$ for destimulants $z_{ik} = \frac{\max_i \{x_{ik}\} - x_{ik}}{\max_i \{x_{ik}\} - \min_i \{x_{ik}\}}$ (1)

where i – the number of country (i = 1, 2, …, n), k – number of diagnostic variable (k = 1, 2, …, m).

Stage 4: Calculation of the Euclidean distance of each country to the ideal solution
$z_k^+ = [1, 1, ..., 1]$ and to the negative ideal solution $z_k^- = [0, 0, ..., 0]$:
– distance to ideal solution

$$d_i^+ = \sqrt{\sum_{k=1}^{m} \left(z_{ik} - z_k^+\right)^2}, \tag{2}$$

– distance to negative ideal solution

$$d_i^- = \sqrt{\sum_{k=1}^{m} \left(z_{ik} - z_k^-\right)^2}, \tag{3}$$

where i = 1, 2, …, n .

Stage 5: Calculation of the value of the synthetic measure for each country by means of the following formula

$$q_i = \frac{d_i^-}{d_i^- + d_i^+} \quad (i = 1, 2, \ldots, n). \tag{4}$$

The values of the synthetic measure fall within the range [0,1].

Stage 6: Ordering of the studied countries and their division into typological groups
The boundaries of the intervals between the typological groups were established by means of arithmetic means ($\bar{q}$) and the standard deviation (s_q) of the synthetic measure, according to the following formulae: group I – relatively very high level of NIC ($q_i \geq \bar{q} + s_q$), group II – relatively high level of NIC ($\bar{q} \leq q_i < \bar{q} + s_q$), group

III – relatively moderate and low level of NIC ($\overline{q} - s_q \leq q_i < \overline{q}$), and group IV – relatively very low level of NIC ($q_i < \overline{q} - s_q$).

4. Concept of NIC Measurement in EU Countries

On the basis of the literature studies presented in Section 2, it was assumed that NIC reflects the heterogeneous and complex intangible knowledge-based resources which create the current wealth of the country and contribute to its future development, build competitive advantages and represent a potential for growth. Besides that, four components of NIC were identified and defined: human capital, social capital, structural capital, and relational capital. The proposed division of intellectual capital reflects all the functional and resource relate spheres of a country. Similar taxonomies are used, among others, by: Salonius and Lönnqvist (2012), Käpylä *et al.* (2012). Human capital represents knowledge, education, and competencies of individuals in realising national tasks and goals (Bontis, 2004). Social capital refers to the institutions, relations, and norms which determine the quality and number of social interactions in a society (Jianbin *et al.*, 2014).

Structural capital, i.e. intellectual capital hidden in national organisational and technological structures is another component of intellectual capital distinguished by researchers (Malhotra, 2003). It encompasses several types of structures: organisational, communicative, technological, informative, and process-related, as well as other intangible resources, i.e. intellectual property (e.g. patents, trademarks, scientific achievements), innovations, or R&D activity (Stam and Andriessen, 2009; Batog and Batog, 2015). Relational capital is the value inherent in the external relations of a country (Weziak, 2007), the liaisons which facilitate co-operation, the attractiveness and competitiveness of an economy, the image of a country among its business partners, investors and other stakeholders (Salonius and Lönnqvist, 2012).

On substantive grounds, a set of 31 potential diagnostic variables of NIC was chosen. Years 2013-2017 were selected as the period of research. Mean values of the diagnostic variables in the period under consideration were assigned to each of the analysed EU countries. In the case of some of the variables, data availability problems occurred. As a result, various supplementation methods were used: naive prognosis (which consists in replacing a lacking value with an adjacent one), establishing an average for a shorter study period, or (like in the case of the variables regarding social capital) assuming that the average level of a variable in a given country throughout the study period is the same as the value of the variable for the year 2015. Due to serious data limitations, Great Britain was excluded from the study. The set of potential diagnostic variables was verified statistically, as a result of which the insufficiently varied and overly correlated variables were eliminated. The final set of variables used for constructing the synthetic measure of NIC is presented in Table 2.

Table 2. *Diagnostic variables of NIC*

Symbol	Description of diagnostic variable	Availability of data	Type
Human capital			
HC02	Percentage of employees aged 15-64 having completed tertiary education (%)./E	2013-2017	S
HC03	Percentage of population aged 15-64 participating in education and training (%).	2013-2017	S
HC04	Early leavers from education and training, percentage of population aged 18-24 (%).	2013-2017	D
HC06	Infant mortality rate.	2013-2016	D
HC07	Percentage of population declaring their health status as very good and good (%).	2013-2017	S
Social capital			
SC01	Participation in any cultural or sport activities in the last 12 months (% of people aged 16 and over).	2015	S
SC02	Frequency of getting together with family and relatives – not in the last 12 months (% of people aged 16 and over).	2015	D
SC03	Frequency of getting together with friends – not in the last 12 months (% of people aged 16 and over).	2015	D
SC07	Participation in informal voluntary activities (% of population aged 16 and over).	2015	S
SC10	Not having someone to discuss personal matters (% of people aged 16 and over).	2015	D
Structural capital			
STC02	Intramural R&D expenditure in business enterprise sector (% of GDP)	2013-2017	S
STC03	Enterprises that have either introduced an innovation or have any kind of innovation activity (% of total enterprises).	2012, 2014, 2016	S
STC05	Scientific publications among the top 10% most cited publications worldwide (% of total scientific publications of the country)	2013-2015	S
STC06	Percentage of households with broadband access (%).	2013-2017	S
Relational capital			
RC01	Enterprises engaged in any type of innovation co-operation with a partner in EU countries, EFTA or EU candidates countries, except a national partner (% of total enterprises).	2012, 2014, 2016	S
RC03	Enterprises engaged in any type of innovation co-operation with a partner in China or India (% of total enterprises).	2012, 2014, 2016	S
RC05	Exports of goods and services (% of GDP).	2013-2017	S

Notes: *S – stimulant, D – destimulant.*

5. Results

The values of all the diagnostic variables were normalised using formulas (1). Next, the values of the synthetic measure of NIC were calculated and, on their basis, a linear ordering and division of the countries into typological groups was performed. The obtained results are presented in Table 3. Denmark was found to have had the highest level of NIC in the years 2013-2017. The country ranked high in terms of the following diagnostic variables: Percentage of population aged 15-64 participating in education and training" (HC03: 1st), "Participation in any cultural or sport activities in the last 12 months" (SC01: 3rd), "Frequency of getting together with friends – not in the last 12 months" (SC03: 2nd) and "Enterprises engaged in any type of innovation co-operation with a partner in China or India" (RC03: 2nd). Romania had the least NIC resources. It ranked low (25th, 26th or 27th) in nine out of the seventeen diagnostic variables. The analysed EU countries were divided into four typological groups. The first one, countries with (relatively) very high NIC included: Denmark, Finland, Sweden, Slovenia, Luxembourg, and Netherlands. The group with high level of NIC comprised nine countries: Austria, Ireland, Belgium, Cyprus, Estonia, France, Greece, Czech Republic, and Slovakia. Seven countries were classified as having moderate and low level of NIC: Germany, Lithuania, Croatia, Latvia, Hungary, Poland, and Spain. The fourth group, countries with very low level of NIC, consisted of five countries: Malta, Portugal, Italy, Bulgaria, and Romania.

Table 3. *Ranking of EU countries in terms of NIC*

Country	Value of synthetic measure	Ranking position	Group
Denmark	0.683	1	1
Finland	0.679	2	1
Sweden	0.664	3	1
Slovenia	0.623	4	1
Luxembourg	0.620	5	1
Netherlands	0.618	6	1
Austria	0.610	7	2
Ireland	0.558	8	2
Belgium	0.552	9	2
Cyprus	0.528	10	2
Estonia	0.525	11	2
France	0.523	12	2
Greece	0.514	13	2
Czech Republic	0.512	14	2
Slovakia	0.510	15	2
Germany	0.501	16	3
Lithuania	0.499	17	3
Croatia	0.478	18	3
Latvia	0.468	19	3
Hungary	0.459	20	3
Poland	0.451	21	3
Spain	0.442	22	3

Country	Value of synthetic measure	Ranking position	Group
Malta	0.398	23	4
Portugal	0.391	24	4
Italy	0.319	25	4
Bulgaria	0.319	26	4
Romania	0.261	27	4
Minimum value	0.261		
Maximum value	0.683		
Mean	0.508		
Standard deviation	0.107		
Coefficient of variaton	21.1%		

The obtained results indicate that the studied EU countries were strongly diversified as regards NIC level. As Figure 1 demonstrates, a clear division exists between the north and the south of the EU. Northern European states scored the highest in the ranking and comprised the group of countries with very high level of NIC. This is consistent with expectations as those countries had long been aware of the significance of NIC and its particular components in the processes of socio-economic development. The Scandinavian countries are considered to be the birthplace of the concept of intellectual capital, initially at a company level, and the at the national level. What is more, studies by other authors (Lin and Edvinsson, 2008; Navarro *et al.*, 2011; Skrodzka, 2018) confirm the existence of a robust NIC base in this part of the EU, regardless of the measurement method, study period, or study sample. The lowest positions in the ranking were occupied by countries from the south of Europe: Italy, Bulgaria, and Romania. As regards Bulgaria and Romania, which are also characterised by low level of socio-economic development, the obtained result is further confirmed by research conducted by Užiene (2014), Navarro *et al.* (2011) and Skrodzka (2018). The low ranking of Italy is caused by the fact that in the analysed period the diagnostic variables for the country (particularly those concerning relational capital) had low values.

6. Conclusions

The article presents the outcomes of empirical research into NIC resources in 27 EU countries (excluding Great Britain). The obtained results indicate that in the years 2013-2017 there were considerable disparities as regards the level of NIC in the EU countries. This was manifest at the stage of the statistical analysis carried out for individual diagnostic variables, as well as during the analysis of the values of the synthetic measure and during the division of the countries into typological groups. The countries of Northern Europe (Denmark, Finland, Sweden) proved to have had the highest level of NIC, whereas the countries from the south of the continent (Italy, Romania, Bulgaria) had the lowest level of NIC. The conducted study can provide a starting point for debate and further work in this area, e.g. research into the relationship between NIC and other economic categories. Being easily available, the

applied set of diagnostic variables which identify NIC makes it possible to measure NIC in different periods of time and thus can enable a researcher to monitor the changes in NIC resources. Systematic empirical studies can provide decision-makers – both at the EU level and in individual countries – with significant information and become a useful tool for improving policies and practices promoting a holistic approach to socio-economic development (e.g. by identifying the areas into which resources should be redistributed). Taking account of the diversity of NIC in comparative analyses can bring valuable benefits since it would mean going beyond financial parameters, which at present are the basis of the assessment of economies.

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