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A STUDY OF THE EFFECTIVENESS OF NATIONAL INTELLECTUAL CAPITAL USE IN THE MIDDLE EAST ECONOMIES

In the world of big business, one of the leading trend is the increase of the role of intangible assets and intellectual resources. As a result, these new variables are considered as the drivers of entailing like-for-like economic growth and spreading globalization processes. That is why investigation of theoretical and practical aspects of the formation, use, and development of national intellectual capital is an actual scientific and practical matter.

The brief review of scientific papers have gave a clear understanding that modern economists, in particular H. Chun, K. Corrado, S. Dutta [2], J. Haskel [3], S. Hulten, D. Grass, B. Lanvin [2], M. Nadiri, C. Warden, S. Westlake [3], S. Wunsch-Vincent [2] and others, mainly explore the effectiveness of national intellectual capital use (NIC use) by calculating the integral indexes. At the same time, investigations related to the effectiveness of national intellectual capital use and based on econometric modeling is so limited yet. Therefore, for the future science development it is very important to investigate the effectiveness of NIC use by building econometric models.

This writing is mainly to study the effectiveness of national intellectual capital use in the Middle East economies by discriminant analysis tools.

In order to complete the study, it has been taken four stages: a) selection of the indexes which characterized the effectiveness of NIC use; b) gathering information covering 16 Middle East economies, namely Bahrain, Cyprus, Egypt, Iran, Islamic Rep., Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates and Yemen in 2017; c) building of discriminant function and calculation of its parametres; d) economic interpretation of the results of discriminant analysis.

At the outset, based on existing economic researches [2-3] and own previous scientific findings [1], the authors formed a list of attributes which characterized the effectiveness of NIC use. That list have included the following indexes: percentage of innovation products in the total output (x_1), number of patents per capita (x_2), number of researchers per capita (x_3), R&D spending per capita (x_4), percentage of venture enterprises (x_5). It has been the basis for testing and implementation of discriminant analysis tools that will be very useful in our research because it will help the authors to define to which cluster (or group of countries) each of the analyzed economies which characterized a great number of quantitative characteristics, multitude, should be belonged.

The equation of discriminant function has been mathematically described as a linear combination of initial quantitative characteristics [4, p. 139-142]:

$$Z=\beta_1 x_1+\beta_2 x_2+...\beta_n x_n \quad (1)$$

where Z – discriminator; β – parametres of discriminant function; x – meanings of the standartized ß-coefficients of the indexes that characterized NIC use.

After that it has been gathered all needed information and using global innovation index (GII) as a tool of matrix formation completed two “sample clusters” covering 10 Middle East countries in 2017. Accordingly, Israel (GII = 53,88 scores), Cyprus (GII = 46,84 scores), United Arab Emirates (GII = 43,24 scores), Turkey (GII = 38,90 scores), Qatar (GII = 37,90 scores) have been included in the first cluster which is called “leaders”. On the contrary, Iran, Islamic Rep. (GII = 32,09 scores), Lebanon (GII = 30,64 scores), Jordan (GII = 30,52 scores), Egypt (GII = 26,00 scores), Yemen (GII = 15,64 scores) have been included in the second cluster which is called “outsiders” [2, p. 20-21].

Taking into account that independent variables must be normally distributed in comparison with the common covariation matrix, coefficients of the first discriminant function have been selected in following way. Average meanings of this cluster have been distinguished between each other at the maximum level. In turn, coefficients of the second discriminant function have been selected in same way and furthermore they have not been correlated with coefficients of the first one [4, 144-145]. Accordingly to the laws of discriminant analysis number of objects in each cluster must be equaled number of indexes (initial quantitative characteristics). For that reason, in our research number of countries (economies) in each cluster equals 5 that is the same with the number of indexes which characterized the effectiveness of NIC use.

Then average values of indexes, values of total intra-type dispersion and vector of discriminant multitude as well as dispersion covariation matrixes have been calculated. In addition to this, all discriminant constants have been normed using Stat soft Statistica 8.0 package (module – Discriminant Analysis) and, on its basis, it has been calculated critical meaning of integral index (or discrimination line) for both clusters using the formula below:

$$Z=\frac{Z1+Z2}{2} \quad (2)$$

where Z – limit of discrimination; Z1, Z2 – average arithmetic meanings of discriminant functions of each cluster.

Built discriminant model has been checked on reliability and adequacy. For this purpose, the authors have used the following formulas:

$$R^2 = 1 - \frac{\sigma^2}{\sigma^2_y}, \quad (3)$$

where R^2 – determination coefficient; σ – dispersion of dependent variable;

$$F = \lambda \frac{n-k}{k-1}, \quad (4)$$

where F – Fisher's criteria; λ – number of objects (economies) in each cluster; n – total number of objects in both clusters; k – number of clusters;

$$\Delta = \sum_{i=1}^{k} \frac{1}{1+\lambda_{1\ldots5}} \quad (5)$$

where Δ – Wilk's lambda (0 > Δ < 1) [4, p. 152-154].

So calculated determination coefficient (R^2) indicated that built discriminant model is reliable at 88,04%. It has been also calculated Fisher's criteria equaled 4,8211 that is higher than table meaning (F_{tab}. = 4,40) and, therefore, proved a quantitative impact of selected factors (indexes characterized the effectiveness of NIC use) on discriminator. Besides, in the research, in order to estimate ability of discriminant function to detect the clusters in the multivariate statistical space, it has been calculated Wilk's lambda that equals 0,3247 in the research. That proves the existing of the discrimination clusters (groups) between Middle East economies one more time. The authors also have compared χ-square meaning with the critical meaning at this level of significance and number of dependence degree ($\chi^2_{крит}$ = 29,5, P-Value < 10%) and came to conclusion that modeling relationship between variables is not occasional [4, p. 159].

Parametres of discriminant function is another important characteristic of that. Actually, they equal the ration between intragroup and extragroup sums of the squares of the deviance from average meanings or, in other words, such parametres is a measure of integral difference between the clusters. In our case, the meaning of the distance between clusters has been high enough, so we concluded that the quality of built discriminant model is also high.

After all it has been obtained a discriminant function that is below:

$$Z = -8{,}01166x_1 + 3{,}2596x_2 - 12{,}8579x_3 + 1{,}2356x_4 + 21{,}0658x_5.$$

We see that in obtained function discrimination line equals 9978,23. In other words, the Middle East economies is belonging to cluster “leaders” if the meaning of discriminant function is higher than discrimination line (Z > 9978,23). The Middle East economies is belonging to cluster “outsiders” if the meaning of discriminant function is lower than discriminant line (Z < 9,97823). Following this line of argument, 16 analyzed Middle East countries have been distributed by classified characteristics and, on its basis, the authors have defined three groups (Table 1).

Table 1

Discriminant analysis of the effectiveness of national intellectual capital use in the Middle East countries

Cluster	Countries (economies) belonging to the cluster	Meaning of the discriminant function	Zone of the effective-ness of NIC use
1	Israel, Saudi Arabia, Turkey, United Arab Emirates	12235,69-10123,68	High
2	Cyprus, Egypt, Iran, Islamic Rep., Kuwait, Qatar	8945,67-10123,68	Middle
3	Bahrain, Iraq, Jordan, Lebanon, Oman, Syria, Yemen	7125,84-8945,67	Low

Table 1 shows that author's hypothesis related to the existing of clusters, groups of economies, in the Middle East region depending on effectiveness of NIC use have been confirmed. There exists the following clusters: economies with high-, middle-, and low effectiveness of NIC use. Consequently, from the author's viewpoint, countries which have low level of the effectiveness of NIC use and, for that reason, lag behind should take the following steps. Firstly, governments should develop innovation entrepreneurship by special privileges, subsidies, and preferences for economic agents which are engaged in the knowledge-intensive branches of the national economy. Secondly, it needs to stimulate increase of number of venture enterprises which are capable to invest in the high-technological but also high-risking innovation projects. Thirdly, state budget expenditure on intellectual property rights protection must be risen that will help to accelerate the processes of transition of low-knowledge-intensive countries to the economies based on innovation, information and intellectualization, new type of economic systems.

So, taking into account the above, further author's researches will find better ways to implement above mentioned recommendations in the low-knowledge-intensive economies.

References

1. Cherkashyna, T. S. (2017). Estimation and forecasting of the value of national intellectual capital of Ukraine in terms of structural and innovative transformations. *Фінансовий простір, 3 (27).*

2. Dutta, S., Lanvin, B. & Wunsch-Vincent, S. (2017). *The Global Innovation Index 2017: Innovation Feeding the World.* Geneva: World Intellectual Property Organization (WIPO).

3. Haskel, J. & Welslake, S. (2017). *Capitalism without capital: The rise of the intangible economy.* Princeton, NY: Princeton University Press.

4. Studenmund, A. H. (2017). *Using Econometrics: A practical guideline.* Harlow: Pearson Education Limited.