VOL. 2, NO. 5, August 2013 ISSN 2307-2466
International Journal of Economics, Finance and Management


http://www.ejournalofbusiness.org

# The International and Regional Human Development Indicators By Neuronal Approach

[1] Karoui Khayria, [2] Rochdi Feki
[1,2] Unité de Recherche en Economie du Développement (URED), Ecole Supérieure de Commerce, Université de Sfax, Tunisie.
[1] Rochdi.feki@escs.rnu.tn, [2] Kiria.karoui@gmail.com

## ABSTRACT

This paper uses a neural approach based onkohonen self-organizing for the classification of countries according to a calculation of the index of human development during 2010. We will try to translate the various indicators of the human development while focusing on the key criteria. The empirical results show that neural network is a promising technique for the evaluation of the countries.

**Keywords:** *Composite index, neuron networks.*

## 1. INTRODUCTION

Over the past three decades, economic development has opened a research program on the construction and use of synthetic indicators of well-being. After the pioneering work of Nordhaus and Tobin (1972), Prophets (1972), Usher (1973), Sen (1976, 1979 and 1981), Goedhart et al. (1977), Morris (1979), and Morris and McAlpin (1979), a series of criticisms and new proposals led to what Fukuda-Parr (2003) calls the paradigm of "human development".

Internationally, the most known synthetic indicators are probably those of the United Development Programme(UNDP), and particularly the Human Development Index (HDI), Gender-related Development Index (GDI), the indicator of Women's Participation in the economic and political empowerment measure (GEM) and the index of global gender gap index (GGGI) calculated at the national level. These indicators have as a first interest comparison of performance or levels of development of countries beyond the sole criterion of monetary wealth measured by the gross domestic product per capita.

The purpose of this study is to classify the world from a composite indicator consisting mainly clues as to the performance of countries using self organizing maps of Kohonen.

The paper is organized as follows: Section 2 is devoted to present the human development index. Section 3 addressed the critical indicators of human development. Section 4 discusses the methodology and data used. The results and their discussion in Section 5. The conclusions of this work are presented in the last section.

## 2. THE MAIN INDICATORS OF HUMAN DEVELOPMENT

In 1995, the Fourth World Conference on Women, UNDP implemented sensitive measures to the inequality between men and women: the human development index (HDI), the index gender development index (GDI), the index of women's measure (GEM) and the Index of Global Gender Gap index (GGGI). Widely criticized, these indicators have led to many measures of the gender inequality.

The human development index (HDI) is a statistical composite index, created by the UN program for Development (UNDP) in 1990 to assess the level of countries human development. The HDI is based on three major criteria: life expectancy, education levels and living standard. It is calculated by the average of three indices.

| Index | Measuring | Minimum Value | Maximum Value |
|---|---|---|---|
| life span | Life Expectancy | 25 years | 87 years |
| Education | Literacy rate<br>Enrollment rates schooling | 0%<br>0% | 100%<br>100% |
| Standard of living | GDP per capita | 100USD | 40000 USD |

The HDI = 1/3 (life expectancy index) + 1/3 (education index) 1/3 (income index)

The gender development index (GDI) is a statistical indicator. It approximates the HDI, since it uses its variables but takes into account the inequalities between men and women. It also counts, as a criterion of life expectancy at birth for male and female populations, the literacy schooling rate of men and women the income estimated part of men and women's. The calculation of the GDI involves three steps. Indices are first calculated by the female and male forth three dimensions considered essential in any development process. The indices obtained for each variable are then combined to assign a penalty to the different levels between men and women. The GDI is then calculated by combining the three indices of equal distribution (IEDE), which is defined as:

$$Iede = [(PF.IF^{1-\varepsilon}) + (Pm.Im^{1-\varepsilon})]^{1/1-\varepsilon}$$

Third, the GDI is calculated as follows:

The GDI = 1/3 (life expectancy index) + 1/3 (education index) 1/3 (income index)

The women participation index (GEM) created by the United Nations Development Programme (UNDP), measures the relative representation of women in the spheres of the economic and political power. It takes into account the differences between men and women regarding: the number of the parliamentary seats, of the administrative and managerial sanctions, in the professional and management positions in the economic sphere, at the income level.

The IGGG was developed on the bases of methodology used for the first time in 2006 which includes detailed profiles that provide information about the economic, legal and social differences between men and women observed in each country. This index measures the extent of this cleavage in four key areas of the gender inequality: the participation and economic opportunities, the educational level, the political influence, health and survival. So the Global Gender Gap Index is the simple average of the four indices calculated for each dimension.

## 3. CRITICISM OF HUMAN DEVELOPMENT INDICATORS

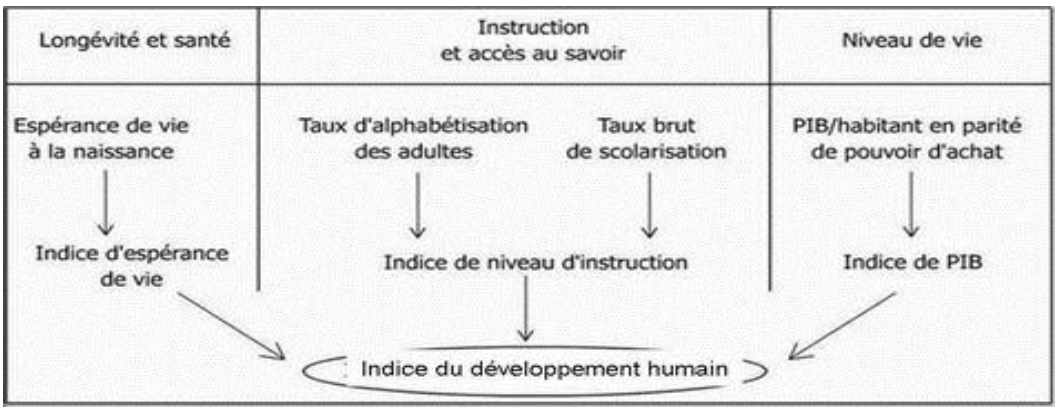
The main criticism of these synthetic indicators grouped into three categories: The first is the choice of indicators and their weight age. The second is the concept of "inequality" The last category focuses on the limited use of indices. In general, the GDI is subject to all criticism addressed to the HDI for the selection of indicators and their weighting. The choice of indicators and in particular the inclusion of the component related to the income of men and women, is the most frequent criticism since the UNDP indices are highly correlated with GDP per capita. For Dijkstra (2000), GDI gives too much weight to the absolute level of per capita income. The components of the GDI and the GEM are not necessarily appropriate indicators to measure gender disparities in countries such développement.par Peinado and Cespedes (2004) show that the indicators used in the GDI are not better suited to analysis in industrialized countries. For Dijkstra and Hanmer (1997), life expectancy is too insensitive to women's conditions indicator. Klasen (2006) also states that life expectancy is a problematic indicator in the calculation of the GDI. Some authors emphasize the relevance of other indicators, particularly in the areas of health and education in developing countries likewise, for Morrison and Jutting (2005), the GDI and GEM are take sufficient account of the institutional constraints on women and that can be entered by various indicators. In addition, the weighting of indicators is to assign the same value for the penalty factor. Bardhan and Klasen (1999) showed that weight resulted in significant weight given to the component of comparative income with other indicators.

These criticisms relate to more conceptual aspects and the shortcomings of GDI as an indicator of inequality. According Djisktra and Hanmer (2000), the GDI is an index that takes into account both the absolute levels of well-being (human development) and gender inequality. Moreover, these indices do not provide new information about the development because they are highly correlated with GDP per capita. The GDI is in fact primarily a measure of weighted inequalities and not a measure of inequality human development. The harmonic mean penalizes gender inequalities whatever kind, and does not allow differentiating between the disadvantages of men or women. The GEM is interpreted as a measure of the imbalance in representation between the two sexes in the political and economic fields. However, the calculation takes into account the wages of everyone and not from one or the other. In other words, neither GDI nor GEM corresponds to real measures of gender inequality.

Cueva Beteta (2006) believes that the lack of data in developing countries limits the analysis of the two indices to Western countries. This criticism is particularly aimed at IPF which their calculation. Schuler (2006) estimated that as much the GDI and GEM are measurement tools used very little in the literature. When this is the case, attention is mainly focused on the ranking of countries.

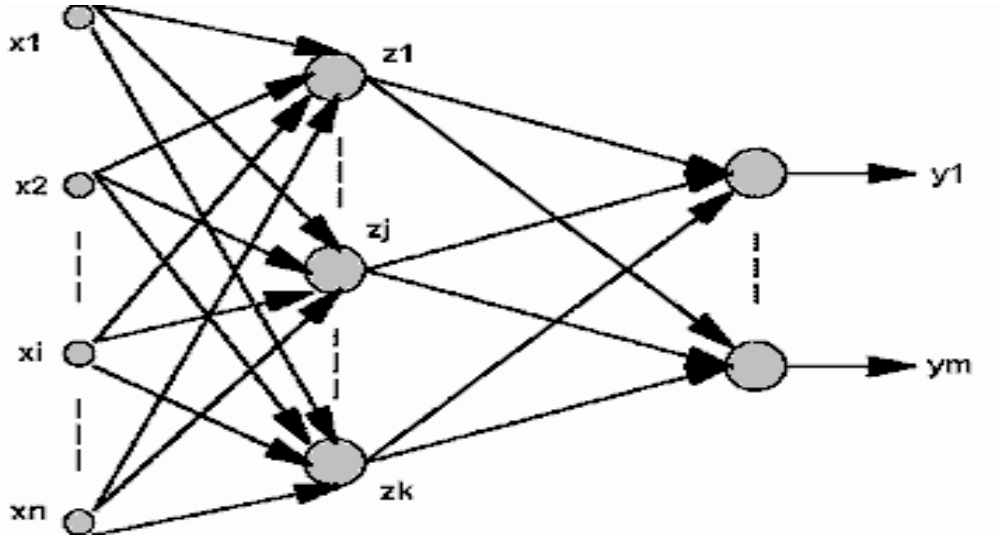
## 4. METHODOLOGY

Our methodology is based on three variables which are the dimensions of the human development index (HDI) as defined below if the figure with 163 observations for the year 2010.



## 5. THE METHOD OF ANALYSIS

To measure the performance of countries and recalculate it in a single index, we used a neural approach based on self-organizing maps of Kohonen. Basically, a neural network is a collection of interconnected cells organized in layers. The first layer is called the entry layer and the last one is the exit layer which provides the results of the calculation performed by the network. Between these two layers there are other layers called as hidden layers, which have neurons that, have no contact with the outside.




Layer entry intermediary layers exit layer

Several researches and mathematical models show that neural networks represent excellent models which moved results than conventional approaches.

There are a large number of neural networks, the famous of which are the layer perceptions and the self-organizing maps of kohnen.

The multilayer perceptions (MLP) is the most widely used network is the networks in which each neuron belonging to any layer except that of the entry, is connected only to the neurons of the following layer (no communication between the cells in the same layer is allowed) . The second type of networks is in at of Kohonen's self-organizing maps introduced by TeuvoKohonen in 1984. This type of network is based on unsupervised learning methods and has only two layers: an entry layer and anexit layer.

The technique of self-organizing maps created from a space of n dimension data, sets or less homogeneous groups consisting of the initial data heaving the same characteristics.

The major advantage of these self-organizing maps is a visual classification technique of which the interpretation is much more intuitive than that of the techniques for "classical".

They cover an unsupervised learning: the results emanate directly from the intrinsic properties to the data in the absence of any "supervisor" or expert who would love to get a priori knowledge of the response to be obtained. They are often higher than the traditional classification methods to correct the structural shortcomings of the data.

## 6. RESULT

Using the software 'Malabo' the learning of a map of Kohonen obtained is an optimal map that includes 16 × 4 = 64 classes shown in Figure 1.

| | | | |
|---|---|---|---|
| AFG<br>LIB<br>RWA<br>CAF<br>GLE | | AGO<br>GMB<br>MLI | BFA<br>DJI<br>ETH<br>GIN<br>SWE |
| OUG<br>ZMB | | MRT<br>SEN<br>TZA | CIV<br>PNG |
| CMR<br>COG<br>LSO<br>NGA | GHA<br>KEN | TOG | COM<br>HTI<br>MMR<br>NPL |
| GNQ<br>SWZ | | KHM<br>IND<br>TIM | SLB<br>PAK<br>LAO<br>STP |
| ZAF<br>DWA<br>GAB | NAM | | CPV<br>GMT |

| | | | |
|---|---|---|---|
| TKM<br>BOL | | HND<br>IND | MDV<br>MAR<br>NIC<br>SYR |
| KGZ<br>MNG<br>OUZ<br>MDA | MIC | PRY | VNM |
| TJK | PHL | SLV<br>LKA | CHN<br>DOM<br>SUR<br>THA |
| ARM<br>FJI<br>GEO<br>TON | BLZ<br>JAM<br>JOR | ECU | DZA<br>COL<br>TUN<br>TUR |
| AZE<br>UKR | PER | ALB<br>BIH | CRI<br>MKD<br>IRN<br>MUS<br>VEN |
| BLR<br>RUS<br>KAZ | BGR<br>SER | MYS<br>PAN | MEX |
| LET<br>LTU<br>MON<br>ROM | ARG | CHL<br>HRV<br>URY | SAU<br>LBY<br>TTO |
| EST<br>HUN<br>SVK | POL | CYP<br>MLT | BHR<br>BHS<br>BRB<br>PRT |
| ISL<br>TCE | GRC<br>ITA<br>REL | SVN | |
| GER<br>KOR<br>ISR | DNK<br>ESP<br>FIN<br>FRA<br>JPN | AUT<br>ROU | AND<br>BRN<br>ARE<br>KWT<br>QAT |
| AUS<br>USA<br>IRL<br>NOR<br>NZL | CAN<br>PAB<br>SDN | SUI | HKG<br>LCT<br>LUX<br>SGP |

**Fig 1:** Map obtained optimal

Kohonen card shows three distinct zones of the country. A first zone seen at the top of the map which includes the Least Developed Countries like Zamia, Rwanda,...

A second area includes the under developed countries such as Tunisia, Turkey…

And a third zone including the developed countries, for example Norway, Sweden, Switzerland,...

Better to work with our Kohonen card, it is obvious to use the vector code to illustrate the distances between the different boxes of the map. On this distance map (also called the U-matrix), blue color indicates a short distance between the cells and can detect a homogeneous area (countries that are close to it).However, and a red color (a border area) indicates significant distances between the cells.

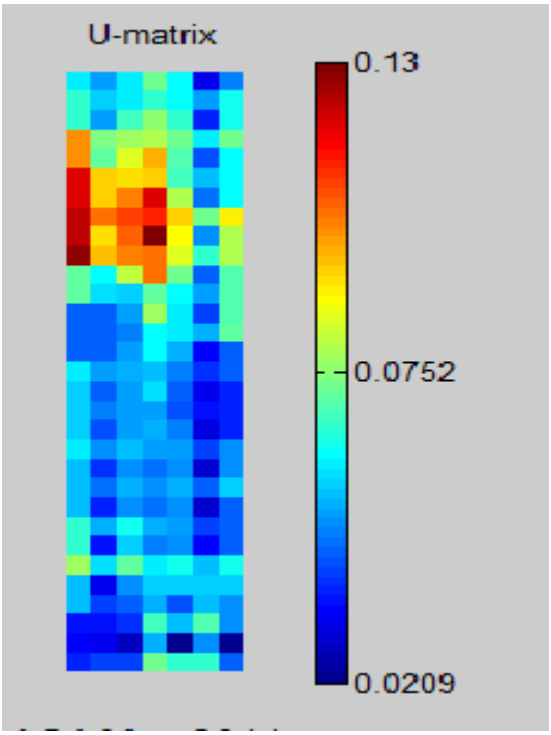
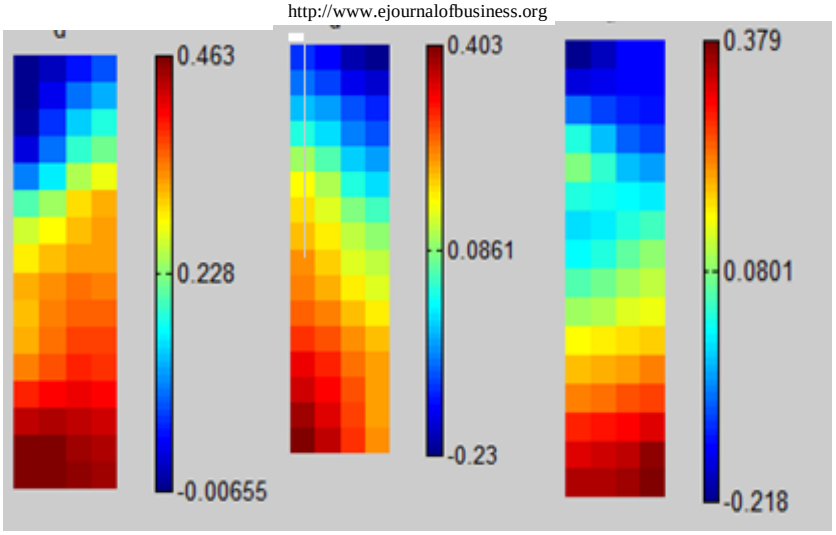



**Fig 2:** Map of the distances: U-matrix

The first result that can be obtained from the distance map is that the countries are characterized by a some kind homogeneity because the blue color is the most dominant on this map. The second result, in the lower left corner, shows a homogeneous area accurately characterizing the countries of the (OECD).

Finally, one can use the code vectors to generate a map of weight for each variable called "map of the variable"




Index of life expectancy index educated GDP Index

Examination of the first card on the variable of life expectancy shows a dominance of red color indicating that the majority of countries in the sample is the most important part of this variable.

The second map on the index of education is characterized by the dominance of the same color indicating that countries have the major share the same level of schooling.

The last card on the GDP index shows a dominance of blue and represents the level of countries with the largest GDP. Finally an overview shows that similar variables have the same projection implying that the variables are highly correlated.

## 7. CONCLUSION

Our project is part of the branch of artificial intelligence by applying neural network tool as an alternative interesting statistics using traditional measure country performance.

A first task was to present key indicators of human development and critical to address and end use a type of neural network on a sample of 163 countries and three of the HDI dimension that we do the ranking. Following an incremental algorithm is obtained which comprises card problems 48 classes (SOM), then a second step is to converse the map in three groups of countries. And third stage it is obvious to use the code vectors to illustrate the distances between squares on the card that called U-matrix. Finally, using the code vectors to generate a map of weights for each variable called "variable map." This map shows that the variables have the same projection which implies that the variables are highly correlated with each other.

## REFERENCES

[1] PNUD (Programme des Nations Unies), Note technique: Calcul des indices ans le Rapport sur le développement humain 2000.

[2] PNUD [2003]: “Rapport mondial sur le développement” Economica.

[3] PNUD [2004]: “Rapport mondial sur le développement” Economica. Poverty”, Oxford [4] Economic Papers, 40, pp. 505-522. Programme des Nations Unies pour le développement

[4] Bandura, R (2006), Une enquête sur les indices composites de mesure de performance du pays: 2006 Mise à jour, Programme des Nations Unies pour le développement Bureau d'études du développement.

[5] Dijkstra, A.G. (2000), “A Larger Pie through a Fair Share? Gender Equality and Economic Performance”, Working Paper 315, Institute of Social Studies, April 2000,

[6] Klasen, S. (1998), “Gender-related Indicators of Well-Being”, Wider Discussion Paper 2004/05, Helsinki, UNU-WIDER.

[7] Bardhan, K. and S. Klasen (1999), “UNDP’s Gender-Related Indices: A critical Review”, World Development, Vol. 27 (6), June, pp. 985-1010.

[8] OECD (2005): \Handbook on constructing composite indicators: methodology and user guide," OECD statistics working paper.

[9] Unicef, (Fonds des Nations Unies a), L'État de la population mondiale Enfants 2009: Santé maternelle et néonatale. New York: UNICEF, December 2008,

http://www.unicef.org/sowc09/docs/SOWC09-FullReport-EN.pdf.

[10] Nardo, M. AL., (2008), Handbook on Constructing Composite Indicators: Methodology And User Guide. Inspira, Italie, Organisation de Coopération et de Développement Economiques, Commission Européenne (JRC).

[11] Unesco, (2003), (Organisation des Nations Unies pour l'éducation, la science et la culture). Genre et Education pour tous: Le pari de l'égalité. Rapport de synthèse. Paris: UNESCO.

[12] Freudenberg, M. (2003), Composite Indicators of Country Performance: A Critical Assessment. OECD Science, Technology and Industry Working Papers, OECD Publishing.

[13] Bandura, R. (2005), Measuring Country Performance and State Behavior: A Survey of Composite Indices. New York, United Nations Development Programme.

[14] Smith, P., (2002), Developing Composite Indicators for Assessing Health System Efficiency. In: OECD, editor. Measuring Up: Improving Health System Performance in OECD Countries. Paris: OECD; p. 251-75.

[15] Francois, B.et Verleysen M. (1996),"Les réseaux de neurones artificiels", Presses Universitaires de France, Que Sais-je No 3042.

[16] Paul J., 1989. Modèles connexionnistes pour l'intelligence artificielle.

[17] CHtourou N, and FeKi R., (2009), "Nouvelle approche neuronale de construction d'Indicateurs Composites: C-FARm.

[18] Cottrell, M., Ibbou, S., Letremy, P., Rousset, P., (2003) :cartes auto-organisées pour l'analyse exploratoire de données et la visualisation, à paraitre dans le journal de la société française de statistique

[19] Ibbou, S., (1998): Classification, analyse des correspondances et méthodes neuronales, Thèse, Université Paris 1.