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# A multivariate approach in measuring socio-economic development of MENA countries

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ABSTRACT

Socio-economic development of countries is a complex problem that has been constantly elaborated upon over the past few decades. An analysis of a country's welfare cannot be limited to either economic or social factors; it must be determined by combining both of these aspects. As technology has advanced, those indicators crucial for describing this phenomenon have also changed. internet connectedness has been introduced as an indicator of socio-economic development. Furthermore, the development of a health system is essential for a country's development. The aim of this paper has been to present one synthesized indicator that is able to quantitatively demonstrate any country's welfare. The statistical I-distance method is thoroughly explained and has been applied to 22 countries. Crucial indicators for ranking are also elaborated.



## 1. Introduction

Socio-economic development is a concept that is often cited in contemporary literature, but approaches to its evaluation are scarce and unstructured at best. In the absence of well-defined measures of development, many researchers have utilized various indicators that have been rather arbitrarily chosen. In order to overcome these obstacles, the development of countries should be observed as a multi-dimensional concept.

The measure of a country's development is one of the most critical and highly debated issues in economic research. Different approaches have been applied and numerous indicators have been used in the process to do so, but the most common ranking of countries is done according to their GDP. Nevertheless, due to the fact that this method is unable to capture real inequalities among countries in terms of the different and sometimes contrasting dimensions of the well-being of their populations (Cracolici et al., 2010), it is only a partial measure of socio-economic development at best. Furthermore, small and medium enterprises are one of the main factors for national economic development, especially in developing countries where transitional processes are ever the more common (Gveroski et al., 2011). However, development is much more than economic growth; therefore, non-economic factors must be included in the analysis of a country's welfare.

One potential improvement is the Human Development Index (HDI) developed by The World Bank. Due to its simplicity, the HDI has been both remarkably successful and much criticized. The actual problem facing the Index is its small number of variables (merely three) and the high correlation among them. Therefore, meaningful inferences about the development of countries are hardly able to be drawn from the variations of this Index (Neumayer, 2001). The HDI has been described as "yet another redundant composite development indicator" (McGillivray, 1991) and "conceptually weak and empirically unsound" (Srinivasan, 1994). Attempts at improvement of the HDI have also been made, based on increasing the number of its variables; therein, the 2010 Human Development Report (HDR) introduced several changes in the HDI. Life expectancy remains the indicator used for health, while Gross National Income has replaced GDP as the measure used for living standards. The mean number of years of schooling and expected years of schooling now make up the dimension used for education. Furthermore, these four indicators represent the most basic elements of human development.

There have been numerous attempts for further improvement of HDI. One of them has been the Calibrated Human Development Index, which has a simpler structure and places greater weight on life expectancy and

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less on education. This variant of HDI is calculated to reflect peoples' revealed evaluations of education and the productivity of work (Lind, 2010). The CDI is similar to the Life Quality Index, both of which express the lifetime expected utility of consumption. Irrespective of any improvements, a country's HDI index only has a low level of sensitivity to changes from year to year. In contrast, the value of the CDI is more adaptable, as it takes changes in socio-economic development into account.

Certain researchers have elaborated on a development index that presents a more general concept of wellbeing; one which contains the basis of the HDI with its notions of social and economic progress. Three key areas can be drawn upon for its identification and determination: resources, infrastructure, and the environment (Natoli and Zuhair, 2011). These three dimensions form the basis of the resource–infrastructure-environment (RIE) index, which also includes analyzing ICT infrastructure. Over the last few decades, internet connectedness has been introduced as an indicator of socio-economic development and several papers have emphasized its importance (Dobrota et al., 2012; Gholami et al., 2010). Considering this, it is essential to note this indicator as being hugely important. Furthermore, the capacity of humans to process – otherwise known as IT literacy – can be considered a form of literacy for the 21st century (Leung, 2010). For instance, at present, it is impossible to plan any research without IT experts (Jeremic et al., 2011a), not to mention that the whole range of one's daily activities is dependent upon the internet and upon telecommunications (Jeremic et al., 2011b). Their upper fast broadband and numerous Wi-Fi access points characterize wealthy and powerful countries. Developing countries have a significantly lower level of IT development. Therein, it is necessary to provide wider connectivity that would improve overall information infrastructure and promote positive changes in socio-economic development (Madon, 2000). Still, even when internet access is readily available, its use is limited only to its basic possibilities.

Furthermore, developing countries cannot afford to ignore the socio-economic implications of the internet. This requires combining the analysis of social and economic indicators with a country's ICT dimension as to determine a country's development level. By using these three groups of indicators, countries would be able to be ranked according to their welfare. Concerning the fact that a great deal of research has emphasized the importance of a health system's development, this ranking could be even more accurate if health indicators were also to be included. In this respect, it has also been shown that use of ICT improves and ensures health, and a country's health system (Jovanovic-Milenkovic, 2011).

Most studies that rank countries based on their health status have used countries' life expectancies or mortality rates as an indicator of their health status (Nolte and McKee, 2008). These methods of ranking are not precisely accurate, as health is not a one-dimensional concept (Klomp and Haan, 2010). According to the WHO, health is "a state of complete physical, social and mental well-being and not merely the absence of disease or infirmity" (WHO, 2011). As such, health is considered a fundamental contributor to the welfare of every country. Some studies even rank countries by their development based on their health status (Jeremic et al., 2011c, 2012). Al-Lagilli et al. (2011) compared Middle East and North Africa (MENA) countries using indicators of the health of individuals and indicators of health services. In line with this, an analysis of health indicators is included in this research paper presented here.

As mentioned above, a country's welfare must be considered a multidimensional problem and numerous indicators that greatly influence the socio-economic development of countries must be included. In this research paper, the multivariate I-distance approach shall be conducted on selected indicators and numerous different variables will be synthesized into one value that shall thereafter represent a country's rank. Differences among the countries observed shall be evaluated and crucial indicators for their ranking emphasized.

Those problems present in carrying out such research are the availability and accuracy of data, especially for developing countries, which forces a selection of only those indicators whose values are available for all the countries observed. Only a few empirical studies have dealt with the MENA region (Abu-Bader and Abu-Qarn, 2008; Ben Naceur et al., 2008; Kar et al., 2011; Sassi and Goaied, 2013), largely due to lack of data (Andreano et al., 2013).

## 2. The I-distance method

In order to create a synthesized socio-economic development indicator, selected variables are incorporated into the analysis through use of the statistical I-distance method; one which has been utilized by Ivanovic (1973), Ivanovic and Fanchette (1973), Jeremic and Radojicic (2010), Jeremic et al. (2011d,e), and Radojicic et al. (2012), among others (Jovanovic et al., 2012; Knezevic et al., 2012).

I-distance is a metric distance in an n-dimensional space. Ivanovic had originally devised this method to rank countries according to their level of development based on several indicators. Many socio-economic development indicators were considered and the problem was how to use all of them in order to calculate a single synthetic indicator, which would thereafter represent the rank.

For a selected set of variables $X^T = (X_1, X_2, \ldots, X_k)$ chosen to characterize the entities, the I-distance between the two entities $e_r = (x_{1r}, x_{2r}, \ldots, x_{kr})$ and $e_s = (x_{1s}, x_{2s}, \ldots, x_{ks})$ is defined as

$$D(r,s) = \sum_{i=1}^{k} \frac{|d_i(r,s)|}{\sigma_i} \prod_{j=1}^{i-1} \left(1 - r_{ji.12\ldots j-1}\right)$$

where $d_i(r,s)$ is the distance between the values of variable $X_i$ for $e_r$ and $e_s$ e.g. the discriminate effect,

$$d_i(r,s) = x_{ir} - x_{is}, \quad i \in \{1, \ldots, k\}.$$

$\sigma_i$ the standard deviation of $X_i$, and $r_{ji.12\ldots j-1}$ is a partial coefficient of the correlation between $X_i$ and $X_j$, $(j < i)$ (Ivanovic, 1977).

The construction of the I-distance is iterative; it is calculated through the following steps:

- Calculate the value of the discriminate effect of the variable $X_1$, the most significant variable, that which provides the largest amount of information on the phenomena that is to be ranked,
- Add the value of the discriminate effect of $X_2$ which is not covered by $X_1$,
- Add the value of the discriminate effect of $X_3$ which is not covered by $X_1$ and $X_2$,
- Repeat the procedure for all variables.

Occasionally, it is not possible to achieve the same sign mark for all variables in all sets. As a result, a negative correlation coefficient and a negative coefficient of a partial correlation may occur. This makes the use of the square I-distance even more desirable. The square I-distance is given as

$$D^2(r,s) = \sum_{i=1}^{k} \frac{d_i^2(r,s)}{\sigma_i^2} \prod_{j=1}^{i-1} \left(1 - r_{ji.12\ldots j-1}^2\right).$$

The entity with the minimal value for each indicator or a fictive maximal or average values entity can be set up as the referent entity. The ranking of entities in the set is based on the calculated distance from the referent entity.

By using the calculated $I^2$-distance, the intensity of the observed phenomena and rank entities can be observed. When a correlation coefficient of each indicator with the $I^2$-distance is calculated with the ranking indicators of those values, the importance of each indicator can also be examined. As the correlation coefficient is stronger, the amount of information that is provided with the observed indicator is also greater, when the $p < 0.05$ indicator is significant. Otherwise, the indicator is not important in measuring the phenomena observed. One of two reasons might explain this: either this indicator is not relevant in measuring the phenomena observed, or its discriminate effect is already