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**GLOBALIZATION AND ITS DIMENSIONS**

**Abstract**

*In spite of its frequent use, globalization is an unclear term and there is large consensus on the fact that it is a result of dynamic interactions between different factors which are related to social awareness and to human progress. This paper<sup>2</sup> stems from the need to take a further step forward in the construction of a multidimensional framework combining different elementary dimensions of globalization in order to achieve an overall assessment of integration across countries. Starting from a definition of a sustainable globalization, we implement a k-means Clustering Algorithm to classify 71 countries into three groups by considering a data set of 14 selected variables as indicators of the main dimensions of a sustainable globalization in 2006.*

**JEL CLASSIFICATION:** E60, F0,F15,F43,O1

**KEYWORDS:** GLOBALIZATION, CLUSTER ANALYSIS, K-MEANS ALGORITHM, INTERNATIONAL RANKING.

**Introduction.**

There is a large consensus in the international community on the idea that studies on globalization require a careful analysis of numerous factors which are likely to affect development dynamics

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and not just economic integration.

This paper focuses on a selection of indicators and their assessment, as a preliminary step in building a composite index, it may be appropriate to proceed in three complementary steps: the selection of those variables which are representative of the phenomenon (*descriptive phase*); the aggregation of indicators, for each unit of analysis, across the domains of globalization (*aggregation phase*); and a logical conclusion starting from the results of the previous steps (*inference phase*) (Chiappero Martinetti 2005). The second phase received most of attention in our earlier works (Mattoscio, Castagna and Furia 2007, Furia and Castagna 2008), which focused on the need to overcome some controversial problems about the definition of the relative weight of each indicator in the overall index.

Nevertheless, our results and other empirical studies (Lockwood 2001, Heshmati 2006) have shown that the selection of relevant variables can affect the final rank more than the changes in weighting procedures (de Lombearde and Iapadre 2008). By aiming at improving the framework to measure country integration in the global community, this paper provides an evaluation of the suitability of data.

This will be done by implementing a k-means Clustering Algorithm to classify 71 countries into three groups taking into account a data set of 14 selected variables with reference to 2006.

The paper is organized as follows. First, we introduce the selection of indicators beginning with a critical review of literature about globalization and its role in the process of development. Section two presents the main results of the data analysis and section three concludes.

## **1. A critical review of Globalization literature**

There are few studies dealing with multidimensional frameworks of globalization and most of them concern criticisms and improvements (Andersen 2003, Lockwood 2004) of a pioneer work about this argument, namely *A.T. Kearney Foreign Policy Magazine Index* (Kearney A.T. 2001a, 2001b, 2006). This index is an assessment

of globalization as a result of economic, technological and political integration. However, there are lots of international organizations that use synthetic indexes to monitor global and complex phenomena which represent some different expressions of integration, like human development, global competitiveness, human rights and environment preservation (UNDP 1990-2007, WEF 2004 – 08, La Camera 2005; Wackernagel *et al.* 2004, www.rsf.org).

A multidimensional index is a continuous real valued function which summarize the information about a given distribution. Each distribution is represented by an  $n \times K$  matrix  $X = x_{ik} \in M(n)$ , where  $M(n)$  is the set of  $n \times d$  matrices with non negative elements,  $d$  stands for the set of  $D$  attributes ( $d = [1, 2, \dots, D]$ ) and  $i = [1, 2, \dots, n]$  is the set of  $n$  individuals (countries). Let  $x_i$  represent the row vector of attributes for the  $i$ -th individual and  $x_d$  the column vector of the  $d$ -th attribute among countries, the multidimensional index can be expressed by the following function  $I_n(X) = M(n) \rightarrow \mathfrak{R}$  (Lugo 2005).

It stands for a score representing the country position in the international ranking. In defining this function, decisions about the extent to which each attribute or dimension is assumed to contribute to the overall score had to be made. On one hand, the weight system is defined on the basis of subjective criteria, on the other hand factorial analysis methods may be useful to overcome individual biases. In these direction studies on the well being and poverty are drawn by making use of *fuzzy set theory* (Zadeh 1965; Dubois and Prade 1980; Basu 1987; Cerioli and Zani 1990; Cheli *et al.* 1994, 1995, 1999; Ok 1995; Chiappero Martinetti 1994, 1996, 2000, 2005; Balamoune *et al.* 2003, 2006, Bérenger and Verdier Chouchane 2007), which is based on the idea that "(...) a fuzzy set is a class with a continuum of grades of membership (...). Essentially, such a framework provides a natural way of dealing with problems in which the source of imprecision is the absence of sharply defined criteria of a class membership (...)" (Zedeh 1965, p. 339).

Dealing with the aggregation of information across dimensions for each units of analysis is just one of the problems inherent with a multidimensional framework. Ravallion (2004) argues that the selection of indicators is a crucial point in the debate between globalization

supporters and its discontents because the effects globalization generates on inequality may be affected by inherent value judgment of measurements and each opposing thesis may be sustained by data evidence. In these connection, over the last few years, a number of globalization measures concerning economic indicators have made a distinction between *prerequisites* and *outcomes*, i.e. reduction of transaction barriers and results of integration dynamics (Brahmbhatt 1998). The economic dimension, which was a crucial element of integration in the past centuries, becomes a means of diffusion of ideals able to affect growth dynamics followed by people's capabilities and improvement of their way of life. Economic integration has produced benefits to those countries which have expanded their commercial borders, especially where governments have played a central role in this process. The other face of the medal are the millions of people for whom globalization has been ran without control and whose living conditions are nowadays worsen off (Stiglitz 2002). The easy way by which people get in touch with other cultures, and the awareness of lifestyles and living conditions different from their own, shift the focus of debate about inequality and poverty from a local point of view to a global level analysis and the related issues begin to gain the same weight of national ones (Milanovic 2002). Studies about globalization effects on per capita income inequality between countries show a convergence evolution over the past two centuries attributable to complex mechanisms at various levels of income hierarchy of citizens all over the world. When *life expectancy at birth* is taken into account to examine *lifelong income* inequality in order to explain this kind of dynamics the result is a current divergence in living conditions which have reached levels like two centuries ago (Bourguignon and Morrison 2002). Ben-David (1993) provides evidence that income convergence among specific industrialized<sup>3</sup> countries may be related to movement toward free trade: timing of trade reform coincides with periods of reduction in income disparity, convergence which was not apparent among the same countries

<sup>3</sup> France, West Germany, Belgium, The Netherlands, Luxemburg and Italy during the transition period which lasted from 1959 until 1968 (Ben-David 1993, p. 654).

prior their liberalization nor among other industrialized countries. Focusing on countries' comparative advantage and its implication for trade, Venables (2003) yields predictions about the formation of custom unions leading to the conclusion that agreements between low income countries may lead to a divergence of income levels, and to the opposite direction an integration between high income members. Differences in inequality across countries in their starting point are crucial in the ongoing debate whether the openness to foreign trade and investment rises the living standards for the poor in developing countries. Starting point conditions are central in explaining whether poor countries are able or not to take up the opportunities provided by an expanding economy. In his work, Ravallion (2001) argues that there are lots of factors, like location, social exclusion, exposure to insured risk and not just endowments of physical and human capital, which need more attention to determine why people all over the world show different performances in meeting globalization. Different long run growth paths, therefore, have produced a divergence between rich and poor countries because idiosyncratic characteristics regarding not just their distance from the technological frontier but also desegregation of social and institutional milieu may conduce to an implosion of the system which may lose growth opportunities (Pritchett 1997). Olson (1996) has come to similar conclusions drawing on the fact that a subset of the lower income countries, those countries who have adopted relatively good economic policies along with solid institutions, are growing faster than higher income countries. He also tries to explain the large differences in per capita income across countries by claiming that this divergence is due to differences in attaining their potentials, which are related to the quality of institutions and economic policies and not to differences in factors of production<sup>4</sup>. Stiglitz (2002) advocates that the role of globalization in the development process is not clear and that a number of elements which are the basis of democracy, such as poor people interest,

<sup>4</sup>“(...) access to the world's stock of productive knowledge or to its capital markets. (...) ratio of population to land or natural resources. or (...) the quality of marketable human capital or personal culture.” (Olson 1996, p.19).

environment preservation, free trade and human rights, has to be taken into account to reach its *beneficial potentials*.

With that caveat in mind, in the present work, the following four elementary globalization domains underlining its sustainable features are selected: economic integration, technological potential, social awareness, environment sustainability. Each of them has been described by selected variables which are showed in the tab 1. With reference to our previous works some changes have been made. The economic dimension has been split in two components, one for the *prerequisites* and the other for the *outcomes* of globalization. Income payments and receipts as percentage of GDP has been eliminated from the *outcomes* and there are three new indicators for the former component: a composite measure of the absence of tariff and non-tariff barriers (*Trade freedom*<sup>5</sup>) that affect imports and exports of goods and services, data on the *Investment freedom* which scrutinizes a country's overall investment climate and, as a proxy of social and institutional background, data on extensive perceptions of corruption within countries<sup>6</sup>. Secure Internet servers (per 1 million people) are removed from the technological dimension because of its high correlation with Internet users. Workers' remittances and compensation of employees, received as percentage of GDP, has been substituted by migration flows as percentage of population to analyze the dimension of social awareness. The group of variables representing environment sustainability<sup>7</sup> has been replaced by the ecological *deficit (or reserve)*, as a measure of the reduction of the resources on which human life and biodiversity depend and its trade. The next section will present a data application.

<sup>5</sup> The Trade freedom score is based on the trade-weighted average tariff rate and non-tariff barriers. (...) The weighted average tariff uses weights for each tariff based on the share of imports for each good. (...) An NTB penalty is assigned (...) according to a country's trade policy regime using both qualitative and quantitative information (2008 Index of economic freedom, p. 442).

<sup>6</sup> The CPI is a composite index, making use diverse sampling frames and different methodologies (2008 Index of economic freedom, p. 450).

<sup>7</sup> Marine and Nationally protected areas as % of surface area, CO2 emissions (metric tons per capita), forest as % of total land area.

## 2. Globalization indicators: some stylized facts.

This section presents some stylized facts concerning globalization as a main result of a cluster analysis based on  $k$ -means algorithm used to investigate the role of 14 variables in the description of integration across countries. The aim of  $k$ -means algorithm (Hartigan 1975, Hartigan and Wong 1979) is to divide the selected  $71(n)$  countries in  $14(d)$  domains into three ( $k$ ) clusters. The general procedure is to search for a  $k$ -partition by moving the objects from a cluster to another, with the purpose to minimize the variance of elements within the cluster and to maximize the variance of elements outside the clusters.

Let  $X = \{x_1, \dots, x_n\}$  and  $c_1, \dots, c_k$  be respectively the set of  $n$  points and a set of  $k$  random centers in  $\mathcal{R}^d$ . The algorithm partitions these points into clusters with an loop that will converge as follows:

1. For each  $i \in \{1, \dots, k\}$ , assign to the cluster  $C_i$  the points in  $X$  that are closer to  $c_i$  than they are to  $c_j$  for all  $j \neq i$ .
2. For each  $i \in \{1, \dots, k\}$  set  $c_i$  to be the center of mass of all points in each  $C_i$ :  $c_i = \frac{1}{|C_i|} \sum_{x_j \in C_i} x_j$ .
3. Repeat the assignment steps and update step until the assignment do not change.

The implementation yielded three clusters, which are shown in tab 2. Fig 1 is useful in going over the differences in means between groups and their performances.

There are no doubts in attributing the role of leaders in the global challenge to Hong Kong and Singapore. Most of the analyzed European countries demonstrate good levels of international integration, as well as North America and Pacific high income countries do. The most populous group is cluster 1, which presents performances marginalized relative to the rest of the world (cfr. Fig 1).

*Globalization and its dimension*

In 2006 both members of cluster 3 presented zero percent average tariff rate. With respect to investment climate there are similar treatments between foreign and domestic capital, with a strong government position in encouraging foreign investment. In the same manner, perceived corruption cannot be considered as an obstacle to business transitions. In this connection, an high openness to trade and high foreign direct investment rate characterize this group as the best performer on economic integration.

Economic performance for cluster 2 requires a different judgment on its components. On one hand it presents good *prerequisites* of the integration process, due to low levels of corruption, few deterrents to investments, and a relatively high trade freedom. The EU members, which have an high incidence in this group, share a common policy on trade, including subsidies on agricultural and manufacturing, imports restriction for some goods and services, and some services sectors present access market restrictions. The U.S. enterprises are legally equal to foreign ones, and the U.S. were the first in the world to pass an anti-bribery law.

**Tab. 1: Selected Indicators of globalization**

| Discussion                 | Indicators | Data  |
|----------------------------|------------|---|
| Economic Integration       | Trade      | Trade % of GDP  |
|                            | tar        | FDI, net outflows (billion\$) of GDP*                                       |
|                            | TR-NTR     | Tariff and non-tariff barriers*   |
|                            | Investment | Investment flows**  |
|                            | Corruption | Corruption Perception Index 2006  |
| Technological potential    | Internet   | Internet users (per 100 people)   |
|                            | Hi-tech    | High-technology exports as % of manufactured exports                        |
|                            | R&D        | R&D expenditure as % of GDP   |
|                            | ICI        | ICI expenditure as % of GDP   |
| Social awareness           | Tourism    | International tourism (number of arrivals plus arrivals as % of population) |
|                            | Call       | International voice (inbound and in-out) per capita                         |
|                            | Mig        | International migration as % of population                                  |
|                            | Life       | Life expectancy at birth (years)  |
| Environment sustainability | Ec         | Ecological deficit a reserve(global hectar)**                               |

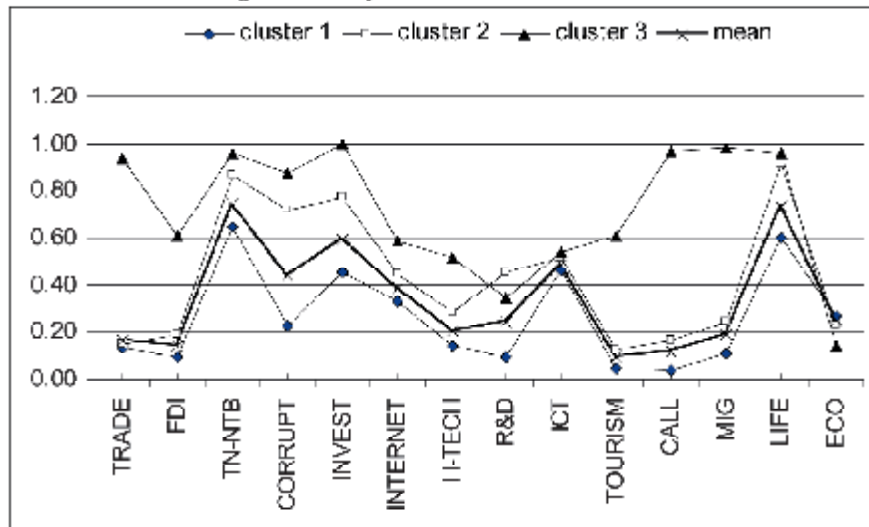
Data source: WDI online- \*Heritage Foundation - \*\*Ecological footprint

**Tab. 2: Countries grouped in clusters 2007**

|   |
|---|
| <p>Cluster 1: Argentina, Bangladesh, Botswana, Brazil, Bulgaria, China, Colombia, Croatia, Egypt Arab Rep., Ghana, Greece, India, Indonesia, Jordan, Kenya, Latvia, Lithuania, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Panama, Peru, Philippines, Poland, Romania, Russian Federation, Saudi Arabia, Senegal, Slovak Rep., South Africa, Sri Lanka, Tanzania, Thailand, Tunisia, Turkey, Uganda, Ukraine, Venezuela, Vietnam.</p> |
| <p>Cluster 2: Australia, Austria, Belgium, Canada, Chile, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Korea Rep., Iceland, Ireland, Israel, Japan, Portugal, New Zealand, Norway, Spain, Sweden, Slovenia, Switzerland, United Kingdom, United States.</p>  |
| <p>Cluster 3: Hong Kong, Singapore.</p>   |

Source: authors representation.

**Fig.2: means plot for clusters**



Source: authors representation

Chile is the only Latin American country belonging to this cluster thanks to its openness to trade due to free trade agreements, its macroeconomic stability and an encouraging investment climate. On the other hand, this cluster registers a marked difference from Hong Kong and Singapore on *outcomes* of the integration process.

The analysis shows differences across countries in technological potential. The selected variables may be considered good indicators, as they are a fair representation of different achievements in global competitiveness. This dimension is representative of a

*digital divide* between the North and the South of the world, where developed countries score higher than DC's. Cluster 3 is better performing than the others; nevertheless, it falls down for *R&D expenditure* as a percentage of GDP and its *Ict expenditures* are comparable with the other units of analysis.

High income countries, which are grouped in cluster 2 and 3, present excellent quality of life, while low income countries incidence in the first cluster puts its *expectancy life at birth* mean down as a consequence of starvation, illness, lack of freshwater and generalized poor standards of living. Social indicators, as a whole, may be considered good markers since they catch the variances among groups. Environment sustainability presents very close performances for the three groups but with a reversal order in the achievements if referred to other dimensions. Ecological deficit, as a difference between *biocapacity* and *ecological footprint*, stands as a unique indicator of this domain. In this connection, the analysis proves that industrialized countries are importing biocapacity through trade.

### **3. Concluding remarks**

The analysis has documented some stylized facts on globalization in order to take a further step forward in implementing a multidimensional framework as an overall assessment of the level of integration across countries. This work has been helpful in justifying the selection of relevant variables through a critical review of some of the most important studies on this topic and its effects on growth. In addition, the cluster application has allowed us to evaluate the suitability of data to understand the implications of the methodological choices during subsequent phases of the construction of an overall index of globalization.

The paper presents some innovation with reference to the author's previous works. Economic integration, which is the historical core of globalization, has been split in two components which stand for drivers and results of the process of globalization, with the introduction of variables representative of trade freedom, invest-

ment climate and perceived corruption. In a view of a sustainable process, the ecological deficit has been taken into account for each country, representing the environmental impact of trade.

The data application shows that Western countries seem to be performers in a play where the market may produce different effects with respect to raw materials distribution, human capital characteristics and institutional performances. The rest of the world needs to improve its potential to meet the global challenge.

This is a result that is in agreement with policymakers and social activists who claim that globalization is not a result of explicit political choices, with a specific reference to poor economies. Nevertheless, the selection of variables in the descriptive phase may involve a *value judgment* which affects the measures. It is necessary to go deeper in the analysis of winners and losers from globalization not just by dealing with the aggregation of information across dimensions, but also introducing dominance criteria to be able to define under which conditions a multivariate distribution is more equal than another. This will be the next challenge to be met.

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*Globalization and its dimension*

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