

Democracy and Economic Development: a Fuzzy Classification Approach

**Ana Margarida Oliveira Brochado
and
Francisco Vitorino Martins**

U.PORTO

FEP FACULDADE DE ECONOMIA
UNIVERSIDADE DO PORTO

DEMOCRACY AND ECONOMIC DEVELOPMENT: A FUZZY CLASSIFICATION
APPROACH

Ana Oliveira-Brochado

(abrochado@fep.up.pt)

Francisco Vitorino Martins

(vmartins@fep.up.pt)

Faculdade de Economia, Universidade do Porto
Rua Dr. Roberto Frias, 4200-464 Porto, Portugal.

ABSTRACT

The aim of this work is to (1) analyse whether countries differ on political indicators (democracy, rule of law, government effectiveness and corruption) and (2) study whether countries with different political profiles are associated with different levels of economic, human development and gender-related development indicators. Using a fuzzy classification approach (*fuzzy k-means algorithm*), we propose a typology of 124 countries based on 10 political variables. Six segments are identified; these political groups implicate the access to different levels of economic and human development. In this study evidence of a positive but not perfect relationship between democracy and economic and human development is observed, thus presenting new insights for the understanding of the heterogeneity of behaviors relatively to political indicators.

Keywords: Democracy, Economic Development, Fuzzy k-means.

JEL-Codes: C21;C61; O10; O57

1. Introduction

During the 20th century we witnessed a significant expansion in the number of sovereign states and the number of governments democratically elected. In fact, “[i]n a very real sense, the 20th century has become the ‘democratic century’” (Freedom House, 2002: 1).

In 1900 no country could be classified as an electoral democracy by universal suffrage, with multiparty elections. In the beginning of the 20th century, 25 countries are classified by Freedom House (1999) as having 'Restricted Democratic Practices' (Table 1), i.e., regimes where the dominant party controlled civil laws or the freedom of press or where the right to vote was denied women, ethnic segments, racial minorities, or the impoverished. Democracy, as a national political system, won great acceptance in the last half of the last century, motivated by the defeat of the Nazi totalitarianism, the process of post war decolonization and the reconstruction of Europe and of Japan (Freedom House, 2002). The percentage of population that lives under electoral governments with universal suffrage increased from 31% in 1950 up to 58,3% in the year 2000, and 98 countries took their steps towards democracy; these movements increased since the 70s - denominated as the ‘*democratic age*’ (Freedom House, 2002: 2). In spite of this, nowadays some countries still live under authoritarian regimes and some new democratic nations didn't get stabilization and therefore retreated in the political regime; other countries that took steps towards democracy are still in a semi-democratic phase. As for the countries considered democratic, in the objective sense of the existence of free, competitive elections and electoral participation, these possess different results in terms of political organization, civil freedom, political rights, freedom of the press, voice and accountability, political stability and the lack of violence, law and order, rules of law, government effectiveness and graft (PNUD, 2002).

In this context, heterogeneity of behaviors in relation to political factors should be systematized, enabling the identification of countries with similar profiles.

Table 1: Classification of the countries – political regime

	Sovereign States and Colonial Units			Population (millions)		
	2000	1950	1900	2000	1950	1900
Democracy	120	22	0	3439,4	743,2	0
Restricted Democratic Practice	16	21	25	297,6	285,9	206,6
Constitutional Monarchy	0	9	19	0	77,9	299,3
Traditional Monarchy	10	4	6	58,2	16,4	22,5
Absolute Monarchy	0	2	5	0	12,5	610
Authoritarian Regime	39	10	0	1967,7	122	0
Totalitarian Regime	5	12	0	141,9	816,7	0
Colonial Dependency	0	43	55	0	118,4	503
Protectorate	2	31	20	4,8	203,3	26,5
<i>Total</i>	<i>192</i>	<i>154</i>	<i>130</i>	<i>5909,6</i>	<i>2396,3</i>	<i>1668</i>

Source: Freedom House (2002: 3)

Democracy can be defined, according to the United Nations proposal, as a system of institutionalized procedures for open and competitive political participation, the main government leaders' election and substantial limits to the leaders' powers (PNUD, 2002). However the word democracy, in Greek, means, “ruled by the people”, summarizing a governing approach for human development, expressing the idea that people are in first place. In this work we aim at investigating two interrelated subjects: 1) to what extent countries stand out due to structural political conditions, namely democratization, citizens' participation and transparency, government effectiveness and legislation; 2) whether countries associated to different typologies of political variables are associated to different levels of economic and human development.

The paper is structured as follows. In Section 2 we survey some studies on the concepts of democracy and economic development and the relationship between these two variables. Next (Section 3) methodological options, concerning variables and classification method, are presented. In Section 4 we propose the classification of 124¹ countries based on 10 political variables using a fuzzy classification approach, having been developed for this purpose a computer program that includes the *fuzzy k-means* method (FKM). In Section 5 we verify whether the formed segments are reflected in the economic indicator (Gross Disposable Income *per capita*) and in the development well to being indicators (HDI - Human

¹ All the countries that had statistical data available for all variables were selected.

Development Index and GDI- Gender-Related Development Index), by using multiple lineal regression models. Finally, we present a conclusive synthesis.

2. Economic development and democracy: an overview

Why is a positive relationship between democracy and economic development expected? Do richer countries have larger probability of being democratic? Is democracy a prerequisite for economic development? Or is economic development a prerequisite for democracy? The study of the relationship between Democracy and Development is widely discussed and a multidisciplinary theme (Ramaswamy and Cason, 2003) - the literature in the political science and economy area offers a great variety of answers to these questions.

Many investigators, both in theoretical and empirical terms, support the hypothesis of the existence of a positive relationship between democracy and development. Lipset's (1959) pioneering work has inspired a great number of empirical studies about the relationship between Democracy and Development. The author argued that in a country with a higher development rate the population possesses larger probability of believing in the democratic values that will support a democratic system. According to the author, only in a society where there is well-being can intelligent participation in political subjects be verified – “the mass of the population could intelligently participate in politics and could develop the self-restraint necessary to avoid succumbing to the appeals of irresponsible demagogues. The society divided between the large impoverished mass and small favored elite would result either in oligarchy (...) or in tyranny” (Lipset, 1959: 75).

Studies on the relationship between democracy and development reveal the existence of a positive relationship between the two variables (e.g. Cutright, 1963; Neubauer, 1967; Olsen, 1968; Jackman, 1973; Bollen, 1979, 1980, 1983; Bollen and Jackman, 1985; Burkhart and Lewis-Beck, 1994), in spite of the differences in the methodological options. The differences in the studies can be grouped into six topics: measurement of democracy; measurement of development and other variables; countries in the study (sample); period of study; nature of the quantitative methods used; type of relationship tested (lineal *versus* non-linear).

Measurement of democracy

Although all the studies use the same theoretical concept of democracy, its quantification form varies, from the definition as a non-metric variable (through categories) (e.g., Gasiorowski, 1996; Przeworski and Limongi, 1997) to the use of indexes developed or compiled by international organizations (Bollen and Paxson, 2000).

In this study several subjective indicators are used that intend to evaluate the extension of Democracy and Civil and Political laws of the various countries. In relation to previous studies, variables that are not limited to the concept of Democracy are considered, emphasizing the Evaluation of the Government (Table 2).

Measurement of development

The empirical tests of the relationship between democracy and development have been developing according to two lines. The first approach, considered by Lipset (1959), analyzes the relationship between development and democracy by crossing the levels of development and democracy. In this investigation line, there are studies that use either monetary indicators of economic development, like the Gross Disposable Income per capita (e.g., Bollen and Jackman, 1985; Lipset *et al.*, 2001; Przeworski and Limongi, 1997), or a social-economic development definition, a reflex of the universal needs or characteristics, usually recognized, of development such as: high income levels, high human capital, high life expectancy at birth (e.g., Cutright, 1963; Olsen, 1968; Diamond, 1992). These authors emphasize the fact that monetary indicators, like the Gross Disposable Income per capita, do not reflect the standard of living of the population in general and they potentially underestimate the development in developing countries where a lot of the economic activity takes place in the informal economy. Other explanatory variables have been proposed, such as urbanization, urban wages/salaries and the consumption of energy (Bernhagem, 2001). Some authors explore alternative propositions, including variables such as cultural pluralism (Bollen and Jackman, 1985), religious groups (Bollen 1979, 1983), military expenses (Lipset *et al.*, 1991) and Center-Periphery relationships (Doorenspleet, 2001).

Recent studies question and test the relationship between democracy and economic development in a dynamic perspective, choosing the growth rate of the Gross Disposable Income per capita as an indicator of economic growth (for instance, Barro 1991, 1996; Perotti, 1996; Tavares and Wacziarg, 2001; Shen, 2002). These studies focus on the elaboration of explanatory models of economic growth, and therefore Democracy is an explanatory variable, among others, such as the stock of human capital, the degree of openness to the exterior, or public consumption.

This study is framed into the first investigation line, i.e. the importance of Democracy (or of other regimes) for Economic Development (conjugating economic development, human development and gender-related development indicators).

Sample of the countries in the study

Studies that consider the relationship between Democracy and Development differ in relation to the segment of countries selected; for instance, Olsen (1968) and Vanhannen (1997) consider all independent countries; Cutright (1963) excludes the African countries from the analysis; Jackman (1973) looks for the non-communist regimes, Jackman (1973) and Bernhagen (2001) just include Latin American countries, and recent studies seek a larger coverage (Arat, 1991; Gasiorowski, 1996; Doorenspleet, 2000). The present study follows these later, trying to maximize the number of countries to include in the sample. The sole restriction is the availability of data for the selected variables.

Period of study

The studies also refer to different moments in time; Bollen (1980, 1983), Bollen and Jackman (1985) and Copedge and Reinecke 1991 are some cases of cross-section studies. Arat (1991) selects the 1948-1984 period, Gasiorowski (1996) Alvarez *et al.*, (1996) include observations since 1950 and Vanhanen (1997) goes back to 1850. Some of these studies allow us to formulate the hypothesis that the relationship pattern between democracy and development varies throughout time and between 'democratization waves' (Huntington, 1991, Diamond, 1992); for instance, Doorenspleet (2000) concludes that the relationship between democracy and development can be separated into the period before the Cold War and the period after. The present study is cross-section, with information since the year 2002.

Nature of the statistical methods used

Due to the democracy measurement scale and the type of relationship to be tested, the use of cross-tables (Coleman 1960; Huntington 1991), the analysis of correlations (Cutright, 1963; Neubauer, 1967; Olsen, 1968), the analysis of multiple regression (Jackman, 1973; Bollen and Jackan, 1985; Lipset, *et al.*, 1991) and logistic regression models (Gasiorowski, 1996; Lipset *et al.*, 1991; Doorenspleet, 2000) can be verified.

In the proposed study, the methods to use should incorporate the multiple explanatory factors - Democracy, Government Effectiveness, Rule of Law and Corruption - and should consider the diversity of political segments where the countries are framed. Therefore, having the variables selected a multivariate character, and considering the heterogeneity as a central requirement, we propose the use of the cluster analysis in the construction of a typology of segments of countries. In a second phase, regression analysis is used with the purpose of

verifying if the different formed segments exhibit different behaviors in relation to the economic and human development variables.

Type of linear or non-linear relationship

Since Lipset's (1959) initial work, there has been a lot of debate on the existing relationship between development and the presence of democracy and of it being or not linear. Przeworski and Limondi (1997) refer that the relationship is non-linear and there is a minimum threshold of development from which the probability of democracy being reached and maintained increases. The authors emphasize that results are influenced by the measurement used to quantify democracy (metric or non-metric). The used methodology - constitution of groups of countries - allows the estimate of different proximities inter segments and the definition of non-linear hierarchies for the segments.

In the following section a thorough description of the methodology used in the present study is presented.

3. Variables and classification methods

In the segmentation that involves countries as an analysis unit, just as in any other segmentation process, two technical options are necessary: the choice of the segmentation base – the variables used, and a classification method option.

In the present work 10 subjective indicators are used for the political factors (PNUD, 2002) to classify 124 countries based on the fuzzy classification method *fuzzy k-means*.

3.1 Political factors

The democracy can be defined as a system of institutionalized procedures for an open and competitive political participation, the election of the main government's leaders and substantial limits to the leaders' powers (PNUD, 2002). Considering that a truly democratic government requests the citizens' widespread and substantive participation and the responsibility of the people that have the power, the use of subjective indicators, based on the specialists' opinions on the degree of democracy of a country, constitutes the most appropriate approach for the reception of this qualitative concept for each country (in spite of the possible bias resulting of knowledge differences, opinion and the specialists' perception). In this work

the data used is the one published in the United Nations Report (PNUD, 2002), which comes from several sources (Appendix).²

Thus, the classification is made based on a segmentation base of 10 variables, defined in evaluation scales that intend to capture the extension of democracy, governmental effectiveness and rule of law and corruption level (Table 2). It is important to emphasize that the variables civil freedom, political rights and freedom of the press are codified contrarily to the remaining ones, therefore its increase represents a more negative classification.

Table 2: Political factors: characterization of the segmentation variables

Indicator	Variable	Source	Range	Average	Standard-deviation	Maximum	Minimum
Democracy	Political score	IV dataset University of Maryland	-10 (less democratic) to 10 (most democratic)	4,33	6,29	10	-10
	Civil liberties	Freedom House	1-2,5 free; 3-5 partly free; 6-7 not free	3,44	1,69	7	1
	Political rights	Freedom House	1-2,5 free; 3-5 partly free; 6-7 not free	3,21	2,12	7	1
	Freedom press	Freedom House	0-30 free; 31-60 partly free; 61-100 not free	43,83	23,84	100	5
	Voice and accountability	World Bank Governance Indicators Dataset	-2,5 (worst) to 2,5 (better)	0,18	0,92	1,73	-1,93
Rule of aw and government effectiveness	Political stability and lack of violence	World Bank	-2,5 (worst) a 2,5 (better)	0,13	0,86	1,61	-2,01
	Law and order	International County Risk Guide	0 (worst) a 6 (better)	3,83	1,41	6	0,50
	Rule of law	World Bank Governance Indicators Dataset	-2,5 (worst) a 2,5 (better)	0,12	0,94	1,91	-1,50
	Government effectiveness	World Bank Governance Indicators Dataset	-2,5 (worst) a 2,5 (better)	0,10	0,93	2,16	-1,58
Corruption	Graft	World Bank Governance Indicators Dataset	-2,5 (worst) a 2,5 (better)	0,09	0,97	2,25	-1,24

In the present study a fuzzy classification method is used to identify the component countries of each segment (it is assumed that a country can belong to more than a segment, thus being calculated the respective probabilities of belonging).

3.2. Fuzzy k-means

The governmental classification of the 124 countries is based on a fuzzy classification approach – the *Fuzzy k-Means* (FKM) proposed by Bezdek (1973, 1974) and Dunn (1974). The model and its associated algorithm were developed on the Statistical package, according to the Statistical Basic programming language.

² Polity IV Database (Center for International Development and Conflict Management at the University of Maryland); Freedom House and Indexes from the World Bank.

The *Fuzzy- k-means* model is a fuzzy version of the non-overlapping partition model *hard k-means* or *hard ISODATA algorithm*, and it is based on the generalized fuzzy variance criterion:

$$J_{FKM} = \sum_{n=1}^N \sum_{s=1}^S p_{ns}^r d_{ns}^2 \quad (1)$$

where $p_{ns} \in [0,1]$, $\sum_{s=1}^S p_{ns} = 1$ represents the membership degree of object n ($1 \leq n \leq N$) in group s ($1 \leq s \leq S$). The extension is made by introducing a weight r , named '*fuzziness factor*', which characterizes the family $\{J_{FKM} | 1 \leq r < \infty\}$. If $r=1$, the obtained solution would be a non-overlapping partition. If r tends to the infiniteness then the membership degree values to each class become close to $1/S$. The fuzzy partition degree grows with r , and 2 is the most used value (Dunn's original version (1974)). From (1) we can infer that J_{FKM} is a function of d_{ns}^2 , a measurement of the error incurred on the representation of the object n by the centroid v_s of each group s :

$$d_{ns}^2 = \|\mathbf{x}_n - \mathbf{v}_s\|_A^2 = (\mathbf{x}_n - \mathbf{v}_s)^T \mathbf{A} (\mathbf{x}_n - \mathbf{v}_s) \quad (2)$$

Three choices are possible for matrix \mathbf{A} , which lead to the Euclidean, Diagonal and Mahalanobis distance.

Thus, the FKM model constitutes a nonlinear optimization model, which is synthesized in Table 3.

Table 3: Fuzzy k-means model

$$\begin{array}{l} \min J_{FKM}(\mathbf{P}, \mathbf{v}, \mathbf{A}) = \min \left\{ \sum_{n=1}^N \sum_{s=1}^S (p_{ns})^r \|\mathbf{x}_n - \mathbf{v}_s\|_A^2 \right\} \\ \text{su}j. \text{ a :} \\ \sum_{s=1}^S p_{ns} = 1 \\ p_{ns} \geq 0 \end{array}$$

The optimal strategy to minimize the J_{FKM} function, subdivided into classical stages – Initialization (**1** and **2**), Iteration (**3** and **4**) and Stop Criterion (**5**) - is synthesized in Table 4.

Table 4: Fuzzy k-means algorithm

(1) Determining an initial fuzzy partition matrix, selecting the distance measure and parameter r fixation.

(2) Calculation of the group centroids using the expression:

$$v_{sk} = \frac{\sum_{n=1}^N p_{ns}^r x_{nk}}{\sum_{n=1}^N p_{ns}^r} \quad (3)$$

where x_{nk} represents the value of variable k ($1 \leq k \leq K$) for object n ($1 \leq n \leq N$).

(3) Construction of a new fuzzy partition matrix (determination of the new membership values):

(3.1) if an object n keeps a distance 0 from the centre of class s , the value of p_{ns} is equal to 1 and the membership values of n towards the remaining classes is equal to 0;

(3.2) if all the distances from an object to the centroids of the S groups are above 0, the membership values are determined by:

$$p_{ns} = \left[\sum_{t=1}^S (d_{ns}/d_{nt})^{2/r-1} \right]^{-1} \quad (4)$$

(4) Calculation of the group centroids associated to the partition determined in 3 from expression (3).

(5) Repetition of steps 3 and 4 until the stop criterion is reached.

Source: adapted from Dunn (1974: 37)

4. Political classification

4.1. Determining of the number of segments

For the selection of the number of existent groups in the data, the validation measures used are the ones proposed by Riviera *et al.* (1990) - '*Minimum Hard Tendency*' and '*Mean Hard Tendency*'.³ These are robust measures, totally independent from the number of segments and

³ For each country the quotient between its two highest membership degrees (r_s) is defined; this quotient ranges between 0 (non-overlapping membership of country n) and 1 (completely fuzzy membership). Additionally, a hard partition matrix is defined based on the highest membership values in the fuzzy membership partition matrix. The set of countries belonging to

of the size of the data being classified and they don't exhibit the undesirable tendency to underestimate of the number of segments revealed by other measures published in the literature. The search of the best partition of the clustering suggests the maximization of these functions.⁴ This way a 6-class segment is chosen (Table 5).

Table 5: Selection of the number of segments

Criteria	Number of Political Groups					
	2	3	4	5	6	7
Number of iterations	12	20	31	46	27	didn't converge
Minimum Hard Tendency	0,719	0,652	1,237	0,786	1,386	
Mean Hard Tendency	0,647	0,492	0,629	0,540	0,644	

4.2. Evaluation of the heterogeneity in the government

We now proceed to the classification using the fuzzy classification algorithm *fuzzy k-means*. The derivation of a non-overlapping partition matrix from the matrix of fuzzy partition allows obtaining six relatively balanced segments (Segment 1-18; Segment 2-23; Segment 3-20; Segment 4-18; Segment 5-24; Segment 6-21) in terms of dimensions (number of countries). The result of the non-parametric *Kruskall-Wallis* test for the difference between segment centroids reveals that all the variables present different mean patterns (statistically significant) in the obtained result (Table 6).

the S non-overlapping segments is defined as: $Y_s = \{x_n : p_{ns} = \max_{1 \leq r \leq S} (p_{nr})\}$. The hard tendency of each segment s (T_s) is defined as the average of all quotients r_n of countries classified in non-overlapping cluster s . Mean hard tendency is defined as $1/S \sum_{s=1}^S -\log_{10}(T_s)$ and Minimum hard tendency is calculated through $\max_{1 \leq s \leq S} [-\log_{10}(T_s)]$.

⁴Notice that the fuzzy partition obtained tends towards to be non-overlapping as Minimum hard tendency and Mean hard tendency values increase.

Table 6: Results of the political grouping

	Centroid										
	Number of contries	Political score	Civil liberties	Political rights	Freedom press	Voice & accountability	Political stability & lack of violence	Law and order	Rule of law	Government effectiveness	Graft
Cluster 1	18	-3,78	5,39	6,06	71,44	-1,06	-0,96	2,61	-0,93	-0,87	-0,77
Cluster 2	23	7,52	2,96	2,26	36,04	0,27	0,07	2,80	-0,35	-0,31	-0,42
Cluster 3	20	4,95	4,20	3,80	55,35	-0,31	-0,74	3,00	-0,67	-0,76	-0,70
Cluster 4	18	-5,17	5,44	6,00	71,83	-0,64	0,43	4,56	0,31	0,30	0,06
Cluster 5	24	9,04	2,17	1,33	26,54	0,91	0,52	4,29	0,60	0,53	0,53
Cluster 6	21	9,95	1,29	1,00	13,48	1,45	1,29	5,62	1,60	1,55	1,70
Kruskal-Wallis		106,0	103,5	106,5	84,3	100,7	72,8	62,2	84,7	91,0	66,4
Significance value		0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Segment 6 includes the 21 countries that occupy the best positions in all indicators: they present the most democratic systems of the sample and register the highest degree of respect for civil and political laws; they possess the institutional factors (laws and institutions) necessary for an effective democratic participation. These countries are the leaders of democracy and have one of the largest governmental effectiveness, thus can be classified as *Political Vanguard*.

Segment 5 gathers the countries that present close profiles of the first Segment, but less effective on the democratic and of government effectiveness level. They occupy the second place in all 10 variables, of political nature, considered. It is the *Politically Developed Segment*.

Segment 4 includes the 18 countries that present the largest deficit in the democratic variables: political organization, political rights and freedom of the press and the next to last place in the voice and accountability indicator. They are characterized by political systems where the citizens' participation is restricted, there is little objectivity in the media and limitations to the freedom of expression; the main government leaders' recruitment is considered to be the least competitive of the sample. In spite of this, they present positive results in the variables associated to rules of law and government effectiveness, and corruption doesn't assume a very expressive place. This Segment is named the *Political Effectiveness Segment*.

In Segment 3 there are 20 countries that present, in average, the second worst punctuations in political stability and lack of violence, law and order, rules of law, government effectiveness and graft, the fourth worst positions in civil freedom, political rights and freedom of the press but they possess some (although weak) political organization. It is a segment that, in a summarized way, can be considered as *Restricted Governmental Practices*.

In Segment 2 are the countries that are positioned in the third place relatively to the democratic variables: political organization, civil freedom, political rights, freedom of press and voice and accountability; however they present negative indicators thus descending a position in the variables associated to rules of law, government effectiveness and graft. It is the *Democratic Development* Segment.

In Segment 1 are included the countries that present the worst punctuations in terms of government effectiveness, and the second worst places in democracy terms. This is, therefore, a segment where there are limitations in the political process, civil freedom and freedom in developing points of view. These are *Democratic Deficit* countries.

Figure 1 summarizes the relevant information for the interpretation of the structure of the formed segments.

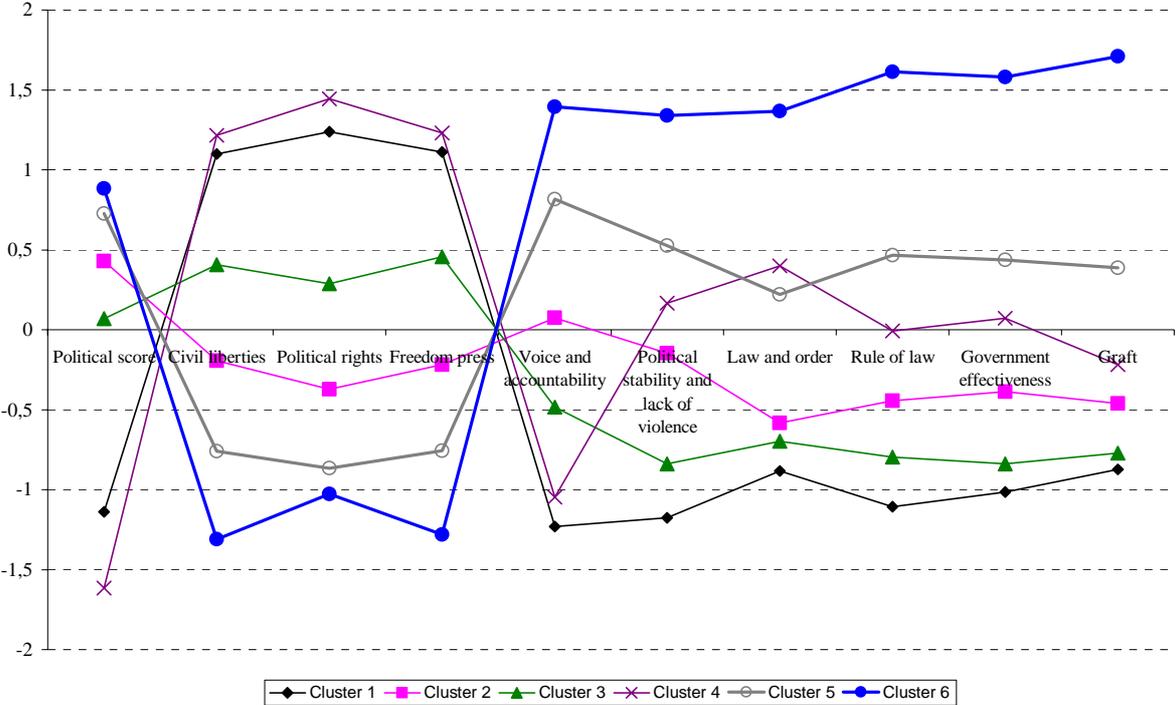


Figure 1: Political factors: centroids of the segments

After an analysis of the mean profiles, it becomes interesting to study the characteristics of some of the fuzzy classified countries (Figure 2) (i.e., those that share characteristics of more than one segment), referring the variables where these countries distance themselves from the centroids of the segments where they were classified and that eventually are share the characteristics of other segments:

- Spain, classified in Segment 6, assumes indicators that distances itself from this group in the criteria of political stability and lack of violence and law and order, assuming a similar pattern for these variables as the countries classified in the Segment 5.
- Thailand distances itself from the mean pattern of the countries of Segment 5 when assuming punctuations similar to those of the countries classified in Segment 2 in political organization, civil freedoms, political rights and graft; it assumes the second worst position in political stability and lack of violence and government effectiveness of Segment 5.

4.3. Clustering validity

If the criterion for the definition of a typical element of a segment is defined by membership degrees higher than 0,75, then 17 countries are typical of Segment 6, 10 of Segment 5, 5 of Segment 4, 2 of Segment 3, and 1 of Segment 2. This can be quantified by the ratio of this frequency with the fuzzy cardinality of the Segments. The fuzzy cardinality is defined by $\sum_{n=1}^N p_{ns}$ (Hruscha 1986). Otherwise the homogeneity intra-segment is larger in Segment 6, followed by Segment 5, Segment 4, Segment 3, Segment 2 and Segment 1.

Table 7: Fuzzy cardinality of the segments

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	
Fuzzy membership degree							
	[1;0,75]	0	1	2	5	10	17
	]0,75;0,5]	10	11	9	6	8	4
	]0,5;0,25]	10	19	21	8	16	4
	]0,25;0]	104	93	92	105	90	99
Fuzzy cardinality		17,85	22,07	21,4	16,02	24,06	22,61
Number of typical countries/fuzzy cardinality		0,000	0,045	0,093	0,312	0,416	0,752

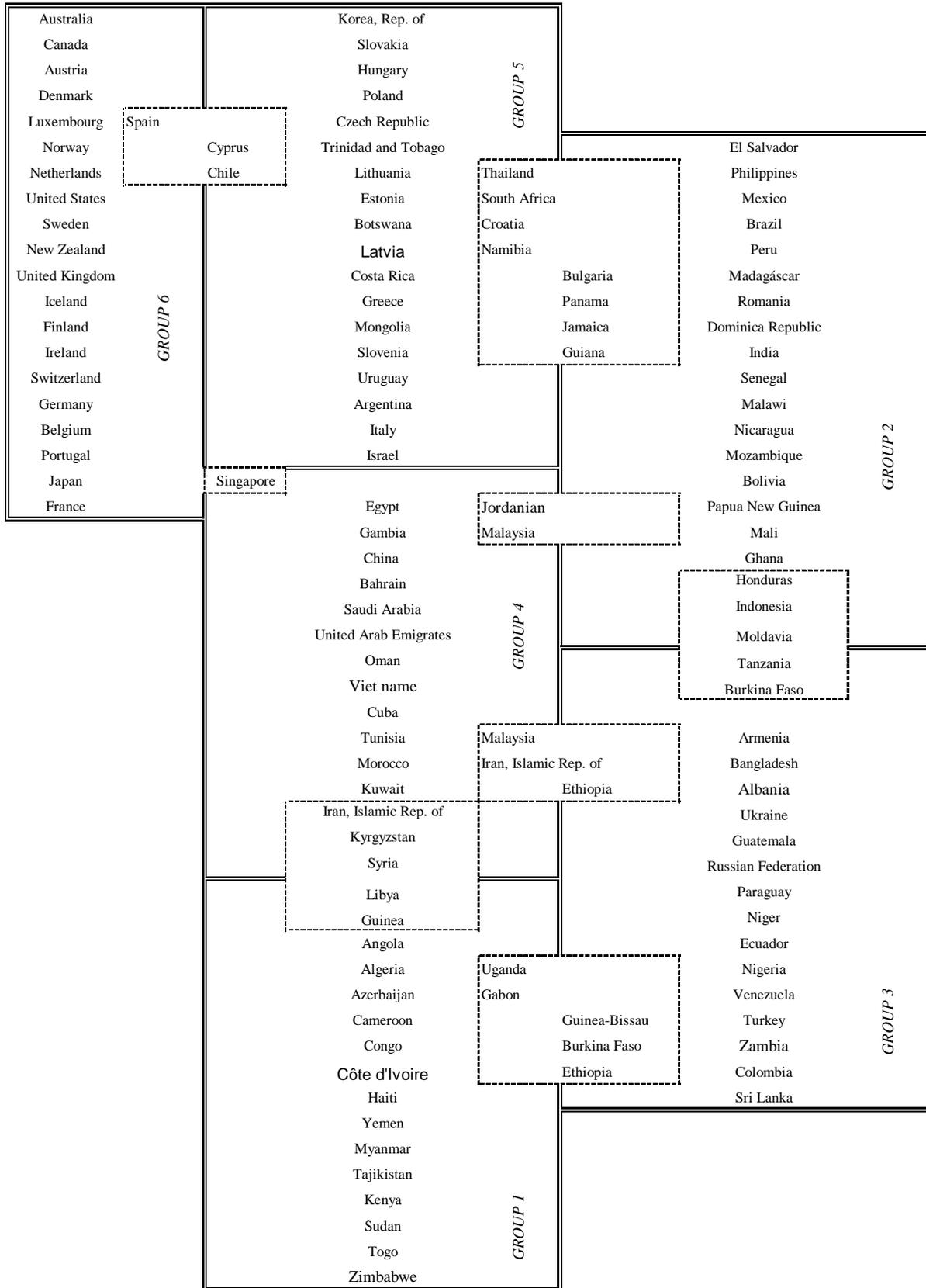


Figure 2: Political factors: segmentation structure

5. Political factors: contribution for economic and human development

Here we verify, for the obtained classification structure, if the respective segments appear associated to different Gross Disposable Income levels *per capita*, of human development and gender-related development. In order to accomplish that, the model of multiple lineal regression is used, considering, as explanatory variables, the dummy variables related to the segments (5 *Dummy* variables where $D_i=1$, if the observation belongs to Segment i , $i=1,2,3,4,5$; 0, otherwise) and as dependent variables, one at a time, Gross Disposable Income *per capita*⁵, Human Development Index (HDI)⁶ and Gender-Related Development Index⁷ (GDI).

The univariate statistical analysis of the three dependent variables in the sample of 124 countries allows the extraction the following conclusions (Table 7 and Figure 3):

- Gross Disposable Income *per capita* assumes a left-bias distribution, 50% of the countries present a higher Gross Disposable Income *per capita* value than 5878; it possesses an extreme *outlier*, Luxembourg, registering a Gross Disposable Income *per capita* of 50061, and a moderate *outlier*, for a Gross Disposable Income *per capita* of 24142, in the USA; the mean for 5% is 8502.
- The mean value of HDI is 0,7 and 50% of the countries register values higher than 0,748; the minimum value is 0,277 (Niger) and the maximum 0,942 (Norway).
- The behavior of the GDI is similar to the HDI. However the mean value (0,708) and the median (0,716) are smaller, thus suggesting a small inequality between men and women in the sample.

Table 7: Descriptive statistics

<i>Variable</i>	Mean	95% Confidence Interval for mean	Median	Std. Deviation	Minimum	Maximum
<i>GDP pc</i>	9362	[7648;11075]	5878	9640	523	50061
<i>HDI</i>	0,710	[0,679;0,742]	0,748	0,177	0,277	0,942
<i>GDI</i>	0,708	[0,674;0,740]	0,744	0,180	0,263	0,956

⁵ The Gross Disposable Income per capita is a measurement of a country's well being.

⁶ HDI is a summary of three dimensions of the concept human development: live a long and healthy life, be educated and have a dignified lifestyle. It combines life expectancy, education and income.

⁷ GDI adjusts the HDI to the inequalities between men and women.

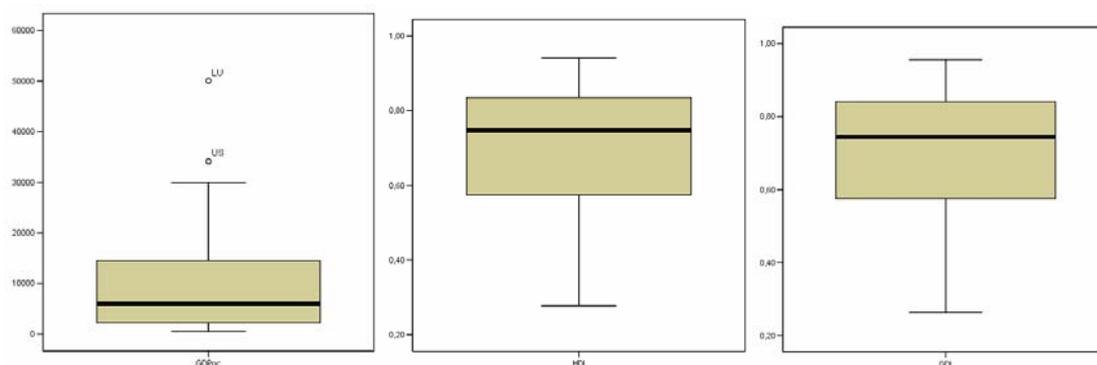


Figure 3: Boxplot: GDPpc, HDI and GDI

Economic development – Gross Disposable Income per capita

When determining the Gross Disposable Income *per capita*, we can conclude (equation 1) that the political segments (through the two *dummy* variables D1, D2, D3, D4 and D5) are statistically significant (at 1%) either individually or globally considered. The political Segments explain 73,4% of the Gross Disposable Income *per capita* variations. The countries that present the highest Gross Disposable Income *per capita* in mean terms are the ones classified in Segment 6, located in the *Political Vanguard*, followed by *Politically Developed* countries, classified as Segment 5, *Political Effectiveness* countries (Segment 4), *Democratic Development* countries (Segment 2), countries with *Restricted Governmental Practices* (Segment 3) and *Democratic Deficit* countries (Segment 1).

Human development - Human Development Index (HDI)

To evaluate the importance of the political factors in a country's performance the Human Development Index, that adjusts the Gross Disposable Income *per capita* indicator according to social factors, was also considered. The democratic Segments (equation 2) reveal their strong explanatory capacity again (their three variables explain about 56,3% of the variations of HDI). The hierarchy of the HDI mean values remains, in relation to the Gross Disposable Income *per capita* (Segment 6-5-4-3-2-1).

Table 8: Influence of the politicians in economic performance and human development

	Eq. 1	Eq. 2	Eq. 3
	GDPpc	HDI	GDI
Explanatory variables	<i>Coefficients.</i> <i>(p-value)</i>	<i>Coefficients.</i> <i>(p-value)</i>	<i>Coefficients.</i> <i>(p-value)</i>
Intercept	26061.86 (0.000)	0.928 (0.000)	0.927 (0.000)
G1	-23628.69 (0.000)	-0.394 (0.000)	-0.414 (0.000)
G2	-22448.94 (0.000)	-0.295 (0.000)	-0.301 (0.000)
G3	-22996.41 (0.000)	-0.332 (0.000)	-0.339 (0.000)
G4	-17677.08 (0.000)	-0.202 (0.000)	-0.213 (0.000)
G5	-14626.77 (0.000)	-0.121702 (0.001)	-0.122982 (0.000)
R²	0.734	0.563	0.568
F	65.265 (0.000)	30.406 (0.000)	29.431 (0.000)

Human development – Gender-Related Development Index (GDI)

Next, the relationship between the political segments and IDH is analyzed and adjusted to the inequalities between men and women. Once again a statistically significant relationship is verified, both individually and globally ($R^2=56,8\%$). The highest differential between the mean values of the HDI and the GDI occurs in Segment 1 ($IDG=0,512$ versus $IDH=0,534$), revealing inequalities disfavoring women.

Conclusion

The pioneering work of Lipset (1959) originated a great number of empirical studies about the relationship between Democracy and Economic Development. Using several methodologies, the studies are consensual in the results - in sectional terms, a positive but not perfect correlation exists, between the two variables.

In this work an alternative methodology in the study of the relationship between economic development and democracy is proposed. The conjugation of a group of data on subjective

indicators obtained from the specialists' opinion, related not only to the democratic profile of the countries, but also to government effectiveness, was an innovation in this type of studies. Based on this set of 10 variables, we proceeded to the classification of the 124 countries, with the objective of systemizing the heterogeneity of the sample in relation to political indicators.

The advantages of the fuzzy classification methods are demonstrated (method *fuzzy k-means*) in the international classification context, when detecting countries that share characteristics of more than one segment.

The partition made revealed pertinent because it allows the countries to be grouped according to their degree of political development based on concrete variables - six segments are identified, denominated as *Political Vanguard* (Segment 6), *Politically Developed* (Segment 5), *Political Effectiveness* (Segment 4), *Restricted Governmental Practices* (Segment 3), *Democratic Development* (Segment 2) and *Democratic Deficit* (Segment 1). In hierarchical terms, the *Political Vanguard* Segment is followed by the *Politically Developed* Segment in the Evaluation of the Government; Segments 4 and 2 share positions amongst themselves, i.e., the *Political Effectiveness* Segment presents a political deficit, but good indicators of governmental effectiveness, and the *Democratic Development* Segment presents weak punctuation in government effectiveness and better punctuation (relative) in the government indicators. Segments 3 and 1 can again be nested, the *Democratic Deficit* Segment occupying the worst positions.

These Segments also implicate the access to certain levels of economic and human development. The defined hierarchy corresponds to different mean punctuations in the indicators of economic and human development; surprisingly, in the Segments that share positions in the hierarchy (4 and 2), the countries that possess better result in the indicators of government effectiveness (and worse in the democratic indicators) reveal better indicative means of well-being.

To conclude, in this study evidence of a positive relationship between democracy and economic and human development was once again demonstrated, thus presenting new insights for the understanding of the heterogeneity of behaviors in the indicators of the evaluation of the government.

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Appendix

<i>Indicator</i>	<i>Variables</i>	<i>Concept measured</i>	<i>Source</i>
Democracy	Polity score	Competitiveness of chief recruitment	Polity IV dataset University of Maryland
		Openness of chief executive recruitment	
		Constraints on chief executive	
		Regulation of participation	
		Regulation of executive recruitment	
	Civil liberties	Competitiveness of participation	Freedom House
		Freedom of expression and belief	
		Freedom of association and organizational rights	
	Political rights	Rule of law and human rights	Freedom House
		Personal economy and economics rights	
Free and fair elections for offices with real power			
Freedom of political organization			
Press freedom	Significant opposition	Freedom House	
	Freedom from domination by powerful groups		
Voice and accountability	autonomy or political inclusion on minority groups	World Bank Governance Indicators Dataset	
	Media objectivity		
	Freedom of expression and belief		
	Free and fair elections		
	Freedom of the press		
	Civil liberties		
	Political rights		
Military in politics			
Rule of law and government effectiveness	Change in government	World Bank Governance Indicators Dataset	
	Transparency		
	Business is kept informed of developments in laws and policies		
	Business can express its concerns over changes in laws and policies		
	Perceptions of the likelihood of destabilization (ethnic tensions, armed conflict, social unrest, terrorist threat, internal conflict, fractionalization of the political spectrum, constitutional changes, military coups)		
Rule of law	Legal impartiality	World Bank Governance Indicators Dataset	
	Popular observance of the law		
	Black markets		
	Enforceability of private government contracts		
Government effectiveness	Corruption in banking	World Bank Governance Indicators Dataset	
	Crime and theft as obstacles to business		
	Losses from and costs of crime		
	Unpredictability of the judiciary		
Graft	Bureaucratic quality	World Bank Governance Indicators Dataset	
	Transaction costs		
	Quality of public health care		
	Government stability		
	Corruption among public officials		
Corruption	Corruption as an obstacle to business	World Bank Governance Indicators Dataset	
	Frequency of "irregular payments" to officials and judiciary		
	Perceptions of corruption in-civil service		
	Business interest payment		

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