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Interpreting bargaining strategies of developing countries in climate negotiations – A quantitative approach

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Abstract

Despite the efforts made during the last climate conferences (COPs), countries participating in the negotiation process are still far from reaching an agreement on the implementation of a new Post-Kyoto climate regime. The growing role played by developing countries in negotiations is one of the main causes behind the deadlock. Further attention should therefore be paid to the composition of the coalitions formed by developing countries in order to better understand the key structural features driving their bargaining positions. By applying a cluster analysis, this paper aims to investigate the role played by heterogeneity in specific characteristics of developing countries in forming bargaining coalitions in climate negotiation. By clustering developing countries according to their economic, geographic, environmental, energy and social characteristics, the paper presents some considerations on climate political economy strategies in these countries.

Keywords: Climate negotiations, Developing countries, Vulnerability, Cluster analysis, Climate models
J.E.L. codes: O19; Q54; Q56

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1. Introduction

In 2007, during the COP13 in Bali, the Parties started to negotiate for a new climate agreement to be implemented at the end of the first commitment period defined by the Kyoto Protocol (KP) in 2012 (UNFCCC, Decision 1/CP.13). Nevertheless, the so-called Bali Action Plan was too ambitious and the Parties failed to achieve a new binding agreement for all countries. As a result, the KP has been extended for a second commitment period (2013-2020), with the intent of reaching an agreement by 2015 for the implementation of a new climate regime to be effected by 2020.

Despite this failure, climate negotiations have been characterized by a remarkable novelty: compared with the first phase, when the main objective was to get Annex I "reluctant" countries to ratify the KP whereas developing country concerns remained marginal (Najam et al., 2003), in current negotiations developing countries have assumed a central role (Cantore et al., 2009; Ott et al., 2008).

The attention devoted to developing countries' interests results in two major decisions. The first one is the implementation of Nationally Appropriate Mitigation Actions (NAMAs), debated during COP16 (Cancun 2010) and COP17 (Durban 2011). By submitting country-specific NAMAs, developing countries can obtain support in terms of technology, financing and capacity-building transfer from economically advanced Parties to enable and facilitate their mitigation efforts.[4] The second achievement is represented by the institution of the Green Climate Fund (GCF), created to become the main financial instrument for promoting the adoption of mitigation and adaptation measures in developing countries (UNFCCC, Decision 1/CP.16; Decision 3/CP.17). The GCF, in particular, constitutes a great success for developing countries that have actively supported it (especially the ALBA group)[5] and have a strong representation in its current management structure.[6]

Other relevant decisions concerning developing countries were taken during COP19 held in Warsaw in 2013 such as the establishment of the Warsaw International Mechanism for Loss and Damage (UNFCCC/CP/2013/L.15), intended to address the

[4] This process is facilitated by the implementation of the NAMA registry, a web platform where developing countries publish their mitigation plans so that developed countries can decide whether to participate or not.

[5] The ALBA group consists of Bolivia and other Latin American and Caribbean countries with the exception of Brazil.

[6] 12 out of 24 Board members represent developing countries.

adverse impacts of climate change in developing countries that are expected to be particularly vulnerable to extreme events (IPCC, 2014).

In this complex scenario, the Parties seem to be far from reaching the main objective of negotiations: a new agreement for the implementation of an ambitious climate regime that limits average global warming to 2°C above pre-Industrial Revolution levels. The only step ahead is given by the agreement signed by COP20 (Lima 2014), where the Parties agreed on the basic rules to be adopted in order to facilitate the Intended Nationally Determined Contributions (INDCs) that will form the foundation for climate action post 2020 when the new agreement expected in COP21 (Paris 2015) is set to come into effect. The regulation of INDCs constitutes a small contribution to escaping the deadlock, since they only suggest how Parties should contribute to the discussion in climate negotiations, without concrete solutions to the distribution of mitigation efforts and the allocation of investment resources.

The causes behind the deadlock are diverse and involve both the huge projected global costs of achieving ambitious emission targets and the global public good characteristics of climate change, which provide incentives for countries to act as free riders, impeding the implementation of the Agreement (Zhang and Shi, 2014).

Nevertheless, another reason behind the deadlock is related to the emergence in climate negotiations of more differentiated positions compared with the traditional segmentation between developed and developing countries. In particular, the group of developing countries (known as the G77) has become significantly fragmented (Brunnée and Streck, 2013), with large emerging economies that frequently negotiate bilaterally with major developed countries on climate and energy issues and marginalize the more vulnerable countries that could benefit from the adoption of more stringent commitments (Kasa et al., 2008). As has become evident during the last COPs, countries within the G77 group have different expectations and concerns. We can therefore expect divisions within the group to exacerbate in the future, leading to the formation of new or differently shaped alliances that promote their interests. At the same time, the role of these groups has not been yet comprehensively addressed in the negotiations literature (Blaxekjaer and Nielsen, 2014).

With regard to this last point, in this paper we investigate how the characteristics of developing countries may explain their differentiated positions. Specifically, by exploiting countries' specificities and structural features, we perform a cluster analysis and identify subgroups of countries pooled together by reasonably homogeneous interests and characteristics. By presuming that countries that have common features and concerns will advocate the same interests in negotiations, our analysis can help to understand different attitudes of participant countries in climate agreements. Our clusters of developing countries are then compared with existing climate bargaining coalitions, with the aim of investigating to what extent the two types of grouping overlap. By analysing overlapping and similarities, we can then define the main determinants of coalitions' stability and consequently the major interests and concerns influencing their bargaining positions.

The rest of the paper is organized as follows. Section 2 presents a literature review concerning climate negotiations with a focus on developing countries. Section 3 describes the dataset and the empirical methodology, Section 4 discusses the empirical results and Section 5 provides some concluding remarks.

2. The climate change negotiations process

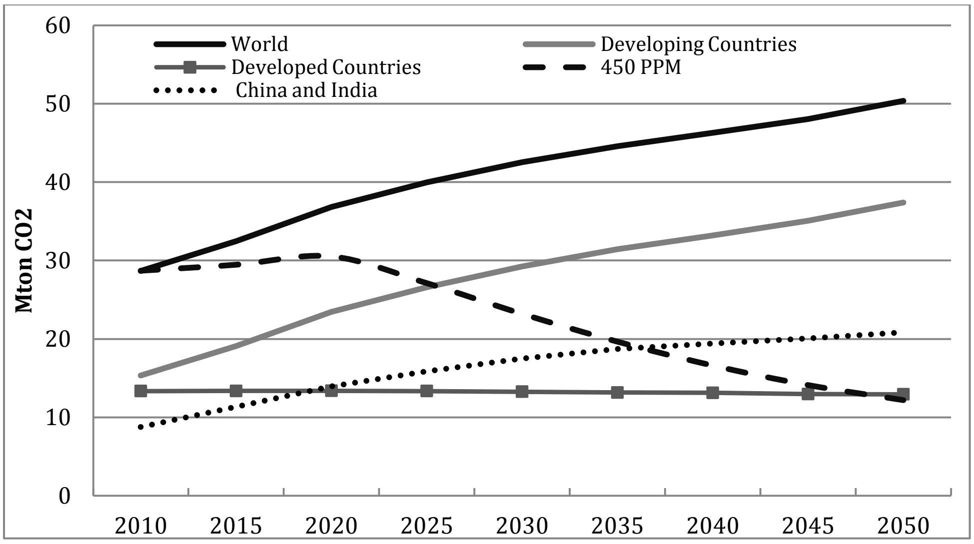
The issue of climate negotiations has been widely debated in recent years and several contributions have emphasized the need for a better understanding of the role and needs of developing countries whose interests have been systematically marginalized during the initial negotiation and implementation phase. The key interests of developing countries are the creation of an implementable and equitable climate regime within a sustainable development framework, as well as improvements in countries capacities to react to the effects of climate change, enhancing the adaptive capacity and resilience, especially of the more vulnerable countries (Najam et al., 2003; Sokona et al., 2002). The claim that mitigation must be accompanied by sustainable development, especially with regard to energy issues, has always been advocated by developing countries, also with regard to the Post-Kyoto debate: "a post-2012 regime that advances development goals sustainably must find a way to help provide the energy needed for development. But it must also find a way to help ensure that the energy in question does not lock us into decades of high-emission technologies" (Cosbey, 2009, p. 27).

With regard to climate change action, in recent years equity has been one of the most debated issues, being a highly contentious area of negotiation for the design of a 2015 agreement (Markandya, 2011; Mathur et al., 2014; Morgan and Waskow, 2014; Ngwadla, 2014). In particular, great emphasis has been given to the different interpretation of the CBDR principle and its consequences, both in terms of deadlock in negotiations and burden sharing implications (Winkler and Rajamani, 2014; Zhang and Shi, 2014). According to Article 3.1 of the Convention:"[t]he Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof." The CBDR principle can be considered the focal point of climate negotiations, its interpretation determining the burden sharing of emissions targets in the future climate regime.

Developing countries have interpreted responsibilities according to historic contributions to the climate problem, insisting on a rigid differentiation between developed and developing countries, and hence requiring rich nations to take on a bigger share of the burden for carbon cuts (Brunée and Streck, 2013). In contrast, developed countries have resisted the notion of historic responsibility as well as clear distinctions between North and South, focusing instead on current and future contributions to climate change and shifting the responsibility towards fast developing economies, such as China and India. Indeed, the share of GHG emissions by developing countries, and in particular emerging economies, is expected to substantially increase in the future, whereas emissions from developed countries are projected to remain fairly stable. In Figure 1, we report the CO_2 emission flows target scenario of ensuring a stable concentration of GHGs in the atmosphere of 450 PPM by 2050, in order to limit average global warming to 2°C above pre-Industrial Revolution levels (Markandya et al., 2015). As a matter of fact, the increasing share over time of emissions associated with the development process of emerging and less advanced economies shows how crucial active involvement of the developing part of the world is in climate negotiations.

Even though China and other developing countries have refused to make international commitments, considering past economic growth paths of industrialized countries responsible for climate change, it is clear that failing to engage developing countries in serious efforts at emissions reduction will have dramatic consequences on the possibility of controlling climate related problems. At the same time, the need to reexamine the CBDR and achieve a common interpretation of the principle in order to implement a new climate regime is also compelling (Bortscheller, 2010). Otherwise, the efforts of industrialized countries to actively involve developing countries in international climate negotiations may be regarded as a hostile act, or at least an indirect way to partly reduce the economic growth and development potential of less advanced economies (Rübbelke, 2011).

Figure 1 - CO_2 emissions projections 2010-2050



Source: own elaboration on Markandya et al. (2015).

In order to convince developing countries to actively participate in climate negotiations and also play an active role in mitigation policies, their level of confidence in the fairness of the bargaining process must be raised. For this purpose, the role of adaptation support measures such as the implementation of the GCF or the improvement of financial aid aimed at technology transfer may be extremely beneficial in increasing this confidence. In other words, when industrialized countries finance adaptation actions, developing countries may feel treated more fairly and this in turn may have a positive impact on climate negotiations, especially with regard to their involvement in international mitigation efforts (Markandya et al., 2015). To this end, great expectations are placed on GCF functioning rules which are only partly established, especially with regard to distribution criteria among receiving countries and mitigation or adaptation purposes (Cui et al., 2014).

Several approaches have been developed in order to contribute to escaping the deadlock. Weiler (2012) investigates the determinants of bargaining success in climate change negotiations by adopting a political economy perspective, where success is defined by evaluating the coherence of the final decision with expectations on single bargaining coalitions. Specifically, bargaining success is measured as the distance from the state's original positions to the negotiated outcomes, also adjusted to account for the relevance of each negotiation issue. On the basis of these measures, he finds that countries' external power (measured by their GDP), their vulnerability to climate change, as well as the adoption of soft bargaining strategies for relevant issues, positively affect bargaining success, whereas assuming extreme positions and the state's share of emissions have a negative influence. These conclusions suggest that, in order to assess the relative bargaining power of different coalitions, it is necessary to fully understand the characteristics of the countries forming the groups. Along the same lines, Kasa et al. (2008) analyse countries' specificities and provide interesting insights into understanding the positions of developing countries in climate negotiations. While poverty and other common problems related to economic and political underdevelopment have been driving factors behind the formation of the G77 as a group and the maintenance of unitary positions in the early period of the climate regime, the increasing economic heterogeneity among members has led to the emergence of bilateral agreements between the richest developing countries (such as Brazil, China, and India) and the major advanced countries on relevant climate and energy issues. This new type of cooperation weakens the position of the rest of the developing countries, especially those that would benefit most from the adoption of universal, strict commitments, since they are the most vulnerable to the adverse impacts of climate change.

As a result, there is no agreement in the scientific literature about what factors determine bargaining success or disease, especially in large (global) negotiations. According to Weiler (2012), there are two ways of evaluating the success of an international negotiation process. The first refers to a success that consists in a final agreement, preferably followed by a legal document. The second consists in appraising to which extent a party has influenced the outcome of the negotiations. In analysing this second aspect, the strategic choices in climate change negotiations have been mainly investigated with respect to the party specific success, without a quantitative analysis of the underlying preferences driving bargaining positions of parties.

To account for the relevance of countries' specificities in determining the formation of negotiating groups, we draw on the methodology developed by Costantini *et al*. (2007) which explores the bargaining positions of developing countries in World Trade Organization (WTO) negotiations by assuming that the under-lying preferences of parties can proxied by the structural features of parties with respect to the specific issue under negotiation. Individual countries are expected to join coalitions on the basis of similar expected benefits that arise from a specific negotiation outcome. Thus, member countries of existing coalitions should present a certain degree of homogeneity with regard to a set of variables related to the aspects covered by the negotiation process under scrutiny.

As emphasized in Depledge (2008), it is possible to define the concept of salience as how important climate change is for a country, which in turn depends heavily on the expected consequences of a changing climate for a given country.

Going beyond the measurement approach proposed by Depledge (2008) based on the amount of efforts played by a government in discussing at the national level the climate change issues, we adopt a quantification relative to several dimensions influencing both vulnerability to climate change and vulnerability to mitigation costs. According to Hasson *et al*. (2010), the mitigation vs. adaptation investment remains an unsolved dilemma. Our quantitative exercise allows also quantifying how different countries are positioned with respect to this dilemma.

This is in line with the quantitative assessment proposed by Nagashima *et al*. (2009), which explicitly address the issue of quantifying costs and benefits of large coalitions in participating to climate negotiations, finding that complimentary policies might ensure stability to large coalitions, but not arrive at a Grand coalition, able to reach a final international agreement.

In our paper we reveal that the structural features explaining effective coalitions allow explaining the instability of bargaining coalitions. In order to reach a consensus on a final global agreement, such differences should be carefully accounted for. As a matter of fact, if complimentary and compensatory measures might be the right way to reach stable coalitions, it is necessary to design differentiated measures in order to minimize defection risk.

3. The empirical methodology

3.1. Dataset description

In the case of climate negotiations, relevant country features relate to several aspects, such as the vulnerability to climate change, the current and projected level of GHG emissions, the level of technological capabilities, the availability of knowledge capital and so forth. Hence, in order to cluster countries with respect to their interests in climate negotiations, the choice of the variables that form the dataset to be used in subsequent analysis is a preliminary step.

Given the aim of this research, we have excluded from the analysis emerging economies which are characterized by strong specificities (from an institutional and economic point of view) that distinguish them from other developing countries. The statistical analysis has been carried out on a sample of 89 countries, where two driving criteria are used for the selection: i) the ratification of the Kyoto Protocol as Non-Annex I Parties; ii) the availability of information covering all the selected structural features for the years 2011-2013.[7]

For all the considered countries, several variables representing different country features have been included in order to reduce subjectivity bias in the statistical results as much as possible. In addition, the average value of variables in the period 2011-2013 has been considered to avoid the biasing effect of fluctuations. We have selected 55 variables that can be divided into seven dimensions: geography, economy, demography, energy, institutional quality, technological innovation and development. The complete list of variables used in the analysis and data sources are provided in Table A1, Appendix A.

1. Geography. This dimension includes all homogeneously available physical

[7]Countries included in the analysis are: Algeria, Argentina, Armenia, Azerbaijan, Bahrain, Bangladesh, Benin, Bolivia, Botswana, Burkina Faso, Cambodia, Cameroon, Chile, Colombia, Comoros, Congo, Republic, Costa Rica, Cote d'Ivoire, Cuba, Dominican Republic, Ecuador, Egypt Arab Republic, El Salvador, Ethiopia, Gabon, Gambia, Georgia, Ghana, Guatemala, Honduras, Indonesia, Iran Islamic Republic, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kuwait, Kyrgyz Republic, Lao PDR, Lebanon, Madagascar, Malawi, Malaysia, Maldives, Mali, Mauritius, Mexico, Morocco, Mozambique, Namibia, Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Qatar, Rwanda, Saudi Arabia, Senegal, Sierra Leone, Sri Lanka, St. Lucia, St. Vincent and the Grenadines, Sudan, Suriname, Swaziland, Syrian Arab Republic, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkmenistan, Uganda, United Arab Emirates, Uruguay, Uzbekistan, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe.

characteristics related to geography, including, among others, surface area, length of coastline and temperature. Special attention has been devoted to climatic characteristics, related to the degree of vulnerability to climate change of each country and other crucial aspects in climate negotiations. The main statistical source for geographical information is the World Bank, with the exception of the Vulnerability Index and the "Index of projected precipitation impact". The first one is provided by the University of Notre Dame together with the Readiness Index in order to calculate the ND-GAIN (Notre Dame Global Adaptation Index), an index that represents the degree of vulnerability to climate change as well as a country's readiness to adaptation (University of Notre Dame, 2013).

To evaluate the impact of projected precipitation, we have constructed an indicator, known as the "Index of projected precipitation impact", obtained in three steps. First, the average value between the minimum and the maximum projected precipitation values has been calculated as an indicator of "rain direction" (a positive average value indicates a probability that precipitation will increase and vice versa). Second, on the basis of the "Mean annual precipitation per squared km", a coefficient has been assigned to each country in order to classify all countries from the driest (5) to the wettest (-5). Finally, this coefficient has been multiplied by the average value between the minimum and the maximum projected precipitation measure previously calculated, obtaining an "impact index" that has been normalized in order to assume values from 0 (negative impact) to 1 (positive impact).[8]

2. Economy. This dimension provides a comprehensive representation of the economic structure of each country, containing information on GDP, employment, exports, FDI and many other aspects. All data are taken from the World Bank WDI online database.

3. Demography. Several measures regarding population issues constitute this dimension, such as, for instance, the number of inhabitants, the growth rate, and the share of female or rural population. Here too, the source of data is represented by the World Bank WDI.

4. Energy. This dimension contains information on the energy sector, such as energy

[8] A negative impact is registered, for example, if precipitation is expected to increase in very wet countries and decrease in very dry ones and vice versa (positive impact if precipitation decreases in wet countries and if it increases in dry ones).

and electricity production and consumption, as well as information on the use of renewable energies. Data come from the World Bank WDI tool and the EIA (Energy Information Administration) online data service. This dimension also includes the level of CO_2 emissions from fuel combustion (as defined by IEA, 2013); accurate data for developing countries are taken from the World Bank WDI tool.

5. Institution: As a proxy for the quality of institutions, we have used data from the Political Risk Services Index (PRI), provided by the PRS Group (2014). Among the indices provided by PRI, we have selected four indicators of political and socio-economic characteristics: Socioeconomic Conditions (SE), Investment Profile (IP), Law and Order (LO) and Democratic Accountability (DA). Since the maximum values of the indices are different (6 for LO and DA; 12 for IP and SE), in order to conduct the analysis, values have been normalised to a common 12 maximum value.

6. Technological Innovation. This dimension contains information on infrastructure endowments as well as on technology diffusion, including road density, number of internet users, number of telephone lines, and degree of specialization in high technology exports. All data are taken from the World Bank WDI.

7. Development. We have considered indicators focused on aspects related to climate issues. Accordingly, variables included in this dimension refer to poverty, income distribution, the well-being level as designed in the human development framework, and public policies for basic needs, such as health and education. The sources of these data are the World Bank and the UNDP. We have also included the Human Development Index (HDI), one of the most widely used indicators of development, calculated by the UNDP on the basis of the country's average achievements in three dimensions: a long and healthy life, access to education and a decent standard of living.

3.2. Cluster analysis

The methodology used to classify developing countries in homogeneous groups on the basis of the previously described dimensions is represented by a cluster analysis. This is a "generic term for procedures that seek to uncover groups in data" (Everitt et al., 2001, p. 5). In other words, it allows for the identification of groups of units that are similar to each other within the group, but different from units that belong to other groups.

Given the multiplicity of variables adopted in this study and in order to avoid potential correlations between variables in the cluster procedure, we perform a preliminary Principal Component Analysis (PCA) on the original dataset.[9] PCA is a technique for reducing the dimensionality of datasets by extracting only the information that is strictly necessary for representing the variance of the phenomena. Accordingly, it replaces the original variables by a smaller number of derived variables, the principal components (PCs), which are linear combinations of the original variables (Jolliffe, 2005).

Several methods can be used to select the number of PCs to be retained. The most widely used in literature are: i) the Kaiser criterion, according to which the components to be selected are those with eigenvalues greater than 1 (Hsieh et al., 2004; Kaiser, 1960); ii) the cumulative percentage of total variation criterion (Lee et al., 2006; Mazzanti and Montini, 2014). As illustrated by Jolliffe (2002), it consists of selecting the number of components that explains an established variance threshold level. This level should be in the range 70% to 90%, assuming lower values when the number of variables is high. Following this criterion and given that, according to Jackson (1993), this method can overestimate the number of PCs, a fairly low threshold has been chosen in this study. In particular, two attempts have been made to apply the cluster analysis to two different numbers of PCs that explain 75% (9 PCs) and 80% (11 PCs) respectively of the cumulative variance. With a threshold level at 75%, countries are classified into seven clusters, whereas with a 80% threshold, the optimal number of clusters is seven or nine. It is also worth mentioning that in the case of seven clusters, the specific countries entering the groups are almost totally overlapping by choosing 9 or 11 PCs. Accordingly, we have performed the cluster analysis by selecting 9 or 11 PCs in order to select the most stable and robust results.

The cluster analysis is conducted in two steps. The first one consists of a hierarchical cluster analysis that is needed to determine the optimal number of clusters. When the number of clusters is defined, the second step consists of using the number of clusters to inform a non-hierarchical clustering process by imposing the number of clusters obtained in the first step.

With regard to the first step of the cluster analysis, the process of hierarchical

[9] Table A2 in Appendix A shows the Kaiser-Meyer-Olkin test. An overall value higher than 0.5 suggests the use of a PCA.

clustering consists of four phases (Johnson, 1967): i) to assign each item to a cluster so that there are N clusters, each containing just one item; ii) to find the closest (most similar) pair of clusters and merge them into a single cluster so that there is one cluster less; iii) to compute distances (similarities) between the new cluster and each of the old clusters; iv) to repeat phases two and three until all items are clustered into a single cluster of size N. Phase three can be done in different ways which is what distinguishes alternative methods. The method used in this analysis is Complete Linkage, according to which the distance between one cluster and another cluster is equal to the greatest distance from any member of one cluster to any member of the other cluster. This is computed in terms of the Euclidean distance, defined as the square root of the squares of the differences between the coordinates of the points. Once the complete hierarchical tree was obtained, in order to choose the optimal number of clusters (k), the Duda-Hart test was conducted (Duda and Hart, 1973) and interpreted according to Cao et al. (2008). The implementation of this test gives as a result a matrix made of three columns: the first column represents the number of clusters, the second column provides the corresponding Duda–Hart Je(2)/Je(1) index stopping-rule,[10] whereas the third one gives the pseudo-T-squared values. From the comparison of these two values, as already mentioned, seven and nine are found to be the best numbers of clusters, as they have a high Duda–Hart Je(2)/Je(1) value (0.92 and 0.88, respectively) associated with a low pseudo T-squared value (3.62 and 4.00, respectively).[11] Thus, the analysis were carried on both seven and nine clusters. Results show that there are no substantial differences between the composition of groups which are the same with the exception that two clusters become part of two others when considering seven groups. Thus, in order to choose the best number of clusters, considerations regarding the dataset structure must be made. In particular, it is worth noting that it is composed of variables that explain the overall structure of countries but it does not include mere geodesic information (e.g. latitude and longitude) that otherwise would have driven the cluster analysis. As a result, we choose the classification that has the best geographical representation, namely the one with nine clusters.

[10] The Duda–Hart Je(2)/Je(1) index is the ratio between the total within sum of squared distances about the centroids of the clusters for the two-cluster solution (Je(2)) and the within sum of squared distances about the centroid when only one cluster is present (Je(1)).
[11] See Table A3 in Appendix A.

Thus, after the implementation of the Complete Linkage hierarchical tree, the optimal number of PCs representing the dataset here explored is 11, and the optimal number of clusters is nine.

This is the final number of clusters implemented in the second step of the cluster analysis, consisting of a non-hierarchical k-means clustering in which the number of groups must be pre-determined and aims to minimize the sum of the distances of each item from the centroid of its cluster, thus the intra-cluster variance (MacQueen, 1967). In particular, the k-means algorithm is made up of four phases: i) to determine the centroids; ii) to calculate the distance between cluster centroid to each object and assign each object to a cluster based on the minimum distance; iii) to compute the new centroid of each group based on the new memberships; iv) to repeat phases two and three until the assignments no longer change. At the end of the process, the final composition of the nine clusters is achieved.

4. Cluster analysis results feeding the political economy discussion

4.1. Definition of climate clusters

According to the three-step analysis described in Section 3, the 89 developing countries selected in the dataset can be pooled into nine groups, where Table 1 describes the final composition of each cluster.

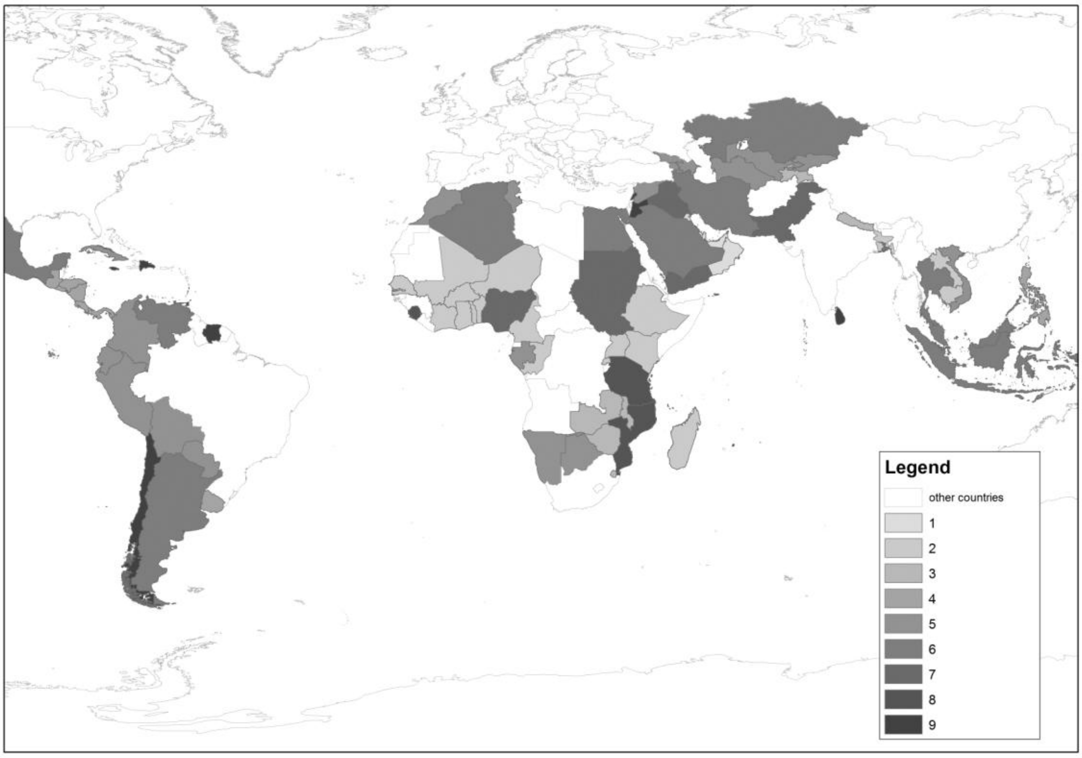
Cluster 1 and 6 include small and large energy exporting economies, respectively. Whereas Cluster 6 is composed of countries not belonging to the same geographical area, Cluster 1 also has a common geographic feature since it gathers countries located only in the Middle East. A geographic feature also drives Cluster 3 that includes all landlocked countries, and Cluster 9, that mainly consists of islands. Cluster 5 seems to be mainly driven by countries' endowment of natural resources, whereas Cluster 7 includes countries with serious problems of political instability and low institutional quality. Finally, the world's poorest countries are split into two different clusters: the poorest African economies mainly based on mineral resources constitute Cluster 8, whereas the others belong to Cluster 2.

By looking at Figure 2, the spatial representation of cluster distribution reveals that the African continent shows the highest heterogeneity with countries assigned to a relative higher number of clusters than other continents. This provides a first overall view of the increasing importance that less advanced countries actively participate in a final global agreement. If several contrasting interests gather a large number of countries, it could be difficult to reach a consensus without several compensating schemes for more vulnerable countries.

Table 1 – Bargaining coalitions from cluster analysis

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8	Cluster 9
Bahrain Kuwait Oman Qatar United Arab Emirates	Benin Burkina Faso Cameroon Comoros Congo, Rep. Cote d'Ivoire Ethiopia Gambia Ghana Kenya Madagascar Mali Niger Rwanda Senegal Togo Uganda Bangladesh Cambodia Lao PDR	Malawi Swaziland Zambia Zimbabwe Nepal Tajikistan	Costa Rica El Salvador Guatemala Honduras Nicaragua Panama Uruguay Philippines	Bolivia Colombia Cuba Ecuador Paraguay Peru Botswana Gabon Morocco Namibia Tunisia Armenia Azerbaijan Georgia Kyrgyz Republic Syrian Arab Republic Turkmenistan Uzbekistan Vietnam	Argentina Mexico Venezuela Algeria Egypt Indonesia Iran Kazakhstan Malaysia Saudi Arabia Thailand	Nigeria Sudan Iraq Pakistan Yemen	Mozambique Sierra Leone Tanzania	Chile Dominican Republic Jamaica St. Lucia St. Vincent and the Grenadines Suriname Trinidad and Tobago Mauritius Jordan Lebanon Maldives Sri Lanka

Figure 2 - Developing countries' bargaining coalitions from cluster analysis



In order to analyse the nine clusters, we have first investigated the driving criteria of the clustering process. We have calculated the mean and the coefficient of variation (CV, calculated as the ratio between the standard deviation and the mean) for each variable composing the whole dataset by considering that the higher the value of the CV, the stronger the influence of the variable in driving the formation of the groups. Table 2 shows values for the first two variables with the highest CV for each dimension.

To identify the variables that have the largest driving power in forming the clusters, we have considered a threshold value for CV equal to one. Quite interestingly, variables related to Energy, Geography and Economy dimensions have a CV higher than 1, whereas variables referring to Demography, Institution and Development have lower values. This suggests that the first three dimensions can play a major role in determining the composition of clusters than the others, as illustrated by Table 3 that lists the first ten drivers.

All the variables identified in Table 3 are crucial to the formation of bargaining coalitions in the context of climate negotiations. Geographical variables (precipitation and coastline), for example, represent characteristics strictly related to the vulnerability of a country. At the same time, economic conditions can explain potential concerns and requests from developing countries to shift the climate debate towards adaptation and sustainable development issues.

The large influence played by indicators representing the energy system and CO_2 emissions reflects how important it is to consider different aspects of the mitigation efforts. For those countries characterized by a high emission level, the abatement costs will be necessarily higher than for small emitters; we can therefore expect the emission levels to have a strong impact on shaping the bargaining positions related to the distribution of mitigation efforts. The same reasoning applies to those countries whose economy largely depends on energy exports: these countries can be negatively affected by the adoption of more stringent abatement objectives which can have the effect of reducing international energy prices due to demand restrictions.

Table 2 – Driving variables

Dimension	Index	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8	Cluster 9	CV
Geography	Precipitation per sq km (mm)	0.03	0.06	0.01	0.03	0.01	0.00	0.00	0.01	0.75	2.43
	Coastline (km)	926.60	457	0.00	5397.25	1104.26	8023.364	943.2	1432	1012.25	1.26
Economy	GDP (bln$ PPP const 2011)	252.24	55.34	27.31	125.56	146.48	1041.56	483.05	37.67	76.14	1.32
	FDI inflows (% GDP)	1.71	4.71	2.77	5.16	4.28	2.25	1.38	20.65	6.65	1.08
Demography	Population (mln)	3.82	26.70	13.41	18.00	17.86	70.50	88.33	26.33	5.46	0.98
	Population growth (%)	5.05	2.61	2.30	1.47	1.29	1.36	2.29	2.48	0.92	0.56
Energy	Electr. prod. Renew. (%)	0.00	1.79	0.13	15.95	0.96	1.43	0.00	0.00	2.84	1.99
	CO_2 emissions (Mton)	82.65	6.49	3.46	16.96	39.18	307.73	78.20	3.47	17.77	1.57
Institution	Socioeconomic conditions (score)	8.01	3.05	2.87	4.99	5.53	6.16	2.59	2.75	5.09	0.41
	Law & Order (score)	9.49	5.86	6.09	5.01	6.89	6.03	4.60	7.67	5.84	0.23
Technology	Road density (%)	137.57	26.92	17.26	36.80	18.73	17.49	15.60	7.63	98.50	1.08
	High-technology exports (%)	1.39	4.92	5.96	18.38	7.64	11.95	0.86	11.46	3.15	0.79
Development	Mortality rate - under 5 (%)	8.99	77.28	71.11	20.79	29.77	17.87	75.38	103.83	16.56	0.74
	Child malnutrition (%)	5.03	23.75	17.37	7.96	7.32	6.55	27.90	19.73	7.68	0.63

Table 3 – Principal drivers

Variable	CV
Precipitation per sq km	2.43
Electricity production from renewables	1.99
CO2 emissions	1.57
Primary energy consumption	1.51
Primary energy production	1.47
Electricity production	1.41
GDP	1.32
Coastline	1.26
Road density	1.08
FDI (inflows)	1.08

At a general level, these results show that the clusterization process is mainly driven by those characteristics that represent the most debated issues in climate international negotiations. This suggests that specific country features must be considered in order to understand the origins of bargaining positions and foresee potential new alliances of defections based on countries' common or divergent interests.

4.2. Climate bargaining strategies of developing countries

These statistical results help to explain the bargaining interests of developing countries and compare existing countries' coalitions and the groups derived by the cluster analysis, in order to highlight potential hot spots in climate agreements. Starting with fossil fuels exporters (Cluster 1 and 6), it is worth mentioning that these countries have a strong interest in avoiding economic losses that may arise as a consequence of mitigation actions. We can therefore expect them to try and keep the international demand for fossil fuels high by assuming negotiating positions intended to limit mitigation actions.

Consequently, the large decrease in fossil fuel demand at the international level will substantially reduce net gains for energy exporters. It is also worth noting that efforts made by these countries to delay and prevent the implementation of mitigation actions are also justified by their low level of vulnerability to the negative effects of climate change. Compared with other developing countries, energy exporters (Cluster 1 and 6) are the countries with the highest GDP per capita associated with the lowest degree of vulnerability, as illustrated in Table 4.

Table 4 – Comparison between GDP per capita, CO_2 emissions and vulnerability of clusters

Cluster	GDP p.c. ($ PPP constant 2011)	Vulnerability Index	Coastline (%)	CO_2 (Mton)	Share of world CO_2 (%)	Fuel exports (%)	Institution quality
1	71,586	0.31	6.22	413.23	1.23	76.77	8.20
2	2,231	0.51	1.08	129.71	0.39	11.18	5.52
3	2,751	0.46	0.00	20.73	0.06	3.99	5.04
4	9,935	0.36	2.70	135.66	0.40	2.14	7.01
5	9,788	0.35	0.42	744.44	2.21	33.17	6.19
6	19,146	0.30	0.58	3,385.08	10.07	48.72	6.59
7	6,386	0.49	0.13	390.99	1.16	73.72	5.18
8	1,424	0.55	0.34	10.42	0.03	9.88	6.49
9	14,334	0.34	24.56	213.18	0.63	8.67	7.03

At the same time, however, the two groups of countries would have very different abatement costs in a mitigation scenario, since their emissions are significantly diverse, both in terms of levels and as a share of overall CO_2 emissions (corresponding to 1.23% and 10.07% of total CO_2, respectively). It is therefore reasonable to presume that their efforts to contrast the introduction of mitigation actions will also be differentiated according to these costs. Specifically, highly polluting energy exporters have a double interest in maintaining low levels of abatement duties which can benefit them both indirectly, through the maintenance of international demand for fossil fuels, and directly, by reducing their contribution to overall abatement efforts. Negotiating positions of countries within Cluster 1 and 6 could also be different with respect to the debate on GCF allocation, with strong polluters calling for funding criteria that privilege mitigation over adaptation measures.

By interpreting the total GDP as a criterion to evaluate the level of external power in negotiations (Nagashima *et al*., 2009), it is worth mentioning that Cluster 6 is by far the strongest coalitions among developing countries, with the highest expected success in bargaining process. This cluster is the most unfavourable to a stringent mitigation commitment, since it will face large direct mitigation costs relative to the other Clusters and will also face a large loss in fossil fuel export flows.

At the same time, since the UNFCCC works with the one country one vote rule, the Clusters most vulnerable to climate change and less affected by mitigation costs have low external power in GDP terms but by far have the largest bargaining power in terms of salience and of wideness of country coverage.

Clusters 2, 3 and 8, on the other hand, are the poorest and most vulnerable groups. They include countries (especially African States) characterized by very low levels of economic development and agricultural performance, low quality in the institutional and infrastructural context, and, conversely, a high vulnerability to desertification and weather extreme events. Therefore, their main interests are to foster the fight against climate change, both in terms of mitigation policies and adaptation, as well as to promote a climate regime that combines climate efforts and sustainable development. Due to their high vulnerability combined with very low levels of CO_2 emissions, they may be interested in negotiating the implementation of strict abatement efforts and national measures that force larger emitters to a more significant cut in GHG emissions.

In fact, Table 4 shows that, despite the multiplicity of countries included, Clusters 2, 3 and 8 are all characterized by low levels of CO_2 emissions (and low percentages in terms of overall emissions, corresponding respectively to 0.39, 0.06 and 0.03%), associated with the highest degree of vulnerability. While confirming one of the main paradoxes associated with climate change, i.e. countries most affected by the negative impacts of climate change are those that are not responsible for it, these considerations also provide a potential interpretation of recent changes in negotiation alliances towards more differentiated positions. Indeed, it is quite evident that these countries will try to negotiate the allocation of more financial resources to adaptation rather than mitigation support.

Cluster 4 and 5 include countries characterized by low levels of vulnerability. Cluster 4 is also geographically homogenous, consisting mainly of Latin American States. We discuss these two clusters together because they include several countries belonging to the same existing negotiating coalitions, namely the ALBA and AILAC,[12] which have played an active role in recent climate meetings. However, as our cluster analysis suggests, these alliances encompass countries with different geographical and economic characteristics that can potentially affect their positions within the coalition and can lead to future defections. Countries in Cluster 4, for instance, have a larger coastline surface than Cluster 5, signalling a higher exposition to the negative effects of global warming; on the other hand, they contribute to a lower share of global emissions (0.40% compared with 2.21%)and fuel exports. These aspects may give rise to different attitudes in climate negotiations, with countries grouped in Cluster 4 that advocate stronger mitigation actions or, at least, an allocation of GCF that is more unbalanced towards adaptation support.

By looking at Cluster 7, we can see that it consists of five countries, namely Nigeria, Sudan, Iraq, Pakistan and Yemen, characterized by high political instability, terrorism, a high crime rate and corruption, as demonstrated by the low value of the indicator for the quality of institutions. From the climatic bargaining point of view, they represent a very interesting group, because, although they have a high level of fuel exports, they can be

[12] ALBA (Bolivarian Alliance for the Peoples of Our America) includes Antigua and Barbuda, Bolivia, Cuba, Dominica, Ecuador, Grenada, Nicaragua, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines and Venezuela, while AILAC (Independent Alliance of Latin America and the Caribbean) includes Chile, Colombia, Costa Rica, Guatemala, Panama and Peru.

classified as poor and vulnerable countries when comparing their GDP per capita and vulnerability index. This suggests that they may have conflicting interests and positions in climate negotiations depending on the main direction adopted in future agreements. In fact, on the one hand, they may benefit from stricter abatement efforts that may reduce the expected adverse effects of climate change; on the other, their economies are strongly linked to fossil fuels exports and a reduction in global consumption would seriously threaten their opportunities of economic growth. These contrasting interests can lead these countries advocating different positions, joining alternative bargaining coalitions (LCDs as well as fossil fuel producers) during different COPs. These considerations also suggest that, whatever the final outcomes in negotiations, they will probably experience some losses, since they have to sacrifice improvements in terms of vulnerability in favour of economic benefits or vice versa.

The same contrasting positions characterize countries belonging to Cluster 9: as shown in Table 4, they have a relatively high GDP per capita and emissions compared with other clusters formed by LDCs, combined with a low general vulnerability, even though they are highly vulnerable to the risk of flooding and sea level rise. Indeed, Cluster 9 is characterized, on average, by the highest percentage of coastline (almost 25% of the surface), including several islands that are countries that are some of the most vulnerable to the effects of climate change. Due to these considerations, we can expect them to be interested in a new agreement for a greater effort in adaptation as well as mitigation actions, even though it would imply their active contribution in mitigation efforts. At the same time, they will advocate more funds for adaptation purposes, requiring special investment efforts in actions oriented towards reducing the specific climate risk of sea level rise.

As suggested by our statistical cluster results, developing countries are characterized by heterogeneous concerns and conflicting interests that can contribute to explaining the deadlock in climate negotiations. In particular, our analysis reveals that in some circumstances, countries may advocate, at the same time, interests that are potentially contrasting, leading to the possibility that very fragile, variegate alliances will be formed. This has become particularly evident in recent years when several new sub-groups (more or less formalized) have been created in order to defend their interests. New negotiating blocks include, for instance, the BASIC countries (Brazil, South

Africa, India and China) which include emerging and large emitting countries and the LDCs, including the more vulnerable countries. Other alliances are the Central American Integration System (SICA), the AILAC, the ALBA, the Alliance of Small Island States (AOSIS) and the Group of like-minded (GLM) developing countries (Roberts and Edwards, 2012). However, these coalitions are strongly influenced by the heterogeneity of their members and are expected to be highly unstable. The AOSIS group, for example, is composed of islands that are threatened by climate change in very different ways; clearly, their degree of involvement in climate efforts is different and individual interests may differ a great deal from those representing the true coalition's interests (Betzold, Castro and Weiler, 2012). This is particularly relevant if we consider that, in recent years, some negotiating blocks (Latin American blocks, in particular) have been able to influence climate negotiations, determining deadlocks as well as important decisions such as the implementation of the GCF.

As seen above, when we compare existing coalitions with our clusters, we can observe that there is no perfect overlapping between them. If we look at AILAC and ALBA groups, for instance, we can see that their member countries belong to three different clusters (Cluster 4, 5 and 9), whereas Venezuela belongs to Cluster 6.

Differences in countries' distribution among the clusters reflect potential weaknesses in existing bargaining coalitions and suggest that potential hot spots and critical situations may arise. By looking, for instance, at Nicaragua and comparing it with the rest of ALBA members, we can observe that it has a lower level of emissions (4.54 against 28.82Mton), a higher percentage of electricity production from renewable sources (22% against 2%) and higher energy imports (83% against 19% of energy use). Furthermore, these values are more similar to those for other AILAC members grouped in Cluster 4. Colombia and Peru, on the other hand, are more similar to ALBA members since their data show higher values than those associated with AILAC countries.

These different structural features of member countries can lead to the adoption of different positions in the bargaining process; consequently, we can expect divergent interests to create problems for the stability of existing alliances, complicating the negotiation process and leading to a standstill.

5. Conclusions

In recent years we have seen the emergence of several new bargaining groups within climate negotiations and the scientific literature has poorly emphasized their crucial role in producing or escaping from a deadlock. Given the heterogeneities of countries included in these bargaining groups and their relative differences in the costs and benefits related to climate actions, it is reasonable to presume that future climate negotiations will be characterized by more nuanced, unstable alliances. This issue is particularly timely in view of the deadline for a global climate agreement at COP21 which will be held in Paris in December 2015.

In light of this emerging debate, our analysis identifies the main driving factors behind countries' interest and constraints and provides a sketch of future potential bargaining positions based on their respective interests and concerns. As our analysis suggests, countries belonging to different groups can have different attitudes towards mitigation and adaptation issues, depending on their specificities in terms of socio-economic and geographical aspects that determine their relative peculiarities and vulnerabilities.

The comparison of the groups formed by the statistical cluster approach proposed here with the already existing bargaining coalitions emphasizes that the relative position toward mitigation vs. adaptation support and with respect to the stringency level of future mitigation pathways is highly dependent of the structural features that characterize single countries.

Given this high heterogeneity, the policy implication we draw is that, in order to maximize the likelihood of a successful climate agreement in the short term, it will be necessary to design differentiated supporting actions according to countries' specific interests and weaknesses in order to equalize costs and benefits of mitigation policies and vulnerability to climate change.

Accordingly, our policy advice is that the already existing compensation mechanisms, primarily the GCF, should be better designed in order to become useful in reducing the distance between the domestic optimal solution desired by each country from the climate negotiations and the final global agreement achieved. The GCF, or whatever complimentary supporting measure will be adopted, should be interpreted not only as a compensation instrument, but also as an active tool for maximizing a successful international climate agreement. Consequently, the distribution criteria across countries and objectives (mitigation vs. adaptation; different types of adaptation costs) should be planned according to quantitative assessment analysis instead of following requirements from unstable bargaining coalitions.

To this purpose, our paper also provides some suggestions with respect to informing ex-ante evaluation models in order to better specify regional aggregation respecting the under-lying preferences of actors with respect to climate change issues, in order to build up payoff matrices more coherent with real costs and benefits. This will allow better computing also those complimentary efforts required to reduce conflicts in negotiations thus reaching to a global climate agreement more rapidly.

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Appendix A

Table A1 – Dataset description and data sources

Dimension	Variable	Definition	Source
Geography	Surface	Surface area (sq. km)	World Bank
	Coastline	Coastline(km)	CIA-World Factbook
	Agricultural land	Agricultural land (% of land area)	World Bank
	Annual temperature	Mean Annual temp. (Celsius)	World Bank
	Daily min temperature	Average daily min temperature (1961-1990, Celsius)	World Bank
	Daily max temperature	Average daily max temperature (1961-1990, Celsius)	World Bank
	Projected temperature change	Projected mean annual temperature change (average2045-2065, Celsius)	World Bank
	Temperature % variation	Temperature percentage variation	Our elaboration on World Bank data
	Annual precipitation	Mean Annual prec (mm per sq km)	World Bank
	Precipitation impact	Index of projected precipitation impact	Our elaboration on World Bank data
	Droughts, floods, extreme temperatures	% pop. Affected by extreme events (avg. 1990-2009)	World Bank
	Vulnerability Index	Vulnerability Index (ND-Gain)	University of Notre Dame
Economy	GDP	GDP, PPP (current international $)	World Bank
	GDP growth	GDP growth (annual %)	World Bank
	Gross fixed capital formation	Gross fixed capital formation (% of GDP)	World Bank
	General government final consumption expenditure	General government final consumption expenditure (% of GDP)	World Bank
	Unemployment, total	Unemployment, total (% of total labour force)	World Bank
	Employment, agriculture	Employment in agriculture (% of total employment)	World Bank
	Employment, industry	Employment in industry (% of total employment	World Bank
	Employment, services	Employment in services (% of total employment)	World Bank
	Employment, female	Employment to pop. ratio, 15+, female (%)	World Bank
	FDI	FDI, net inflows (% of GDP)	World Bank
	Exports	Exports of goods and services (% of GDP)	World Bank
Demography	Population	Population (Total)	World Bank
	Population growth	Population growth (annual %)	World Bank
	Population, 0-14	Population ages 0-14 (% of total)	World Bank
	Population, female	Population, female (% of total)	World Bank
	Rural population	Rural population (% of total population)	World Bank

Table A1 – Dataset description and data sources - continued

Energy	Electricity production	Electricity production (kWh)	World Bank
	Electricity production from oil, gas and coal sources	Electricity production from oil, gas and coal sources (% of total)	World Bank
	Electricity production from renewables	Electricity production from renewable sources, excluding hydroelectric (% of total)	World Bank
	Energy Production	Total Primary Energy Production (Quadrillion Btu)	EIA
	Energy Consumption	Total Primary Energy Consumption (Quadrillion Btu)	EIA
	Energy imports	Energy imports, net (% energy use)	Our elaboration on EIA data
	Fossil fuel energy consumption	Fossil fuel energy consumption (% of total)	World Bank
	Fuel exports	Fuel exports (% of merchandise exports)	World Bank
	Fuel imports	Fuel imports (% of merchandise imports)	World Bank
	CO2 emissions	CO2 emissions (kt)	World Bank
Institution	Socioeconomic Conditions	Socioeconomic Conditions	The PRS Group
	Investment Profile	Investment Profile	The PRS Group
	Law and Order	Law and Order	The PRS Group
	Democratic Accountability	Democratic Accountability	The PRS Group
Technical innovation	Road Density	Road Density (km of road per 100 sq. km of land area)	World Bank
	Internet users	Internet users (per 100 people)	World Bank
	Mobile-cellular subscriptions	Mobile cellular subscriptions (per 100 people)	World Bank
	Telephone lines	Telephone lines (per 100 people)	World Bank
	High-technology exports	High-technology exports (% of manufactured exports)	World Bank
Development	Schooling	Mean years of schooling	UNDP
	Education expenditure	Education exp, public (%GDP)	UNDP
	Health expenditure	Health exp, public (%GDP)	UNDP
	Under 5 mortality rate	Under-five mortality rate (per 1,000)	World Bank
	Child malnutrition	Child malnutrition, underweight (% of under age 5)	World Bank
	Life expectancy	Life expectancy at birth (year)	UNDP
	Distribution	2000-2010 Quintile Income Ratio (q20%)	UNDP
	HDI	Human Development Index	UNDP

Table A2 – Kaiser-Meyer-Olkin Test

Variable	KMO	Variable	KMO
Surface	0.5285	Electricity production	0.8036
Coastline	0.5824	Electricity production from oil, gas and coal sources	0.6726
Agricultural land	0.6099	Electricity production from renewables	0.476
Annual temperature	0.6177	Energy Production	0.7439
Daily min temperature	0.5928	Energy Consumption	0.7309
Daily max temperature	0.5862	Energy imports	0.7896
Projected temperature change	0.4906	Fossil fuel energy consumption	0.8508
Temperature % variation	0.4457	Fuel exports	0.6524
Annual precipitation	0.3982	Fuel imports	0.6164
Precipitation impact	0.1234	CO2 emissions	0.7599
Droughts, floods, extreme temperatures	0.5692	Socioeconomic Conditions	0.7384
Vulnerability Index	0.835	Investment Profile	0.746
GDP	0.7507	Law and Order	0.3169
GDP growth	0.4009	Democratic Accountability	0.338
Gross fixed capital formation	0.3697	Road Density	0.6232
General government final consumption expenditure	0.4179	Internet users	0.776
Unemployment, total	0.3672	Mobile-cellular subscriptions	0.7693
Employment, agriculture	0.7948	Telephone lines	0.8243
Employment, industry	0.783	High-technology exports	0.2693
Employment, services	0.7498	Schooling	0.7021
Employment, female	0.7494	Education expenditure	0.5136
FDI	0.5512	Health expenditure	0.5115
Exports	0.5773	Under 5 mortality rate	0.8407
Population	0.5687	Child malnutrition	0.7729
Population growth	0.5745	Life expectancy	0.808
Population, 0-14	0.7592	Distribution	0.4033
Population, female	0.5911	HDI	0.7553
Rural population	0.8608	**Overall**	**0.6908**

Table A3 – Duda-Hart Test

Number of clusters	Je(2)/Je(1)	pseudo T-squared
1	0.8585	14.51
2	0.9409	4.96
3	0.334	13.96
4	0.7375	27.76
5	0.6857	14.67
6	0.0107	92.1
7	0.924	3.62
8	0.8128	9.9
9	0.8787	4
10	0.878	4.86
11	0.3693	3.42
12	0.8321	5.45
13	0.5096	5.77
14	0.8361	5.29
15	0.741	6.64