How Has the Developing World Changed since the Late 1990s? A Dynamic and Multidimensional Taxonomy of Developing Countries

Andy Sumner and Sergio Tezanos Vázquez

Abstract

Many existing classifications of developing countries are dominated by income per capita (such as the World Bank's low, middle, and high income thresholds), thus neglecting the multidimensionality of the concept of 'development'. Even those deemed to be the main 'alternatives' to the income-based classification have income per capita heavily weighted within a composite indicator. This paper provides an alternative perspective: clusters of developing countries. We take 4 'frames' on the meaning of development: economic development, human development, better governance, and environmental sustainability. We then use a cluster procedure in order to build groups of countries that are to some extent internally 'homogeneous', but noticeably dissimilar to other groups. The advantage of this procedure is that it allows us identify the key development characteristics of each cluster of countries and where each country fits best. We then use this taxonomy to analyze how the developing world has since the late 1990s in terms of clusters of countries and the country groupings themselves.

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Executive Summary

Many existing classifications of developing countries are dominated by income per capita (such as the World Bank's low, middle and high income thresholds), thus neglecting the multidimensionality of the concept of 'development'. Even those deemed to be the main 'alternatives' to the income-based classification have income per capita heavily weighted within a composite indicator.

This paper provides an alternative perspective: clusters of developing countries. We take 4 'frames' on the meaning of development: economic development, human development, better governance, and environmental sustainability. We then use a cluster procedure in order to build groups of countries that are to some extent internally 'homogeneous', but noticeably dissimilar to other groups. The advantage of this procedure is that it allows us identify the key development characteristics of each cluster of countries and where each country fits best. We then use this taxonomy to analyze how the developing world has changed since the late 1990s in terms of clusters of countries and the country groupings themselves.

The main findings are as follows: First, the developing world can be classified into five multidimensional development clusters and this number of clusters remains the same between the periods 1995-2000 and 2005-2010. However, not surprisingly, the nature of the clusters has changed over time. The development taxonomy in the more recent period of 2005-2010 was as follows:

- Cluster 1 consists of countries with high poverty rates and largely 'traditional' economies.
- Cluster 2 is countries with high poverty rates that are primary product exporting and have limited political freedoms.
- Cluster 3 is composed of countries with democratic regimes and high levels of inequality and dependency on external flows.
- Cluster 4 is of "emerging economies" who are primary product exporting with low inequality but high environmental pollution and limited political freedom.
- Cluster 5 is of unequal and highly polluting "emerging economies" with low dependence on external finance.

The development characteristics of four of the five clusters remain similar over time, but cluster 2 changed dramatically.

A third of all developing countries changed cluster membership between these two periods, and the remainder of the developing countries remain in the same cluster.

We argue that these 'dynamic' results mean that there is no simple 'linear' representation of development levels (from low to high development countries), as is implied with the income per capita ranking classification.

Instead, each cluster of countries has its own and specific development issues and there is no group of countries with the best (or worst) indicators in all the development dimensions we used.

Our taxonomy seeks to offer a more nuanced understanding of the diversity of challenges of developing countries and their evolution over time.

Contents

1. Introduction

Existing classifications of developing countries are – arguably – excessively dominated by income *per capita* (such as the World Bank's low, middle and high income thresholds), thus neglecting the multidimensionality of the concept of 'development'. Even those deemed to be 'alternatives' to the income-based classification – such as the Human Development Index (HDI) and Least Developed Countries (LDC) classifications – have income *per capita* heavily weighted.

Not surprisingly, in one recent review of country classifications, Nielsen (2012) argues that the methodology behind such taxonomies lacks clarity:

Existing taxonomies suffer from lack of clarity with regard to how they distinguish among country groupings. The World Bank has not explained why the threshold between developed and developing countries was a *per capita* income level of US$6,000 in 1987 and US$12,475 in 2011. Nielsen (2012: 17).

Additionally the subject of classification enquiry is a moving target: In the late 1990s most developing countries were classified by the World Bank as low income countries. Today most are middle income countries. Given that the World Bank country thresholds are only adjusted for "international inflation" in an attempt to keep their 'real' value constant (see discussion in Sumner, 2012), this means that in real terms the threshold has been fixed for 40 years so, and as countries grow, more and more pass this 'fixed' line.

Moreover, there is now around 50 years of new data available since the World Bank's income classification was originally established, and therefore there is a clear justification for further assessing if *per capita* incomes are closely related to other indicators of economic and social development.

In the precursor to this current paper we proposed an alternative approach to classifying countries (see Tezanos and Sumner, 2013) which is based on four frames on the meaning of 'development' that have been dominant in the academic literature for some considerable time: structural change, human development, environment sustainability and improved governance. Of course there are other potential 'frames' that we did not include as we considered that they are still evolving conceptually and empirically and remain highly contested in measurement.[1]

[1] For this reason we did not claim our taxonomy was the final word, rather an illustration of the enduring weakness of income per capita to capture the many dimensions of development.

The choice of four frames we took is somewhat similar to that of two recent papers (Pritchett *et al.*, 2010; Pritchett and Kenny, 2013). Pritchett *et al.* (2010: 3-4) note thus:

When people speak of the 'development' of societies most people refer, implicitly or explicitly, to a cumulative historical process whereby economies grow through enhanced productivity, prevailing political systems represent the aggregate preferences of citizens, rights and opportunities are extended to all social groups, and organizations function according to meritocratic standards and professional norms (thereby becoming capable of administering larger numbers of more complex tasks). A given society undergoes a four-fold transformation in its functional capacity to manage its economy, polity, society and public administration, becoming, in time, developed… When in everyday speech people say that France is 'more developed' than Congo, or Denmark more developed than Nepal, they mean, inter alia, that France has undergone more of this four-fold functional transformation than the Congo and Denmark than Nepal.

Our review in Tezanos and Sumner (2013) of the academic literature of various development conceptions took us to a similar approach in the sense of economic, social and political development but with two important differences: First we added environmental sustainability and second we found if anything there is no such linear pattern in the data – as if all countries were following a similar 'development path' of income growth.

In this follow up paper we consider again our four frames which produced five clusters of developing countries and develop the taxonomy further by analysing changes over time to the groups themselves and the counties in each group in order to answer the essential question: How has the developing world changed since the late 1990s?

The value-added of this paper is not to suggest that our classification is the end in itself, nor to propose that it should be used by aid agencies. Rather, the intended contribution of the paper is to demonstrate the weakness of existing classifications given an evolving developing world. In order to do so, this paper builds an alternative taxonomy based on four 'frames' on development and this taxonomy is used to analyse how the developing world has changed – beyond income per capita – since the late 1990s in terms of clusters of countries and the country groupings themselves. We use a cluster procedure in order to build groups of countries that are – to some extent – internally 'homogeneous', but noticeable dissimilar to other groups. The advantage of this procedure is that it allows us identify the key development characteristics of each cluster of countries and where each country fits best.

The paper is structured as follows. Section 2 discusses three country analytical classifications in common usage. Section 3 presents the theoretical basis and the methodology for building a multidimensional and dynamic taxonomy of countries using cluster analysis. Section 4 discusses the main results and compares the outcome of the cluster classification with other international classifications of development. Section 5 concludes.

2. Main classifications of developing countries

Classifying developing countries serves two important purposes: First, for *analytical reasons*, country classifications simplify a complex and diverse world into relatively homogeneous groups of countries that share some distinct features, thus supporting understanding of the most significant inter-country differences (or similarities) in development outcomes. Second, for *operational reasons*, country classifications serve a purpose for multilateral and bilateral aid agencies in terms of resource allocations and differentiated policies towards different countries. In short, a better understanding of the nature of differences between countries means resources and policies can be better tailored to suit countries' needs and potentially support the identification of countries with similar development needs.

It is not easy to classify countries according to their levels of development, to begin with because any definition of "development" is complex and multidimensional. Added to this difficulty is the fact that the socio-economic realities of the so-called "developing countries" are becoming more diverse and heterogeneous, which makes universally valid analysis even more difficult (Tezanos and Quiñones, 2012).

Despite these difficulties, there are several international classifications of development that use different criteria to draw some kind of threshold that separates the "developed" and the "developing" countries. Five well known classifications are: the low/middle/high income countries as used by the World Bank; the OECD's Development Assistance Committee (DAC)' classifications of 'developing countries' and "fragile and conflict-affected states"; the HDI of the United Nations Development Programme (UNDP); and the Least Developing Countries (LDC) of other multilateral agencies such as the United Nations Conference on Trade and Development (UNCTAD), amongst others.

The World Bank provides, since 1978, a ranking of countries according to their corresponding levels of *per capita* income (proxied by the *per capita* Gross National Income, GNI, based on the Atlas method, largely an exchange rate conversion).

Although the World Bank recognizes that development is not only a matter of income, it believes that the *per capita* GNI is 'the best single indicator of economic capacity and progress' (World Bank, 2014a). Thus, the successive *World Development Reports* (and the online database, the *World Development Indicators*) classify countries into four income groups using thresholds at about $1,000, $4,000 and $12,000 *per capita* which are adjusted each year by international inflation (World Bank, 2014b). The resulting four country groups are called "low income countries" (LIC), "lower middle income countries" (LMIC), "upper middle income countries" (UMIC) and "high income countries" (HIC).

The OECD-DAC uses the World Bank's income classification in order to distinguish two groups of countries (DAC, 2014): the "developing countries" (LIC, LMIC and UMIC, according to the World Bank), and the "developed countries" (basically high-income countries). The former are potential recipients of Official Development Assistance (ODA). Moreover, the DAC classification divides the LIC group into 'Least Developed Countries' (LDC) and 'other low income countries'.

One could argue that LIC and middle income countries (MIC) thresholds are worthy of a substantial review, particularly because they are so dated.[2] The exact methodology to set the lines is not public but the World Bank website states that it was based on the relationship between income *per capita* and various other indicators of economic and social development, presumably on whatever data was available in the late 1960s. Since then the lines have been revised by "international inflation", meaning the inflation rates of the world's richest countries (the weighted average of the Euro Zone, Japan, the U.K. and the U.S.). In short, there is now around 50 years of new data available since the thresholds were originally established to assess if GNI *per capita* is closely related to other indicators of economic and social development. Further, "international inflation" ought now to include China and other 'emerging economies' in its calculation. And, indeed, it should be considered whether the use of 'international inflation' rates for the world's richest countries is an appropriate way to assess the income thresholds over time for the world's poorer countries, which may historically have had inflation rates above the 'international inflation' rate. There are also questions as to whether purchasing power parity (PPP) income should be used rather than exchange rate and if the thresholds should be fixed in real terms or linked to the world's GNI *per capita*. In fact, the LIC/MIC threshold has been falling as a proportion of the world GNI *per capita* as Nielsen (2012) noted.

[2] The World Bank itself has recently opened a review of the thresholds and will probably report the conclusions of this review by mid to late 2014. In a similar vein, the United Nations' Development Cooperation Forum of the Economic and Social Council (ECOSOC) is currently reviewing the subject of country classifications, although no information on this debate has been made public yet.

The OECD-DAC also has a grouping of "fragile and conflict affected countries". Initially, three separate sources presented different classification criteria of "fragile states" (Brookings, Carlton and the World Bank).[3] The last of these, the World Bank's 'Harmonised Lists of Fragile Situations' of 34 countries (see World Bank, 2013) arguably has a stronger analytical basis because:

'Fragile Situations' have: either a) a harmonized average CPIA [Country Policy and Institutional Assessment] country rating of 3.2 or less, or b) the presence of a UN and/or regional peace-keeping or peace-building mission during the past three years. This list includes only IDA eligible countries and non-member or inactive territories/countries without CPIA data. It excludes IBRD only countries for which the CPIA scores are not currently disclosed (World Bank, 2013: 1).

The OECD (2010) first combined the three lists into a list of 43 countries. As noted in Sumner (2010), only 17 of those 43 'fragile states' were common across the lists, and the differences in the countries listed mean that the proportion of the world's poor in fragile states in 2007 ranged from 6 per cent to 25 per cent (see detailed critique of the 'fragile states' lists from Harttgen and Klasen, 2010). Then OECD (2013) revisited the OECD-DAC category and only one list – the World Bank list of conflict/post-conflict countries – was merged with a further source – the Failed States Index of the U.S. think-tank, the Fund for Peace –, which had the effect of producing 47 countries:

The list of countries in fragile situations used for this analysis (neither an official DAC list nor an official definition) […] is a compilation of two lists: the Harmonised List of Fragile Situations (2009; World Bank, African Development Bank, Asian Development Bank) and the 2009 Fund for Peace Failed States Index. (OECD, 2013: 1).

Further, if more than a third of all developing countries fall under the OECD's definition of fragile and conflict states this sets up a binary that countries are either "fragile" or "stable". In reality stable countries may have fragile or conflict-affected sub-national units (e.g. India's Naxalite insurgency) and fragile and conflict states may have largely stable areas.

The UNDP ranks countries by levels of "human development" by means of a composite index – the *Human Development Index*, HDI – that tries to capture the multidimensionality of the development process. The HDI was first developed by Mahbubul Haq with the collaboration of Amartay Sen and other leading development thinkers for the first

[3] See respectively for Brookings and Carlton: www.brookings.edu/reports/2008/02_weak_states_index.aspx and www.carleton.ca/cifp

Human Development Report (see UNDP, 1990). Specifically, the index includes three dimensions of development: health, education and living standards. The HDI classifies countries into four relative groups of human development: very high, high, medium and low human development (UNDP, 2013):

The primary critiques of the UNDP classification have been that the HDI is only a partial and somewhat uneven application of human development and capabilities. It does not incorporate a full range of the conditions of human development (such as being sheltered) and, although exchange entitlements are accounted for, endowments are not, and because 'capabilities' are difficult to measure, many of the components of the HDI are actually based on 'functionings' or outcomes rather than opportunities to achieve desirable outcomes. Further, it has been argued that the HDI shows little more than income *per capita* (due to the heavy weighting of GDP per person, which accounts for one third of the index) and the index components themselves correlate very closely (for further discussion, see Desai, 1991; McGillivray, 1991; Srinivasan, 1994).

Finally, there is also the UN category of 'Least Developed Countries' (LDC), which utilises a complex methodology that combines human assets (including nutrition, child mortality, school enrolment and adult literacy), economic vulnerability (measures of the instability of agricultural production, population displaced by natural disasters, instability in exports, and the share of agriculture in GDP and exports), proxies for economic 'smallness', 'remoteness' and GNI *per capita*. The main problem of the LDC category is that it is somewhat static. Guillaumont (2009), among others, has argued that the graduation criteria make it very difficult for countries to "leave" this category (even if they wish to). Furthermore, a third of LDC are actually MIC which somewhat undermines the sense of the LDC being the poorest countries across a set of dimensions if a third are, at least in income *per capita* terms, not amongst the poorest. And finally, the LDC category is not actually a development classification, as it groups countries in a binary way in which there is not criterion for identifying the "non-LDC" (they are just those not deemed as LDC).

3. A multidimensional and dynamic taxonomy of developing countries

3a. Revisiting the dimensions of development

In Tezanos and Sumner (2013) we review the history of thinking about 'development' over the last 50 years, and identify four conceptual frames in the literature on the meaning and measurement of development. These are: i) 'development as structural transformation'; ii) 'development as human development'; iii) 'development as

democratic participation and improved governance'; and iv) 'development as environmental sustainability'. Other recently emerging 'candidates' might include 'subjective wellbeing' and 'state capabilities' (or 'fragilities'). We did not include these last two frames in our development taxonomy as we felt that both are still evolving conceptually and empirically and remain highly contested in meaning and measurement. That is not to say the indicators we chose are without contention; merely that they are less contentious and better conceptually established to some considerable extent, and have better developed international data sets. Moreover, some aspects of state fragility are captured by the governance and democracy measures.

Following this review on different development conceptions we identified indicators for each frame. **Table 1** outlines the indicators chosen.[4] It is worth noting that any choice of indicators is arbitrary to a certain extent: the question is how arbitrary are they and to what extent the data is well used by other researchers. It is also important to note that for the exercise of constructing an international taxonomy we require indicators for which there are well-established data sets with good cross-country coverage. So the choice of indicators, to a considerable extent, is determined by what data is available that fits the four development conceptions for the majority of the developing countries.

[4] See Appendix 1 for descriptive statistics of the data set.

Table 1. Development dimensions and data used

Development dimensions	Sub-dimensions	Proxies	Sources	Methods of construction
I. Development as structural transformation	2.1. Structural change	GDP in non-agricultural sectors (% of GDP)	World Bank (2012)	5-years averages
	2.2. Dependency on natural resources	Exports of primary commodities (% of GDP)	UNCTAD (2012) and World Bank (2012)	5-years averages
	2.3. Labour productivity	GDP per worker, PPP (constant 2005 $)	Heston *et al.* (2011)	5-years averages
	2.4. Innovation capacities	Scientific articles (per million inhabitants)	World Bank (2012)	5-years averages
	2.5. External finance	(ODA+FDI+portfolioinvestment+remittances)/GDP	DAC (2012) and World Bank (2012)	5-years averages
II. Development as human development	1.1. Poverty	Poverty headcount (2$ PPP a day)	World Bank (2012)	Closest available years
	1.2. Inequality	Gini coefficient	Solt (2009)	Closest available years
	1.3. Health	Malnutrition prevalence, weight for age (% of children under 5)	World Bank (2012)	5-years averages
III. Development as democratic participation and improved governance	3.1. Good governance	World Governance Indicators (WGI)	Kaufmann *et al.* (2011)	2-years averages of 6 governance indicators
	3.2. Quality of democracy	POLITY 2	Marshall and Jaggers (2011)	5-years averages
IV. Development as environmental sustainability	4.1. Environmental sustainability	CO_2 emissions (metric tons *per capita*)	World Bank (2012)	5-years averages

GDP: Gross Domestic Product. PPP: Purchasing Power Parity. FDI: Foreign Direct Investment. ODA: Official Development Assistance.

3b. Methodology: a cluster analysis of developing countries

Cluster analysis is a numerical technique that is suitable for classifying a sample of heterogeneous countries in a limited number of groups, each of which is internally homogeneous in terms of the similarities between the countries that comprise it.[5] Ultimately, the goal of cluster analysis is to provide classifications that are reasonably 'objective' and 'stable' (Everitt *et al.*, 2011): 'objective' in the sense that the analysis of the same set of countries by the same numerical methods produces similar classification; and 'stable' in that the classification remains similar when new countries – or new characteristics describing them – are added. Nevertheless, – as we will discuss below – the 'stability' may not hold over time when countries are changing.

[5]This section draws upon Tezanos (2012) and Tezanos and Quiñones (2012), who previously used cluster analysis for classifying the middle income countries of Latin America and the Caribbean.

Specifically, hierarchical cluster analysis allows one to build a taxonomy of countries with heterogeneous levels of development in order to divide them into a number of groups so that: i) each country belongs to one – and only one – group; ii) all countries are classified; iii) countries of the same group are, to some extent, internally 'homogeneous'; and iv) countries of different groups are noticeably dissimilar. The advantage of this procedure is that it allows one to discern the 'association structure' between countries, which – in our analysis – facilitates the identification of the key development characteristics of each cluster.

Furthermore, cluster analysis deals with two intrinsic problems in the design of a development taxonomy. First, it facilitates the determination of the appropriate number of groups in which to divide the sample of countries. Second, given that each country has different values for the set of development indicators, cluster analysis allows a synthetic distribution that makes easier comparisons of the development indicators across countries.

Nevertheless, cluster analysis also poses difficulties for the classification of countries. Nielsen (2012) points to two difficulties: first, if the values of the development indicators are evenly distributed across countries, the analysis is not able to distinguish groups, even though there may be important differences between the indicators for each country. However, this limitation does not affect our exercise, as the analysis clearly discerns the 'association structure' across developing countries and thus allows us to identify a small number of country groups. Second, Nielsen also argues that clustering techniques allow a large degree of freedom in choosing among alternative measures of distance and cluster algorithms, which in turn complicates the selection of time-invariant variables that can be used in periodic updates of the classification. However, this difficulty only applies in the case of restricting the classification over time to the same exact number of groups (regardless of what the cluster analysis suggests).

We argue in this paper that, as the developing world "evolves" over time, cluster analysis can be useful in order to compare the development taxonomies in two different times. Indeed, the analysis suggests that the development characteristics across clusters change over time and therefore the development taxonomy ought to be up-dated regularly. In particular, this analysis allows us to characterize and compare the development clusters built in each period (not necessarily with the same number of groups and, obviously, neither with the same specific countries in each group), and to analyse the dynamics of the development process of a single country in comparative terms (that is, in terms of

the average development indicators of the "peer" countries belonging to the same cluster).

In our piece of research, we conduct a hierarchical cluster analysis using the Ward's method, computing the squared Euclidean distances between each element and standardising the variables in order to correct differences in scale.[6] The analysis includes 99 countries in the period 1995-2000, and 101 in the period 2005-2010 (of the 139 low and middle income countries); hence we are including in the analysis more than 95% of the population of the developing world.[7]

Given the type of data used in this cluster analysis (11 continuous variables), three possible clustering algorithms are the nearest neighbour method, the furthest neighbour method and the Ward's method (Everitt *et al.*, 2011, Mooi and Sarstedt, 2011). Since there is no objective criterion for selecting the most appropriate method, the selection depends largely on the interpretability of the final results.

In our analysis we use the method proposed by Ward (1963), in which the fusion of two clusters is based on the size of an error sum-of-squares criterion. The objective at each stage is to minimise the increase in the total within-cluster error sum of squares. In practical terms, the Ward's method has been proven to be especially suitable for building clusters with similar sizes, when no outliers are present (Hands and Everitt, 1987; Everitt *et al.*, 2011, Mooi and Sarstedt, 2011).

Before running the cluster analysis, we examine the variables for substantial collinearity. The data set includes 11 variables that proxy different development dimensions so highly correlated variables are not surprising.[8] We did not find evidence indicating substantial collinearity between pair of variables.

The next stage is to decide on the number of developing country groups (i.e. the number of clusters to retain from the data), for each of the two analysed periods. This decision is

[6] Regarding the standardisation method, we use the 'range -1 to 1' which is deemed to be preferable than other methods 'in most situations' (Mooi and Sarstedt, 2011: 247). The analysis was conducted using *SPSS* software.

[7] The two additional countries included in the later period are Serbia and Montenegro, which were not independent States in 2000. The countries not included in the analysis are either insular states with less than one million inhabitants (Antigua and Barbuda, Dominica, Fiji, Grenada, Kiribati, Maldives, Marshall Islands, Mauritius, Mayotte, Palau, Samoa, Sao Tome and Principe, Seychelles, Solomon Islands, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Tonga, Tuvalu and Vanuatu), or countries with limited statistical information (Afghanistan, Bosnia and Herzegovina, Cuba, Eritrea, Kosovo, Lebanon, Libya, Mongolia, Myanmar, North Korea, Somalia, Sudan, Timor-Leste, Uzbekistan, West Bank and Gaza, and Zimbabwe).

[8] If highly correlated variables are used for cluster analysis, specific aspects covered by these variables will be overrepresented in the outcome. Everitt et al. (2011) and Mooi and Sarstedt (2011) argue that absolute correlations above 0.9 are problematic.

based on three different tools: the agglomeration schedule, the dendrogram and the variance ratio criterion.

The agglomeration schedule displays the clusters combined at each stage and the distances at which clusters merge. This schedule is used to determine the optimum number of country groups. By plotting these distances against the number of clusters we can identify a distinct break or 'elbow' (that is, where an additional combination of two clusters occurs at a greatly increased distance). The number of clusters prior to the merger is the most probable solution. In this way, and despite the high number of countries included in each of the two periods, the scree plots show a break – albeit not a major break – due to the increase in distance when switching from a five to a six-cluster solution.[9]

The dendrogram graphically displays the distances at which countries (and clusters of countries) are joined. The dendrogram is read from left to right; vertical lines are countries joined together: their position indicates the distance at which the mergers take place[10]. This graph provides guidance regarding the number of groups to retain, suggesting that, for the two analysed periods, between a four and six-cluster solution is appropriate.

Calinski and Harabasz (1974) proposed a more precise and objective method for determining the optimum number of clusters (Milligan and Cooper, 1985). The 'variance ratio criterion' (VRC) recommends choosing the number of clusters that maximises the ratio between the overall between-cluster variation and the overall within-cluster variation with regards to all clustering variables (that is, a good clustering yields groups of countries with small within-cluster variation but high between-cluster variation). In our case, this suggests that, for both periods, the optimum number of clusters is five.[11]

Therefore, using the three procedures (distances scree plots, dendrograms and VCR) we take the optimum number of clusters to be five in both periods. Before comparing the characteristics of these five clusters over time, it is worthwhile to distinguish which variables are more influential in discriminating between countries. This step is particularly important as cluster analysis sheds light on whether the groups of countries are statistically distinguishable (that is, whether the clusters exhibit significantly different means in the development indicators).

[9] See the scree plot in the Appendix 2.
[10] See the dendrogram plots for both periods in Appendix 3. *SPSS* re-scales the distances to a range of 0 to 25. Therefore, the last merging step to a 1-cluster solution takes place at a (re-scaled) distance of 25.
[11] See the VRC in Appendix 4.

In order to verify if there are significant differences between clusters, we perform a one-way ANOVA analysis to calculate the cluster centroids and compare the differences formally. According to this analysis, for the two analysed periods, the 11 variables included in the classification are statistically significant.[12] The size of the *F* statistics shows the relation between the overall between-cluster variation and the overall within-cluster variation and, therefore, it is a good indicator of the relevance of each variable for identifying groups of countries. According to this criterion, the variable with the greatest discriminating power in both periods is *poverty*, followed by quality of *democracy* and *productivity* in the period 1995-2000, and *productivity* and *quality of democracy* in the period 2005-2010. By contrast, the variables with lowest relative importance in the classification are *primary exports*, *inequality* and *external finance* (in both periods).

It should be mentioned that the cluster solutions of our analysis are reasonably 'robust'. As recommended by Mooi and Sarstedt (2011) we verify the robustness of the cluster analysis by means of the following three-step check: firstly, we evaluate the stability of the results by using different clustering procedures, distance measures and standardisation methods on the same data and we test whether these yield similar development taxonomies. However, one should bear in mind that – as noted, among many others, by Everitt *et al.* (2011), and Mooi and Sarstedt (2011) – it is common for results to change even when the cluster solution is adequate, so some degree of variation is expected when changing the cluster procedure. Secondly, we change the order of the countries in our data set and re-run the analysis to check the results' stability.[13] And thirdly, we replace one of the development proxies, the *productivity* variable, with an alternative variable (*per capita* income) for the same conceptual 'frame' (the structural change 'frame').

The first check shows moderate variations in the results. In particular, for the last period of analysis: i) changing the clustering procedure, from Ward to the single linkage (nearest neighbour), only affects 17 out of the 101 countries (all of them are changes to the nearest cluster in terms of development); ii) changing the distance measure, from square Euclidian distance to Chebyshev distance, only renders 14 differently classified countries; and iii) changing the standardisation method, from range -1 to 1 to the simple z standardisation, only renders 14 differently classified countries. The second check shows no variation in the results: changing the order of the countries in the data set (from alphabetical order, to an increasing order of GNI *per capita*) does not affect the classification. Finally, we check the implications of using the variable *GDP per capita*

[12] See the ANOVA outputs for each period in Appendix 5.
[13] The results should not depend on the order of the data set, unless there are outliers that influence the results.

(PPP, constant 2005 dollars) instead of *productivity* and the results only differ in five countries.

4. How has the developing world changed since the late 1990s?

4a. Comparison of the development clusters across time

As noted, the cluster analysis optimally produces five clusters in each of the two analysed periods. The clusters are numbered from one to five in increasing order of GNI *per capita* (Atlas method) solely to make comparisons with the World Bank's income classification.[14]

There are important differences in the clusters' composition over time (**Table 2**). Although the first cluster (*C1*) includes 31 countries in both periods, the second (*C2*) was composed of 18 countries in 1995-2000 and dropped to nine countries in 2005-2010; the third (*C3*) included 18 countries in the first period, and increased to 32 in the last one; the forth (*C4*) increased over time from 11 to 15 countries; and the fifth (*C5*) dropped from 21 to 14 countries. Furthermore, the income composition within each cluster (according to the corresponding World Bank's income classifications in 2000 and 2010) has also changed, as did the total numbered of countries in each category.[15]

[14] Appendix 6 shows the complete set of countries classified by periods, clusters, GNI per capita and income groups.
[15] The overall number of LICs reduced from 51 to 29, and – in return – the number of middle income countries (both LMIC and UMIC) increased (see bottom lines of Table 2).

Table 2. Time variations in the clusters composition

	1995-2000	2005-2010
C1	**31**	**31**
LIC	30	25
LMIC	1	6
UMIC	0	0
C2	**18**	**9**
LIC	14	2
LMIC	4	7
UMIC	0	0
C3	**18**	**32**
LIC	5	2
LMIC	13	20
UMIC	0	10
C4	**11**	**15**
LIC	1	0
LMIC	9	5
UMIC	1	10
C5	**21**	**14**
LIC	1	0
LMIC	8	1
UMIC	12	13
TOTAL	**99**	**101**
LIC	51	29
LMIC	35	39
UMIC	13	33

How can we classify developing countries in the late 1990s and in the current period? A precise interpretation of the time changes of the five clusters involves examining the cluster centroids (i.e. the variables' average values of all countries in a certain cluster and in a certain period, see **Table 3**) so we can compare the average characteristics of each development cluster in the two analysed periods. Overall, the developing world has improved in terms of most of the development indicators (see last section in Table 3, "total"), thus reducing poverty, malnutrition and – to a more limited extent – income inequality; increasing the non-agriculture proportion of GDP, labour productivity and scientific articles production; and improving democracy. However, the overall dependency on primary exports and external finance has increased over time, as well as the CO_2 *per capita* emissions, whereas governance has been virtually static in comparison with the world average (which also includes developed countries).[16]

[16] It is worth noting that the WGI are designed to have a world average value of zero (across all countries and in each year). Thus, if the average WGI for all developing countries remains virtually static across the two analysed periods it means that it has not varied much in relation to the world average (which includes also developed countries).

Despite this general improvement, the development clusters have changed significantly over time, and differently across clusters. On the one hand, the 1995-2000 development taxonomy depicts the following five groups of developing countries:

- Cluster 1 consists of **very poor countries with largely 'traditional' economies** – in the Dudley Seers (1963 and 1969) sense. These countries had the highest poverty and malnutrition headcounts, the least modernized economies (with the highest contribution of agriculture to GDP and the lowest levels of labour productivity and innovation) and very low governance and democracy indicators. However, the income inequalities were less acute than in *C3* and *C5* and they had the lowest CO_2 *per capita* emissions. Moreover, many of these economies received relativity high levels of external flows (mainly ODA).

- Cluster 2 consists of **poor countries with democratic regimes but poor governance**. These countries had moderate income inequalities (relative to the average for all developing countries) and the second worst indicators (after *C1*) in terms of poverty, malnutrition, non-agricultural GDP, productivity, innovation and CO_2 *per capita* emissions. They also had low proportion of exports in primary products and received moderate external finance. Although they had above-average democracy indicators, their governance indicators were comparatively low.

- Cluster 3 is composed of **countries with democratic regimes but high levels of inequality and dependency on external flows**. These countries ranked third of the clusters in terms of income poverty, malnutrition, non-agricultural GDP, productivity, innovation, and CO_2 *per capita* emissions. However, these countries had the highest levels of income inequality, the lowest proportion of exports in the primary sector, the highest external finance, the second best scores in governance indicators (although still below the developing world average) and the highest democracy indicator.

- Cluster 4 consists of **"emerging economies" that were primary product exporting with low inequality but high environmental pollution and severely constrained political freedoms**. These countries had the second lowest poverty and malnutrition headcounts of the clusters, and the second highest indicators of non-agricultural GDP, productivity and innovation capacities. They also had a limited receipt of

external finance. However, they had the highest proportion of exports in primary products, the second worst governance indicators of the clusters, the worst democracy indicators and they were the second most polluting countries of the sample.

- Cluster 5 consists of **highly polluting and unequal emerging economies.** These were the most polluting countries and had the second highest inequality, but the highest non-agricultural GDP, labour productivity and innovation capacities, and the lowest poverty and malnutrition headcounts. They also had comparatively high governance and democracy indicators, and limited dependency on external finance and primary exports.

On the other hand, the development taxonomy in 2005-2010 was as follows:

- *C1* continues to consist of **countries with high poverty rates and largely 'traditional' economies**. Despite the fact that this cluster has the same number of countries in both periods, it is important to note that this cluster has experienced the highest number of movements across clusters. Nine countries moved from *C1* to *C2* between the two periods (Angola, Cameroon, Chad, Republic of Congo, Mauritania, Swaziland, Tajikistan, Vietnam and Yemen), thus moving into a cluster with better average values. Three *C1* countries moved to *C3* (Bhutan, Kenya and Kyrgyz Republic).

- *C2* also changed, and dramatically, over time. Indeed, all countries in *C2* are different between the two analysed periods. In the second period, *C2* groups **countries with high poverty and malnutrition rates that are primary product exporting and have limited political freedoms**. Therefore, although *C2* includes countries with high poverty and traditional economies in both periods (i.e. these countries rank second, after*C1*, in terms of poverty, malnutrition, non-agricultural GDP, productivity and innovation), in the 1990s it was a group of countries with democratic regimes but poor governance (e.g. India, Philippines, Senegal and Madagascar), and currently become a group of – different – countries that have severely constrained political freedoms and high dependency on natural resource exports (e.g. Angola, Chad, Republic of Congo and Vietnam).

- *C3* remains composed of **countries with democratic regimes and high levels of inequality and dependency on external flows**. However, *C3* almost doubled its size over time (from 18 to 32 countries). In fact, the 18 countries included in *C3* in the 1990s remain in this cluster in the latter period, plus other 14 new countries. Cape Verde, El Salvador, Honduras, Lesotho and Nicaragua are, for example, members of this cluster.

- *C4* also remained similar over time –**"emerging economies" who are primary product exporting with low inequality but high environmental pollution and limited political freedoms** –, although four new primary-exporting emerging economies joined this group in 2005-2010 (Belarus, Iran, Jordan and Venezuela).

- Finally, *C5* – **unequal and highly polluting "emerging economies" with low dependence on external finance** – did not change its main development features overtime, although seven countries left this cluster in the last period (precisely the four new members of *C4* previously noted above, plus Macedonia, South Africa, Panama and Thailand, who joined *C3*).

Table 3. Development cluster centroids per period

Development clusters	Period	Poverty	Gini	Malnutrition	Non-agriculture GDP	Primary exports	Productivity	Articles	External finance	WGI	POLITY	CO2pc	*For reference*: GNIpc
C1	1995-2000	73.39	44.02	23.80	64.63	17.54	3,057.67	2.69	16.55	-0.92	-2.42	0.33	931.61
	2005-2010	74.97	41.55	25.77	65.17	12.52	2,515.25	2.83	22.88	-0.77	3.06	0.25	614.19
C2	1995-2000	71.14	41.57	31.63	67.86	12.23	3,265.07	2.95	13.08	-0.50	5.11	0.39	1,065.56
	2005-2010	53.57	41.49	20.36	85.71	38.16	5,646.59	2.89	13.78	-0.95	-3.89	0.71	1,675.56
C3	1995-2000	33.79	48.89	9.68	80.57	12.10	8,647.01	8.76	20.68	-0.37	6.56	1.12	3,117.78
	2005-2010	24.58	44.20	9.48	85.98	11.76	9,512.29	10.49	17.91	-0.34	7.06	1.61	2,984.06
C4	1995-2000	22.98	36.30	8.42	84.38	25.35	11,384.78	10.39	5.75	-0.70	-5.91	3.65	4,320.91
	2005-2010	9.19	35.96	6.36	90.50	28.74	14,978.55	26.09	6.93	-0.76	-4.07	4.91	4,934.00
C5	1995-2000	15.22	45.51	6.74	90.66	12.60	17,171.14	30.67	6.48	0.03	6.48	4.04	6,874.29
	2005-2010	10.10	46.36	4.94	92.92	14.03	22,059.14	54.84	6.02	0.20	8.36	4.13	7,487.14
Total	1995-2000	47.84	43.92	17.33	75.83	15.40	8,030.62	10.63	13.33	-0.52	2.08	1.64	1,305.56
	2005-2010	38.34	42.22	14.36	81.20	17.18	9,571.20	15.93	15.79	-0.51	3.39	1.95	3,053.86

In short, the development characteristics of four of the five clusters remain similar over time, but *C2* changed dramatically. A third of all developing countries (38) in the sample of 101 changed cluster membership between these two periods, and the remainder – the majority – of the developing countries remain in the same cluster (but, it should be borne in mind that groups, at the same time, have evolved over time).

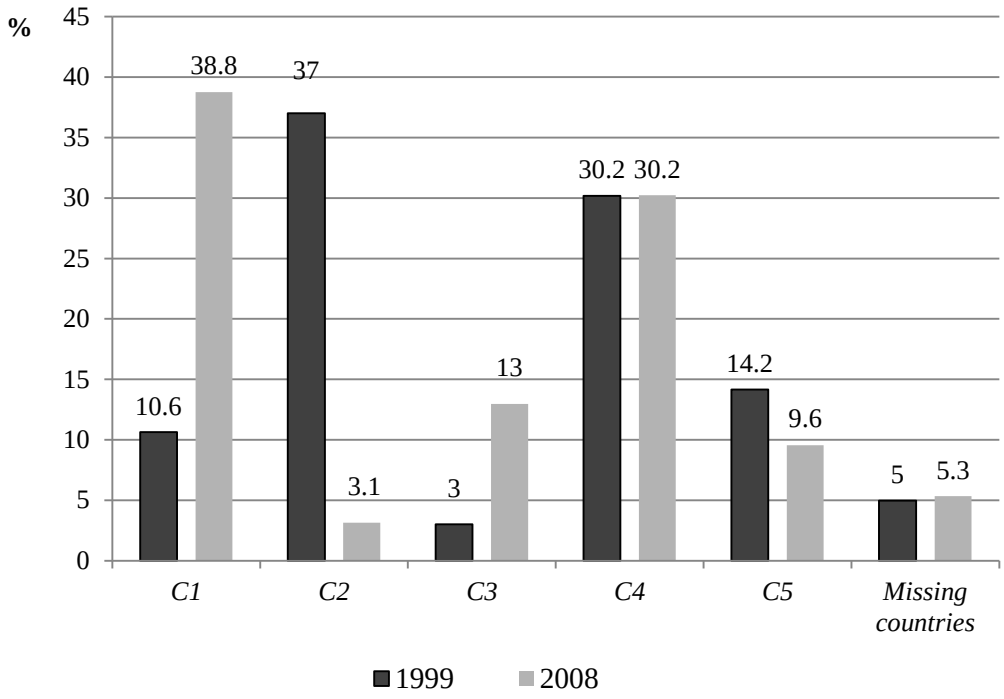
Moreover, this 'dynamic' results mean that – as noted in Tezanos and Sumner (2013) – there is no simple 'linear' representation of development levels (from low to high development countries), as is implied with the income *per capita* – ranking – classification. Instead, each cluster of countries has its own and specific development issues and there is no group of countries with the best (or worst) indicators in all the development dimensions. Whereas the income classification depicts a linear development process where all countries are assessed as if they were following a similar 'development path' of income growth – as described, for example, by Rostow's 'stages of growth' –, regardless of other development dimensions, our taxonomy may offer a somewhat more nuanced understanding of the diversity of challenges of developing countries, and their evolution over time.

4b. Distribution of global population and poverty across time

The clusters classification has important implications in terms of the evolution of the developing world's population distribution (**Figure 1**): in the late 90s, about 11 per cent of the developing countries' population was concentrated in *C1*, 37 per cent was concentrated in *C2* (which included some of the most populated countries of the world, like India, Pakistan and Bangladesh)*;* 30 per cent in *C4* (due to China), and 17 per cent was distributed across *C3* and *C5*. By contrast, the population distribution changed sharply in the 2000s, due to the movement of India into *C1* (this cluster now represents almost 39 per cent of developing countries population), and the increase in *C3* (due to the incorporation of 14 new countries in this group).[17]

[17] See Appendix 7 for detailed information on the population and poverty distribution across development clusters and income groups.

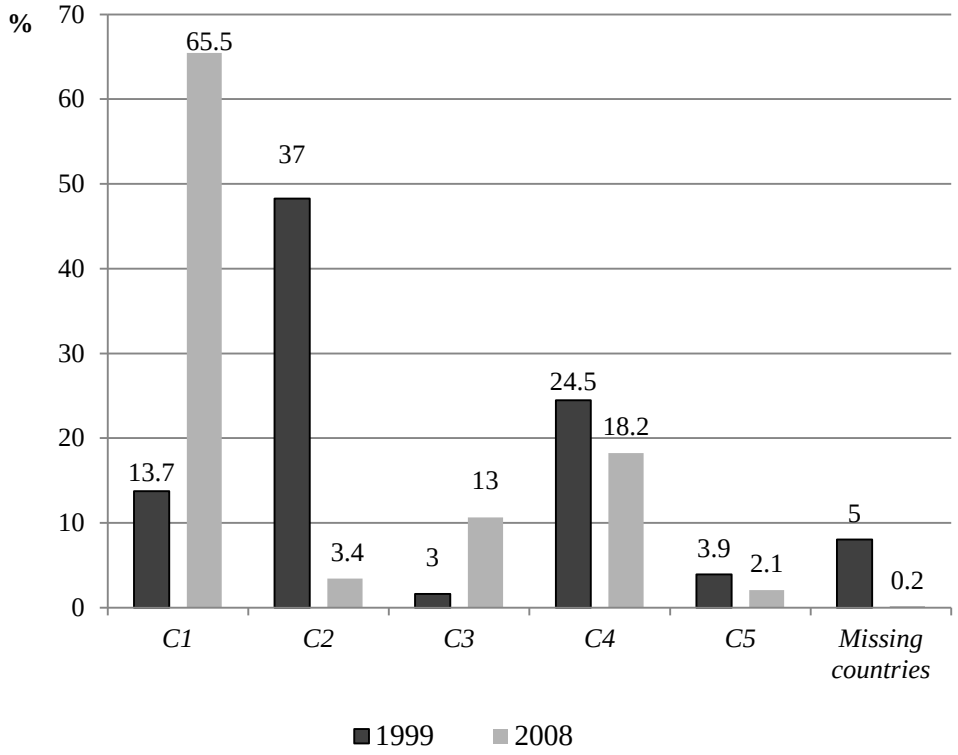
Figure 1. Population distribution across development clusters



Note: India shifted location from *C2* to *C1*. China is in *C4* in both periods.

If we consider the distribution of $2 poverty in our development taxonomy (**Figure 2**), we find that in the late 90s, the two worst off development clusters (*C1* an *C2*) concentrated almost two thirds of the world's poor (specially *C2*, due to India, Pakistan and Bangladesh), another 24.5 per cent lived in *C4* (due to China), and 5.5 per cent was scattered across *C3* and *C5*. One decade later, almost two thirds of the world's poor live in *C1* (due to the incorporation of India, that accounts for a third of global poverty), 18 per cent live in *C4* (the group with overall good development indicators but bad governance), 13 per cent live in *C3*, and 5.5 per cent live in *C2* and *C5*. In sum, the aggregate contribution of *C1* and *C2* to global poverty in both periods is larger than their aggregate contribution to population.

Figure 2. Poverty distribution across development clusters



Note: India shifted location from C2 to C1. China is in C4 in both periods.

Therefore, the two clusters with the greatest development challenges (*C1* and *C2*) concentrate the majority of the world poor, which sharply contrast with the income classification, were the 'poorest' group (LIC) concentrates one fifth of the global $2 poor. In short, our taxonomy reveals a close relation between income poverty and other development problems (such as low levels of productivity and innovation, weak governance, and high dependency on agriculture). It should also be noted that *poverty* is the variable with the greatest discriminating power in the cluster analysis – as it was previously tested with the ANOVA analysis – which in turns implies that countries in *C1* and *C2* share the distinct feature of having high poverty headcounts (and "moderate" income inequalities, in comparison with the other clusters, due to the fact that the majority of the population live under the $2 poverty line).

4c. Mobility in the developing world since the late 1990s

In sum, there have been substantial changes in the developing world since the late 1990s. In terms of the World Bank's classification, a number of LIC have become MIC and a dominant way of thinking in contemporary ODA debates has become that aid should be cut off, or at least reduced, to countries that cross the threshold to MIC and redirect to

LDC or fragile and conflict states. This is somewhat contradictory as many MIC are also fragile states (as noted recently by OECD, 2013), such as Nigeria and Pakistan. One main problem with this approach is that two-thirds of developing countries are now MIC and the crossing of the arbitrary income line at about $1,000 *per capita* does not necessarily mean that domestic and foreign resources will replace ODA quickly – or easily – if at all.

What does our cluster approach tell us about the specific problems of countries that are labeled MIC and/or fragile states and/or LDCs? **Table 4** considers this by building a "contemporary cluster and mobility matrix" that considers countries how the clusters in 2005-2010 compare to the main international classifications and how the clusters compare to countries that have moved from LIC to MIC status since the late 1990s. Some of these are "new MIC" and others are "bounce-back MIC" in the sense that they were MIC in a prior period and fell back.

Indeed, the MIC group itself is currently over 100 countries and thus has considerable diversity. The LMIC and UMIC groups provide something of a split at $4,000 income *per capita* level. However, within the group there are clearly other forms of differentiation: for example, 19 MIC are fragile states (in the OECD-DAC list). Others are 'emerging' powers – meaning G20 members – such as India and Indonesia, who have limited need for ODA *per se* but still have substantial poor populations – especially so at $1.25 and $2 poverty lines or higher.

There are "old" MIC and "new" MIC. Two thirds of MIC were so prior to 1990 and remain so today. This group contains many of the emerging powers or better off MIC such as Brazil. Just a third of MIC are 'new' MIC, meaning the country graduated from LIC to MIC since the end of the Cold War in 1990. This group breaks down further into 20 emerging MIC which were low income countries prior to 1990 and attained MIC status by 2010, and a second group of 14 countries that were MIC prior to 1990 but slipped back to LIC and became MIC again by 2010. In the new MIC there are several small island states or very small countries, one ex-socialist country and 13 other developing countries (Bhutan, China, Ghana, India, Indonesia, Lao, Lesotho, Nigeria, Pakistan, Sri Lanka, Sudan, Vietnam and Zambia). In the re-emerging MIC almost half are ex-socialist countries. The others are developing countries and include Angola, Cameroon, Republic of Congo, Côte d'Ivoire, Nicaragua, Senegal and Yemen.

Table 4 also shows how the five clusters map against various classifications of countries in the contemporary period. Interestingly, *C1* has some considerable similarities to the current LICs and LDC groupings and also the LIC fragile states. Further, the LMIC

spread across clusters *C1*, *C2*, *C3* and *C4* suggesting heterogeneity in the LMIC group, although most are in *C3*. Whilst the UMIC are spread across *C3*, *C4* and *C5* rather equally, suggesting very significant heterogeneity in the UMIC too. Interestingly the "new MIC" (since 1990) are largely in *C1* and *C3*, whilst the "bounce-back MIC" are largely in *C2* and *C3*.

Table 4. Contemporary cluster and mobility matrix of country classifications, 2005-2010

Classification in 2005-2010	*C1*	*C2*	*C3*	*C4*	*C5*
Current LICs	Bangladesh Benin Burkina Faso Burundi Cambodia Central African Rep. Comoros Congo, Dem. Rep. Ethiopia Gambia, The Guinea Guinea-Bissau Haiti Liberia Madagascar Malawi Mali Mozambique Nepal Niger Rwanda Sierra Leone Tanzania Togo Uganda	Chad Tajikistan	Kenya Kyrgyz Rep.		
	25	**2**	**2**	**0**	**0**
Current LMIC	India Lao PDR Nigeria Pakistan Papua New Guinea Zambia	Angola Cameroon Congo, Rep. Mauritania Swaziland Vietnam Yemen, Rep	Armenia Bhutan Bolivia Cape Verde Djibouti El Salvador Georgia Ghana Guatemala Guyana Honduras Indonesia Lesotho Moldova Nicaragua Paraguay Philippines Senegal Sri Lanka	Egypt, Arab Rep. Iraq Morocco Syrian Arab Rep. Turkmenistan	Belize

			Ukraine		
	6	**7**	**20**	**5**	**1**
Current UMIC			Albania Colombia Dominican Rep. Ecuador Macedonia, FYR Montenegro Namibia Panama Peru Thailand	Algeria Azerbaijan Belarus China Gabon Iran, Islamic Rep. Jordan Kazakhstan Tunisia Venezuela, RB	Argentina Botswana Brazil Chile Costa Rica Jamaica Malaysia Mexico Serbia South Africa Suriname Turkey Uruguay
	0	**0**	**10**	**10**	**13**
Current LIC Fragile and Conflict Affected States	Bangladesh Burundi Central African Rep. Comoros Congo, Dem. Rep. Ethiopia Guinea Guinea-Bissau Haiti Liberia Malawi Nepal Niger Rwanda Sierra Leone Togo Uganda	Chad	Kenya Kyrgyz Rep.		
	17	**1**	**2**	**0**	**0**
Current MIC Fragile and Conflict Affected States	Nigeria Pakistan	Angola Cameroon Congo, Rep. Yemen, Rep	Georgia Sri Lanka	Iran, Islamic Rep. Iraq	
	2	**4**	**2**	**2**	**0**
New MIC	India Lao PDR Nigeria Pakistan Zambia	Mauritania Vietnam	Albania Bhutan Ghana Guyana Indonesia Lesotho Sri Lanka	China	
	5	**2**	**7**	**1**	**0**
Bounce-back MIC		Angola Cameroon	Armenia Georgia	Azerbaijan	

		Congo, Rep. Yemen, Rep	Moldova Nicaragua Senegal Ukraine		
	0	**4**	**6**	**1**	**0**
LDC	Bangladesh Benin Burkina Faso Burundi Cambodia Central African Rep. Comoros Congo, Dem. Rep. Ethiopia Gambia, The Guinea Guinea-Bissau Haiti Lao PDR Liberia Madagascar Malawi Mali Mozambique Nepal Niger Rwanda Sierra Leone Tanzania Togo Uganda Zambia	Angola Chad Mauritania Yemen, Rep	Bhutan Djibouti Lesotho Senegal		
	27	**4**	**3**	**0**	**0**

Note: 38 developing countries (of a total of 139 developing countries) are not included due to insufficient data of which the following are states with less than one million inhabitants: Antigua and Barbuda, Dominica, Fiji, Grenada, Kiribati, Maldives, Marshall Islands, Mauritius, Mayotte, Palau, Samoa, Sao Tome and Principe, Seychelles, Solomon Islands, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Tonga, Tuvalu and Vanuatu, and the following are countries with limited statistical information: Afghanistan, Bosnia and Herzegovina, Cuba, Eritrea, Kosovo, Lebanon, Libya, Mongolia, Myanmar, North Korea, Somalia, Sudan, Timor-Leste, Uzbekistan, West Bank and Gaza, and Zimbabwe.

5. Conclusion

This paper has sought to address the question of just how much the developing world has really changed since the late 1990s. In order to do so, the paper outlines a multidimensional taxonomy of developing countries and analyses how groups have evolved over time.

The main findings are as follows: First, the developing world can be classified into five multidimensional development clusters and this number of clusters remains the same between the periods 1995-2000 and 2005-2010. However, not surprisingly, the nature of the clusters has changed over time. Four clusters remain *largely* the same: *C1* is composed of "countries with high poverty rates and largely traditional economies"; *C3* are "countries with democratic regimes but high levels of inequality and dependency on external flows"; *C4* are "emerging economies who are primary-exporting with low inequality but high environmental pollution and limited political freedoms"; and C5 are "unequal and highly polluting emerging economies with low dependence on external finance".

In terms of the specific countries in each cluster, it is in *C1* – very poor countries with largely 'traditional' economies – where there has been the highest number of movement of countries in and out (in particular, nine countries moved out of this cluster and towards *C2*).

Indeed, *C2* has changed dramatically over time in composition of countries and development characteristics. Although this cluster includes countries with high poverty and traditional economies in both periods, it was a group of "countries with democratic regimes but poor governance" in the first period (e.g. India, Philippines, Senegal and Madagascar), and become a group of "countries that have severely constrained political freedoms and high dependency on natural resource exports" (such as Angola, Chad, Republic of Congo and Vietnam).

C3 has changed too in terms of the number of countries in the cluster – it has doubled in size with all of the countries included in *C3* in 1995-2000 remaining in this cluster in 2005-2010 but joined by 14 new countries such El Salvador, Honduras, Lesotho and Nicaragua. Interestingly *C4* emerging economies remained largely the same as did *C5*.

When we compare the five clusters to contemporary classifications (2005-2010) we find some clear similarities between *C1* countries and current LICs, LDC and LIC fragile states suggesting these are the countries with the most pronounced development problems. The UMIC spread across three clusters (*C3*, *C4* and *C5*), although most are in

one cluster (*C3*). However, the LMIC spread across four clusters (*C1*, *C2*, *C3* and *C4)* suggesting major heterogeneity in the LMIC group. Further, the many of those LMIC are "new MIC" (since 1990) and these are largely in *C1* and *C3*, whilst the "bounce-back MIC" are largely in *C2* and *C3*.

If we return to the question of why classify developing countries, we would argue that the clustering approach has some particular strengths. Firstly, for *analytical reasons*: a cluster approach has the advantages of not only tracking movements of countries over time by cluster, but by identifying the changing development needs/problems of each cluster.

Secondly, for *operational reasons,* such a cluster approach has the advantages of grouping countries by needs that international development co-operation might address. Further, a cluster approach can facilitate the countries of the same group collectively identifying specific development strategies for the group and thus the taxonomy may be useful for guiding South-South co-operation policies.

Of course there are other alternative approaches to our multidimensional development classification that may be useful or even better for operational reasons (e.g. for aid agencies). In particular, it is also feasible to identify groups of countries in accordance with a specific development problem (and then classify solely around this problem). This is the case of the list of fragile states (and even the World Bank's income classification which can be either deemed as a one-single-problem classification or as a very imperfect "proxy" of a more complex development conception). The main difference of these one-single-problem classifications is that they offer a partial picture of international development. In fact, this type of classification implies the need of building one specific classification for each single development challenge, and as the development process is complex, it means a very large number of classifications, which has an obvious cost in terms of complexity.

We can further note that cluster analysis itself has four features which make it particularly appropriate for the purpose of producing useful development taxonomy within the area of Development Studies: i) The cluster analysis has the advantage of providing country classifications that are reasonably 'objective' (in the sense that the analysis of the same set of countries by the same numerical methods produces similar classification) and 'stable' (in that the classification remains similar when new countries, or new characteristics describing them, are added). ii) Cluster analysis deals with two intrinsic problems of the design of a development taxonomy, the determination of the appropriate number of groups in which to divide countries and the construction of a

synthetic distribution that makes easier comparison of the development indicators across countries. iii) Cluster analysis can be used to replicate the taxonomy in different periods in order to analyse the dynamics of the development process of each country in comparative terms. And finally, iv) the taxonomy does not offer a simple 'linear' representation of development levels (from low to high development countries), but something that better represents the reality of non-linear development process.

However, perhaps the two greatest challenges to the cluster approach are that, firstly, the cluster analysis is a more complex taxonomy than other approaches (partly because it captures much more). It is not without reason that income-based classifications thrive – it is mainly because of their simplicity... even if that is misleading. And secondly, the cluster analysis is open to accusations – like existing classifications – relating to the "approximate" nature of any proxy. Whilst any choice of indicator is somewhat arbitrary, what we have sought to do is to base the choice on a consideration of the theoretical debate in identifying 'frames' of development and considering what indicators are available and largely used by other researches.

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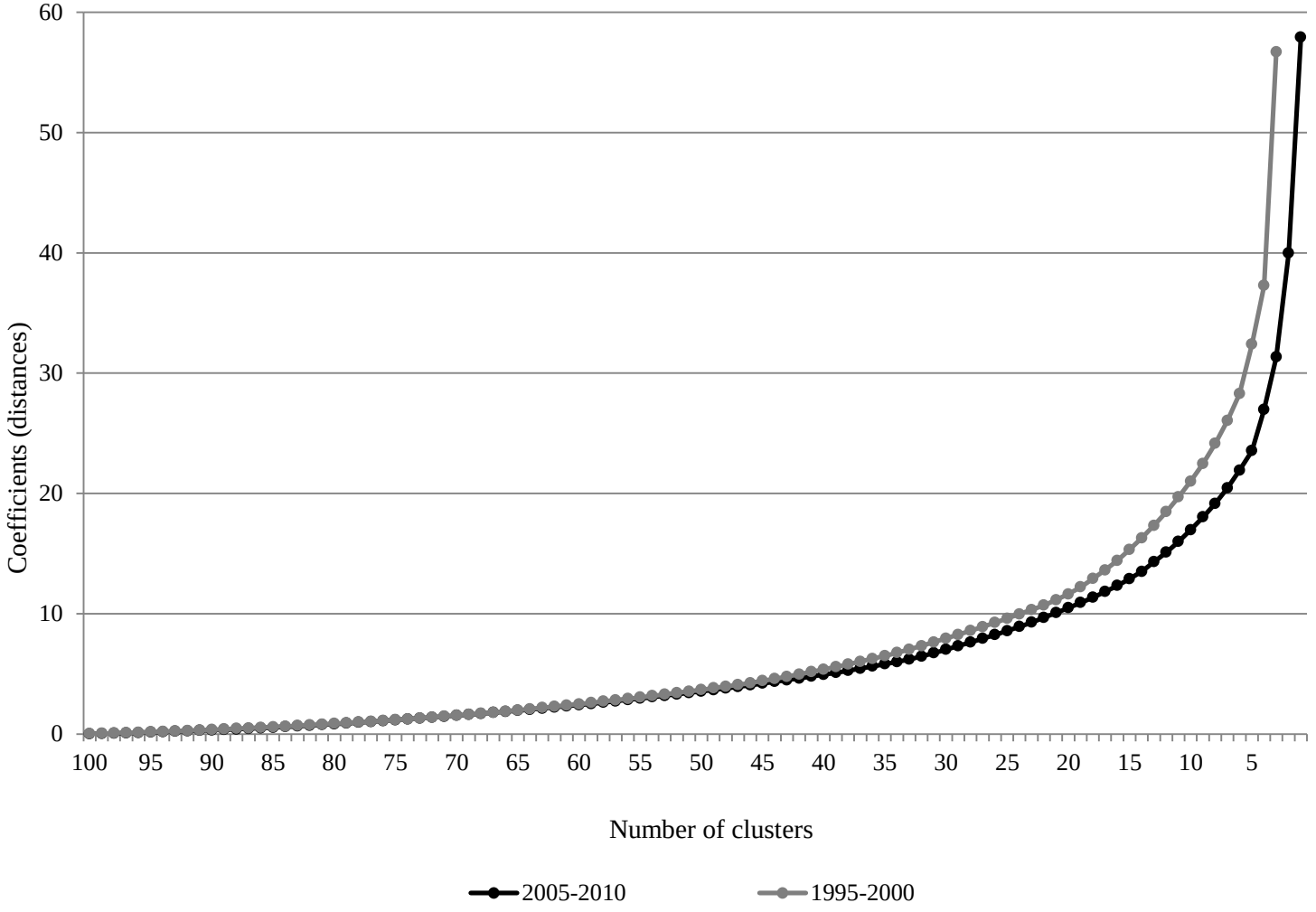
Appendices

Appendix 1. Descriptive statistics of the data set

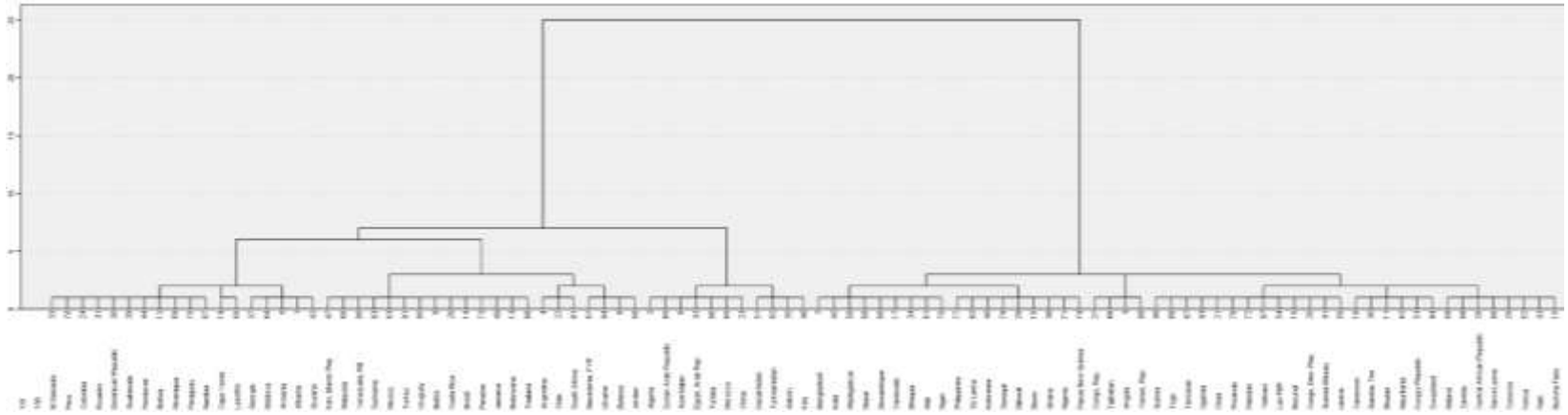
	1995-2000					2005-2010				
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	***N***	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Poverty	111	0.26	96.18	45.83	29.15	111	0.13	94.64	37.33	29.87
Gini	110	25.34	65.97	43.37	8.32	112	18.62	66.64	41.92	7.81
Malnutrition	124	0.72	53.35	17.17	12.71	124	0.55	45.30	14.60	11.51
Non-agriculture GDP	131	20.35	96.87	76.97	15.15	131	40.39	98.28	82.16	13.11
Primary exports	128	0.10	69.06	14.07	13.94	133	0.13	75.95	15.88	15.73
Productivity	124	402.32	47,513.27	8,849.32	7,992.28	123	418.97	49,436.06	10,019.24	8,495.45
Articles	133	0.02	68.28	10.50	14.63	134	0.04	126.00	15.63	24.82
External finance	133	-2.02	122.17	15.81	16.61	135	-7.53	445.12	21.06	40.48
Governance	127	-2.17	1.05	-0.52	0.64	136	-2.35	1.16	-0.49	0.63
POLITY	114	-10.00	10.00	1.54	6.00	117	-9.00	10.00	2.92	5.85
CO2per capita	135	0.02	9.38	1.75	2.06	136	0.02	13.51	2.10	2.50
GNIpercapita	139	90.00	8,490.00	1,617.04	1,772.24	133	170.00	13,280.00	3,387.14	3,065.83
Valid *N* (listwise)	99					101				

Appendix 2. Scree plot: distances against number of development clusters

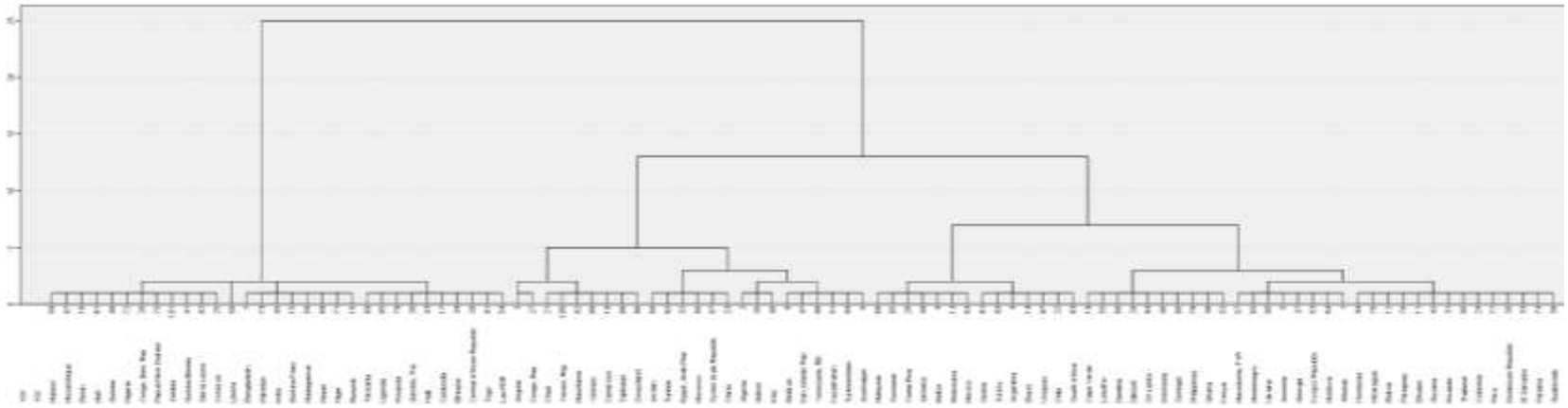


Appendix 3. Dendrograms of developing countries

1995-2000



2005-2010



Appendix 4. Variance Ratio Criterion (VRC)

# clusters	1995-2000		2005-2010	
	VRC_k	w_k	VRC_k	w_k
2	705.23	..	650.47	..
3	565.49	257.69	542.11	233.52
4	683.44	-39.67	667.26	-50.97
5	761.71	-148.88	741.45	-127.31
6	691.11	283.30	688.33	259.60
7	903.80	..	894.81	..

Note: VRC implies choosing the cluster with minimum w. See Mooi and Sarstedt (2011, appendix of chap. 9) for a practical explanation of this criterion.

Appendix 5. ANOVA outputs of the development clusters

1995-2000

		Sum of squares	Df.	Mean square	*F*	Sig.
Poverty	Between	62,703.94	4	15,675.99	77.42	0.00
	Within	19,032.94	94	202.48		
	Total	81,736.88	98			
Gini	Between	1,236.10	4	309.03	5.30	0.00
	Within	5,482.14	94	58.32		
	Total	6,718.24	98			
Malnutrition	Between	9,257.28	4	2,314.32	41.15	0.00
	Within	5,287.22	94	56.25		
	Total	14,544.50	98			
Non-agriculture GDP	Between	10,862.55	4	2,715.64	20.50	0.00
	Within	12,450.58	94	132.45		
	Total	23,313.13	98			
Primary exports	Between	1,772.01	4	443.00	2.06	0.09
	Within	20,198.80	94	214.88		
	Total	21,970.82	98			
Productivity	Between	3,061,000,000.00	4	765,100,000.00	55.01	0.00
	Within	1,308,000,000.00	94	13,909,954.27		
	Total	4,368,000,000.00	98			
Articles	Between	11,511.90	4	2,877.97	21.63	0.00
	Within	12,510.06	94	133.09		
	Total	24,021.96	98			
External finance	Between	2,912.72	4	728.18	6.60	0.00
	Within	10,371.94	94	110.34		
	Total	13,284.65	98			
Governance	Between	12.11	4	3.03	14.46	0.00
	Within	19.69	94	0.21		
	Total	31.80	98			
Polity	Between	2,261.44	4	565.36	56.90	0.00
	Within	933.92	94	9.94		
	Total	3,195.35	98			
CO_2 per capita	Between	251.53	4	62.88	40.04	0.00
	Within	147.64	94	1.57		
	Total	399.17	98			

2005-2010

		Sum of squares	Df.	Mean square	*F*	Sig.
Poverty	Between	73,653.18	4	18.413.30	98.39	0.00
	Within	17,965.57	96	187.14		
	Total	91,618.75	100			
Gini	Between	972.33	4	243.08	4.54	0.00
	Within	5,135.75	96	53.50		
	Total	6,108.08	100			
Malnutrition	Between	7,321.58	4	1,830.40	33.96	0.00
	Within	5,174.59	96	53.90		
	Total	12,496.17	100			
Non-agriculture GDP	Between	12,098.98	4	3,024.75	47.34	0.00
	Within	6,133.92	96	63.90		
	Total	18,232.90	100			
Primary exports	Between	7,714.92	4	1,928.73	11.01	0.00
	Within	16,818.07	96	175.19		
	Total	24,532.99	100			
Productivity	Between	4,304,000,000	4	1,076,000,0	78.33	0.00
	Within	1,319,000,000	96	13,737,304		
	Total	5,623,000,000	100			
Articles	Between	30,536.43	4	7,634.11	20.58	0.00
	Within	35,603.23	96	370.87		
	Total	66,139.66	100			
External finance	Between	4,250.50	4	1,062.63	4.28	0.00
	Within	23,834.78	96	248.28		
	Total	28,085.29	100			
Governance	Between	12.69	4	3.17	22.77	0.00
	Within	13.37	96	0.14		
	Total	26.06	100			
Polity	Between	2,091.16	4	522.79	54.39	0.00
	Within	922.78	96	9.61		
	Total	3,013.94	100			
CO_2 per capita	Between	304.75	4	76.19	25.95	0.00
	Within	281.86	96	2.94		
	Total	586.61	100			

Note: see Table 1 for definitions of the variables

Appendix 6. Cluster membership of developing countries

	1995-2000				2005-2010			
Country	Development cluster	GNIpc	Income group	Income rank	Development cluster	GNIpc	Income group	Income rank
Angola	1	420	LIC	36	2	3960	LMIC	69
Bhutan	1	720	LIC	51	3	1870	LMIC	47
Burkina Faso	1	230	LIC	12	1	550	LIC	18
Burundi	1	130	LIC	2	1	170	LIC	1
Cameroon	1	630	LIC	47	2	1200	LMIC	39
Central African Rep.	1	280	LIC	19	1	470	LIC	12
Chad	1	180	LIC	9	2	620	LIC	21
Comoros	1	380	LIC	31	1	750	LIC	25
Congo, Dem. Rep.	1	90	LIC	1	1	180	LIC	2
Congo, Rep.	1	560	LIC	43	2	2240	LMIC	50
Gambia, The	1	330	LIC	27	1	450	LIC	11
Guinea	1	400	LIC	34	1	400	LIC	8
Guinea-Bissau	1	180	LIC	8	1	590	LIC	19
Haiti	1	300	LIC	23	1	650	LIC	22
Kenya	1	420	LIC	35	3	810	LIC	28
Kyrgyz Rep.	1	280	LIC	20	3	830	LIC	29
Lao PDR	1	280	LIC	21	1	1040	LMIC	31
Liberia	1	140	LIC	4	1	200	LIC	3
Malawi	1	160	LIC	6	1	330	LIC	4
Mauritania	1	530	LIC	40	2	1000	LMIC	30
Pakistan	1	470	LIC	39	1	1050	LMIC	32
Rwanda	1	250	LIC	15	1	520	LIC	16
Sierra Leone	1	150	LIC	5	1	340	LIC	5
Swaziland	1	1600	LMIC	71	2	2930	LMIC	61
Tajikistan	1	170	LIC	7	2	800	LIC	27
Tanzania	1	300	LIC	24	1	540	LIC	17
Togo	1	300	LIC	25	1	490	LIC	14
Uganda	1	260	LIC	17	1	500	LIC	15
Vietnam	1	390	LIC	33	2	1160	LMIC	37
Yemen, Rep.	1	420	LIC	37	2	1170	LMIC	38
Zambia	1	310	LIC	26	1	1070	LMIC	33
Bangladesh	2	380	LIC	32	1	700	LIC	23
Benin	2	370	LIC	29	1	780	LIC	26
Cambodia	2	290	LIC	22	1	750	LIC	24
Djibouti	2	750	LMIC	53	3	1300	LMIC	44
Ethiopia	2	130	LIC	3	1	390	LIC	7
Ghana	2	340	LIC	28	3	1250	LMIC	41
India	2	430	LIC	38	1	1270	LMIC	42
Indonesia	2	560	LIC	44	3	2500	LMIC	54
Madagascar	2	250	LIC	16	1	430	LIC	9
Mali	2	230	LIC	13	1	600	LIC	20
Mozambique	2	230	LIC	14	1	440	LIC	10
Nepal	2	220	LIC	11	1	490	LIC	13
Niger	2	180	LIC	10	1	370	LIC	6
Nigeria	2	270	LIC	18	1	1230	LMIC	40
Papua New Guinea	2	620	LMIC	46	1	1300	LMIC	43
Philippines	2	1050	LMIC	62	3	2060	LMIC	49
Senegal	2	530	LIC	41	3	1080	LMIC	34
Sri Lanka	2	880	LMIC	55	3	2240	LMIC	51

Albania	3	1170	LMIC	63	3	3960	UMIC	70
Armenia	3	660	LIC	49	3	3200	LMIC	63
Bolivia	3	1000	LMIC	60	3	1810	LMIC	46
Cape Verde	3	1390	LMIC	69	3	3270	LMIC	64
Colombia	3	2350	LMIC	83	3	5510	UMIC	83
Dominican Rep.	3	2620	LMIC	84	3	5030	UMIC	81
Ecuador	3	1330	LMIC	66	3	3850	UMIC	68
El Salvador	3	2110	LMIC	81	3	3380	LMIC	65
Georgia	3	750	LIC	54	3	2690	LMIC	55
Guatemala	3	1730	LMIC	74	3	2740	LMIC	57
Guyana	3	890	LMIC	56	3	2870	LMIC	60
Honduras	3	940	LMIC	58	3	1870	LMIC	48
Lesotho	3	530	LIC	42	3	1090	LMIC	35
Moldova	3	370	LIC	30	3	1810	LMIC	45
Namibia	3	1950	LMIC	79	3	4510	UMIC	76
Nicaragua	3	730	LIC	52	3	1110	LMIC	36
Paraguay	3	1350	LMIC	67	3	2720	LMIC	56
Peru	3	2060	LMIC	80	3	4700	UMIC	79
Algeria	4	1600	LMIC	72	4	4390	UMIC	75
Azerbaijan	4	610	LIC	45	4	5330	UMIC	82
China	4	930	LMIC	57	4	4270	UMIC	73
Egypt, Arab Rep.	4	1440	LMIC	70	4	2420	LMIC	53
Gabon	4	3080	UMIC	86	4	7650	UMIC	93
Iraq	4	1000	LMIC	61	4	2340	LMIC	52
Kazakhstan	4	1260	LMIC	64	4	7580	UMIC	92
Morocco	4	1310	LMIC	65	4	2850	LMIC	59
Syrian Arab Rep.	4	990	LMIC	59	4	2750	LMIC	58
Tunisia	4	2300	LMIC	82	4	4160	UMIC	72
Turkmenistan	4	650	LMIC	48	4	3790	LMIC	66
Argentina	5	7460	UMIC	99	5	8620	UMIC	95
Belarus	5	1380	LMIC	68	4	5950	UMIC	85
Belize	5	3110	LMIC	87	5	3810	LMIC	67
Botswana	5	3120	UMIC	88	5	6740	UMIC	88
Brazil	5	3860	UMIC	93	5	9390	UMIC	97
Chile	5	4840	UMIC	96	5	10120	UMIC	99
Costa Rica	5	3710	UMIC	91	5	6810	UMIC	90
Iran, Islamic Rep.	5	1630	LMIC	73	4	4600	UMIC	78
Jamaica	5	3310	LMIC	89	5	4800	UMIC	80
Jordan	5	1790	LMIC	75	4	4340	UMIC	74
Macedonia, FYR	5	1830	LMIC	76	3	4570	UMIC	77
Malaysia	5	3420	UMIC	90	5	7760	UMIC	94
Mexico	5	5010	UMIC	97	5	8930	UMIC	96
Panama	5	3730	UMIC	92	3	6970	UMIC	91
South Africa	5	3050	UMIC	85	5	6090	UMIC	87
Suriname	5	1930	LMIC	78	5	6000	UMIC	86
Thailand	5	1930	LMIC	77	3	4150	UMIC	71
Turkey	5	4170	UMIC	95	5	9890	UMIC	98
Ukraine	5	700	LIC	50	3	3000	LMIC	62
Uruguay	5	7100	UMIC	98	5	10230	UMIC	100
Venezuela, RB	5	4100	UMIC	94	4	11590	UMIC	101
Montenegro			..		3	6740	UMIC	89
Serbia		1400	..		5	5630	UMIC	84

Appendix 7. Distribution of global population and poverty across development clusters and income groups

	1999					2008				
	Total population (millions)	Participation in developing countries population (%)	$2 poverty line			Total population (millions)	Participation in developing countries population (%)	$2 poverty line		
			Total poor (millions)	Participation in global poverty (%)	Poverty incidence (%)*			Total poor (millions)	Participation in global poverty (%)	Poverty incidence (%)*
LIC	633.2	13.1	437.7	15.6	69.1	764.1	13.6	486.3	20.6	63.6
MIC	4,185.5	86.9	2,356.5	84.3	56.3	4,861.0	86.4	1,871.1	79.4	38.5
LMIC	2,043.0	42.4	1,445.4	51.7	70.7	2,442.3	43.4	1,394.5	59.2	57.1
LMIC minus India	1,018.0	21.1	605.9	21.7	59.5	1,251.4	22.2	569.4	24.2	45.5
UMIC	2,142.5	44.5	911.1	32.6	42.5	2,418.7	43.0	476.6	20.2	19.7
UMIC minus China	889.8	18.5	169.1	6.0	19.0	1,094.0	19.4	82.3	3.5	7.5
C1	512.2	10.6	384.1	13.7	75.0	2,181.0	38.8	1,543.1	65.5	70.7
C2	1,783.5	37.0	1,349.6	48.3	75.7	176.3	3.1	80.6	3.4	45.7
C3	145.7	3.0	44.8	1.6	30.7	729.7	13.0	250.9	10.6	34.4
C4	1,454.9	30.2	683.8	24.5	47.0	1,700.1	30.2	429.9	18.2	25.3
C5	682.7	14.2	109.5	3.9	16.0	537.9	9.6	49.1	2.1	9.1
Missing countries in the analysis	239.6	5.0	224.8	8.0	_	299.9	5.3	3.9	0.2	_
Developing countries, total	4,818.7	100.0	2796.7	100.0	58.0	5,625.0	100.0	2,357.5	100.0	41.9

Source: Compiled by authors. $2 Poverty data processed by Edward and Sumner (2013) from World Bank (2014). WGI data processed from Tezanos and Guitierrez (2014).
* Population weighted averages