UNITED NATIONS UNIVERSITY

UNU-WIDER
World Institute for Development
Economics Research

Research Paper No. 2008/44

State Fragility

Concept and Measurement

Mina Baliamoune-Lutz[1]
and Mark McGillivray[2]

April 2008

Abstract

The international donor community has grave concerns about the prospects for poverty reduction in what it terms *fragile states*. A state is classified as fragile if its country policy and institutional assessment (CPIA) score falls below a particular threshold. Recognizing that all states are fragile to varying degrees, this paper questions the method used by the international community to deem a country fragile. This paper develops a framework that uses fuzzy-set theory to deem a country as *fragile*. Fuzzy sets allow for gradual transition from one state to another while also allowing one to incorporate rules and goals, and hence are more appropriate for measuring outcomes

…./.

[1] (corresponding author) Department of Economics, University of North Florida, Jacksonville, email: mbaliamo@unf.edu; [2] Australian Agency for International Development (AusAID), Canberra, email: Mark.McGillivray@ausaid.gov.au

that are ambiguous. Such ambiguity is an inherent characteristic of cross-country fragility classifications. The paper applies its framework to 76 low-income countries, for which the CPIA data are publicly available. The fragile state group that this framework provides is compared to that which the international donor community has constructed.

Acronyms

CPIA   country policy and institutional assessment

CPR   country performance ratings

DAC   Development Assistance Committee of OECD

IDA   International Development Association

LICUS   low-income country under stress

1   Introduction

The international donor community has grave concerns about the effectiveness of aid to countries it classifies as *fragile states*. The positive impact of aid on growth and poverty reduction, and the ability to efficiently absorb additional inflows are thought to be significantly low in these countries compared to other recipients. In some donor circles this impact is even thought to be non-existent (Torres and Anderson 2004; McGillivray 2006. Donors insist that unless aid can be made to work better in fragile states, the intended developmental dividend from these increased flows will not be observed, and the worldwide achievement of the much espoused Millennium Development Goals will not be possible in the foreseeable future, let alone by the agreed target of 2015 (Branchflower et al. 2004).

Two alternative fragile state classifications are employed by the international donor community. The first was proposed by the Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development (OECD). It classifies a country as fragile if it belongs to the bottom two quintiles of the World Bank's country policy and institutional assessment (CPIA) ratings or was not rated in the current CPIA rating exercise. CPIA ratings are prepared annually by World Bank staff and consist of 20 criteria[1] related to the appropriateness of a country's economic policies and the performance of its public institutions. Thirty-five countries were classified as fragile according to the approach in 2004. The second deems a country fragile if it is a low income country that has a CPIA score of 3.0 or less. These are also the criteria that the World Bank uses to allocate a country to the low-income country under stress (LICUS) group. Forty-six countries were classified as fragile states according to this definition in 2004.[2]

The reason why the inability to efficiently absorb aid inflows for growth and poverty reduction is in effect measured by CPIA scores reflects an implicit consensus within much of the international donor community regarding aid effectiveness. That consensus is that the impact of aid on income growth, poverty reduction and other developmental outcomes is conditional on recipient country policy regimes and institutional performance. Specifically, the consensus is that the more appropriate these regimes are from a developmental perspective and the better the performance of these institutions, the greater will be the incremental effectiveness of aid. This consensus is based on the findings of the well-known and extremely influential aid-growth paper by Burnside and Dollar (2000) and subsequent papers by Collier and Dollar (2001, 2002). Burnside and Dollar (2000) estimate a growth model that includes a variable obtained by multiplicatively interacting a measure of policy and aid. The relationship between

---

[1] Since 2004 the number of criteria has been reduced to 16. The CPIA overall score is obtained by adding up the average scores from four clusters and assigning equal weight (25 per cent) to each. The criteria within each cluster have equal weight.

[2] The international donor community's concerns over fragile states are easy to understand if one looks at the plight of these countries. According to the second classification, roughly one-third of the world's population who live in extreme income poverty, some 340 million people, reside in fragile states. Of the estimated 10.8 million children who died before their fifth birthday in 2002, just over 40 percent lived in these 46 states (Branchflower et al. 2004). One should also acknowledge that, as is evident from this discussion, the term *fragile state*, as used in the donor community, might be misleading, to the extent that it is not used to delineate states only in terms of their likelihood of breaking-up or vulnerability to downside shocks.

growth and this interaction was found to be linear, positive and statistically significant at all levels of growth and the aid-policy interaction variables. Collier and Dollar did and found likewise, but for an interaction of the CPIA and aid. On the other hand, recent empirical studies show that the impact of policies on aid effectiveness is not robust or inexistent (Easterly, Levine and Roodman 2004; Baliamoune-Lutz 2006a).

This paper questions the manner in which the donor community delineates fragile from non-fragile states. In short, there seems to be no clear or obvious justification for the CPIA thresholds used to partition fragile from non-fragile states. Indeed, the results of the Burnside-Dollar and Collier-Dollar studies would tend to suggest that no such partition exists in reality. The results of these studies tell us that if we associate fragility with aid effectiveness, all countries are fragile to the extent that their ability to use aid differs. Some are simply more fragile than others.[3] Given this, and assuming that aid effectiveness does indeed vary among states according to their policies and institutional performance, how might one partition fragile from not-so-fragile states? A number of approaches might be valid, but let us highlight two. The first would be to revisit the research of Burnside-Dollar and Collier-Dollar, to seek to establish whether there has been a previously undetected significant structural break in the aid-policy and institutions-growth relationship. The CPIA score at which this break occurs would then be used to partition countries on the basis of their perceived fragility. The second approach would be to acknowledge that such partitioning is not an opaque outcome, that differences in degrees of fragility among countries are not always crisp, clean and unambiguous. It is not clear, for example, that a country with a CPIA score of 3.0 uses aid observably better than one with a CPIA score of 2.9.

This paper adopts the second of the above-mentioned approaches. We develop a framework that uses fuzzy-set theory to deem a country as *fragile*. Fuzzy sets allow for gradual transition from one state to another while also allowing one to incorporate rules and goals, and hence are more appropriate for measuring outcomes that are ambiguous or opaque. The paper applies its framework to 76 low-income countries, for which the CPIA data are publicly available. The fragile-state group that this framework provides is compared to the list which the international donor community would construct using the first of the above-mentioned classification criterion, a CPIA score that belongs to the bottom two quintiles of these scores.

2   Fuzzy CPIA

2.1 Method

Lotfi Zadeh (1965) who is widely credited with the conceptualization of fuzzy-set theory defines fuzzy sets as a class of objects with a continuum of grades of membership.[4] Degrees of membership in the set of achievements (or goals) are usually

---

3   Note that Burnside and Dollar do indicate a level of their policy variable at which aid's impact on growth falls below zero. One might deem a country fragile if aid has no positive impact on growth. But there is no evidence that the donor community has done this, as there appears to have been no attempt to match this level with those of the CPIA used to deem a country fragile.

4   Baliamoune-Lutz (2006b) and Baliamoune-Lutz and McGillivray (2006) provide a discussion of the concept of fuzzy set theory and its application. This section draws on these two studies.

expressed by numbers belonging to the interval [0,1]. Fuzzy sets allow for gradual transition from one state to another while also allowing one to incorporate rules and goals. Thus, fuzzy sets are more appropriate for measuring outcomes that are vague or ambiguous.

In the context of measuring state fragility, fuzzy sets would allow us to examine changes in country ranking depending on the degree of vagueness and the level (threshold) at which performance changes from disastrous to average or good (depending on how we define the cutoff point).

To derive fuzzy CPIA scores, we follow Baliamoune-Lutz (2006b) and Baliamoune-Lutz and McGillivray (2006) and use the following fuzzy membership function:

$$\mu(x_i) = \frac{1}{1 + e^{-\alpha(x_i - \beta)}} \tag{1}$$

This function is quite adequate for the purpose of determining, for example, whether the outcome is close enough to the goal for it to be considered a success or whether differences between two outcomes should be considered as relevant differences. Equation (1) is obtained by first noting that the distance between the actual outcome and the goal provides a measure of the extent of the success in attaining the goal. If the outcome is complete success, we have full membership, i.e., $\mu(x_i) = 1$, and the distance between the actual outcome and the goal is zero. Thus, $d(x) = 0$. At the other extreme, a complete failure to meet the goal would imply $d(x) = 1$ and the membership score $\mu(x_i)$ would equal 1. For cases in between these two extremes, $d(x) > 0$, and $\mu(x_i) < 1$. Thus we may write the membership function μ as:

$$\mu(x_i) = \frac{1}{1 + d(x_i)} \tag{2}$$

Zimmermann (1987) points out that the relationship between physical objects and perceptions takes an exponential form. Thus, $d(x)$ can be expressed as: $d(x) = e^{-a(x_i - \beta)}$. Substituting in Equation (2) yields Equation (1).

It can be shown (see Baliamoune-Lutz 2006b) that the parameters α and β can be obtained as follows:

$$\alpha = \frac{\ln(\frac{\mu_h}{1 - \mu_h}) - \ln(\frac{\mu_l}{1 - \mu_l})}{x_h - x_l}$$

and

$$\beta = \frac{x_l \ln(\frac{\mu_h}{1 - \mu_h}) - x_h \ln(\frac{\mu_l}{1 - \mu_l})}{\ln(\frac{\mu_h}{1 - \mu_h}) - \ln(\frac{\mu_l}{1 - \mu_l})}$$

where μ_h represents the membership degree of the highest achievement (x_h) of the goal, and μ_l represents the membership degree of the lowest achievement (x_l) of the goal.

2.2 Results

Using the information from the above discussion and Equation (1), we derive fuzzy CPIA scores and report the results in Table 1. The assumptions regarding what constitutes high (best) or low (worst) achievement as well as the values for α and β are shown in Table A1 in the Appendix. We should note that the parameter (slope) α can be used to represent the degree of vagueness or ambiguity and β may be used to represent the identification threshold, the score at which a county moves from fragile to stable state (see Zimmermann 1987: 205; Baliamoune-Lutz 2006b).

Table 1
IDA CPIA scores and *fuzzy* CPIA scores (fragile states are in the bottom two quintiles)

IDA rank Country[a]	IDA resource allocation index (IRAI) (1)	Fuzzy scores using the same alpha and beta for all clusters (2)	Fuzzy scores using different alpha and beta for each cluster (3) D (1)	(4) D (2)
1 Armenia	**4.33**	**4.50**	**5.12**	**4.60**
2 Cape Verde	4.09	4.28	4.97	4.53
3 Samoa	3.98	4.17	4.83	4.47
4 St Lucia	3.97	4.16	4.82	4.38
5 Tanzania	3.94	4.14	4.82	4.30
6 St Vincent and the Grenadines	3.92	4.11	4.74	4.14
7 Honduras	3.91	4.10	4.68	3.99
8 Uganda	3.88	4.08	4.58	3.86
9 Ghana	3.85	4.04	4.71	4.12
10 Georgia	3.83	4.03	4.68	4.03
Maldives	3.83	4.03	4.65	4.00
12 Bhutan	3.79	3.99	4.66	4.14
13 Dominica	3.78	3.98	4.57	3.92
14 India	3.77	3.96	4.64	4.05
15 Burkina Faso	3.76	3.95	4.58	3.93
16 Senegal	**3.75**	**3.94**	**4.57**	**3.92**
17 Vietnam	3.74	3.93	4.54	3.85
18 Nicaragua	3.72	3.91	4.53	3.83
19 Bolivia	3.71	3.90	4.42	3.69
20 Mali	3.71	3.90	4.54	3.89
21 Serbia and Montenegro	3.70	3.89	4.47	3.75
22 Grenada	3.69	3.88	4.52	3.93
23 Albania	3.68	3.86	4.35	3.63
24 Pakistan	3.66	3.85	4.24	3.53
25 Azerbaijan	3.65	3.84	4.29	3.59
Benin	3.65	3.84	4.37	3.65
Indonesia	3.65	3.84	4.30	3.59
28 Sri Lanka	3.62	3.80	4.41	3.71
29 Kenya	3.60	3.78	4.28	3.56
30 Bosnia and Herzegovina	3.59	3.77	4.29	3.57
31 Madagascar	**3.54**	**3.72**	**4.29**	**3.57**
32 Kyrgyz Republic	3.51	3.68	3.86	3.41
33 Lesotho	3.51	3.68	4.26	3.54
34 Moldova	3.50	3.68	4.16	3.45
35 Rwanda	3.48	3.65	4.19	3.47

Table 1 (con't)
IDA CPIA Scores and *fuzzy* CPIA scores (fragile states are in the bottom two quintiles)

IDA rank	Country[a]	IDA resource allocation index (IRAI) (1)	Fuzzy scores using the same alpha and beta for all clusters (2)	Fuzzy scores using different alpha and beta for each cluster (3) D (1)	(4) D (2)
36	Mozambique	3.46	3.63	4.08	3.37
37	Mongolia	3.44	3.61	4.14	3.42
38	Bangladesh	3.42	3.58	3.87	3.30
39	Ethiopia	3.38	3.55	3.96	3.29
40	Guyana	3.35	3.51	3.94	3.27
41	Malawi	3.35	3.51	4.10	3.38
42	Nepal	3.34	3.50	3.86	3.23
	Tajikistan	3.34	3.50	3.64	3.25
44	Zambia	3.32	3.47	3.96	3.25
45	**Yemen, Republic of**	**3.29**	**3.44**	**3.75**	**3.17**
46	Cameroon	3.29	3.44	3.87	3.20
47	Niger	3.26	3.41	3.89	3.18
48	Mauritania	3.16	3.29	3.61	3.04
49	Kiribati	3.16	3.29	3.78	3.05
50	Djibouti	3.14	3.27	3.53	3.02
	Nigeria	3.14	3.27	3.43	2.92
	Vanuatu	3.14	3.27	3.69	3.02
53	Sierra Leone	3.12	3.25	3.50	2.93
54	Papua New Guinea	3.11	3.24	3.65	2.98
55	Cambodia	3.09	3.22	3.33	2.94
56	Gambia, The	3.08	3.21	3.52	2.94
57	Guinea	3.02	3.13	3.34	2.89
58	Uzbekistan	3.00	3.11	2.99	2.71
59	Lao, People's Democratic Republic	2.98	3.09	3.06	2.73
60	Sao Tome and Principe	2.98	3.08	3.49	2.81
61	**Burundi**	**2.97**	**3.07**	**3.19**	**2.74**
62	Tonga	2.93	3.03	3.20	2.75
63	Chad	2.88	2.98	3.02	2.74
64	Congo, Democratic Republic of	2.84	2.93	2.95	2.72
65	Solomon Islands	2.83	2.91	2.98	2.59
66	Congo, Republic of	2.79	2.87	2.89	2.50
67	Haiti	2.77	2.84	2.89	2.66
68	Guinea-Bissau	2.68	2.75	2.86	2.47
69	Sudan	2.59	2.64	2.64	2.36
70	Angola	2.58	2.63	2.63	2.35
71	Eritrea	2.50	2.54	2.33	1.82
72	Cote d'Ivoire	2.49	2.53	2.64	2.30
	Togo	2.49	2.53	2.57	2.37
74	Comoros	2.42	2.45	2.23	1.99
75	Central African Republic	2.39	2.42	2.32	2.12
76	Zimbabwe	1.82	1.82	1.52	1.37

Note: [a] Five IDA countries excluded since not rated in IRAI 2005 exercise (Afghanistan, Liberia, Myanmar, Somalia, and Timor-Leste).

For calculation of the cluster averages, all criteria are equally weighted within a cluster; IRAI is calculated as the mean of the score of four clusters. Scale: 1 = lowest, 6 = highest. Rankings are based on un-rounded data.

Source: www.siteresources.worldbank.org/IDA

It is important to note that deciding what constitutes the highest and the lowest achievement may be subjective but it is not arbitrary. Indeed, using substantiated rules we can build scenario or ranges based on perceived degrees of ambiguity and the identification threshold. For example, we could define the CPIA score at which countries move from fragile to stable state. In fact, International Development Association (IDA) for example does something similar to this when it decides on the cutoff point. The main difference is that the use of fuzzy sets allows us to incorporate relevant information about the extent of ambiguity and threshold levels. Given that empirical evidence on the positive impact of aid on growth and poverty reduction, and the effects of many of the components in the four clusters (see Appendix A) used to derive CPIA scores are ambiguous, the use of fuzzy sets seems to be more appropriate than the way CPIA scores have been computed so far.

The scores in Column (1) of Table 1 represent the World Bank CPIA scores also used by IDA to represent IDA's resource allocation index (IRAI). We divided the countries into quintiles with the first country and its scores in each new quintile in bold. We compare these scores to the ones we have derived using fuzzy sets, Columns (2)-(4). It is clear that once we take into account the ambiguity of the outcomes we get different scores from the World Bank's CPIA. In Column (2) we use the same level of ambiguity and the same threshold for all four clusters and get overall scores that are higher than the CPIA scores but are consistent with the classification of countries in their respective quintiles. However, assigning the same ambiguity level to all clusters is not appropriate. For example, while there may be a consensus about what gender equality means, it may be difficult to get a consensus on the definition of good institutions. Furthermore, some components, such as black market premium for example, may have an unambiguous effect on growth (based on the empirical literature), while the effect of trade openness on growth in low-income countries is at best ambiguous.

Table 2
IDA country performance ratings (CPR) and fuzzy CPR scores

| | IDA-CPR | Fuzzy scores based on the scenarios in Table A2 | | | | |
		(3)	(4)	(5)	(2)	(1)
Armenia	5.58	5.33	5.32	6.00	5.99	5.99
Bhutan	5.17	5.11	5.10	6.00	5.97	5.98
Samoa	5.07	5.04	5.04	6.00	5.97	5.97
St Lucia	4.92	4.95	4.95	6.00	5.95	5.96
Cape Verde	4.75	4.82	4.83	6.00	5.94	5.95
St Vincent	4.50	4.62	4.64	5.99	5.90	5.92
Tanzania	4.35	4.48	4.51	5.98	5.87	5.90
Honduras	4.26	4.40	4.43	5.96	5.84	5.89
Georgia	4.13	4.28	4.32	5.93	5.80	5.86
Maldives	4.04	4.19	4.23	5.90	5.76	5.84
Ghana	4.04	4.18	4.23	5.89	5.76	5.84
Senegal	3.97	4.11	4.16	5.85	5.73	5.82
Uganda	3.95	4.10	4.15	5.84	5.72	5.81
Dominica	3.95	4.09	4.14	5.84	5.72	5.81
Nicaragua	3.94	4.08	4.13	5.83	5.71	5.81
Azerbaijan	3.79	3.93	3.99	5.66	5.63	5.75
Sri Lanka	3.79	3.92	3.98	5.66	5.63	5.75
India	3.77	3.90	3.96	5.61	5.61	5.74
Mongolia	3.76	3.89	3.96	5.61	5.61	5.74

Table 2 con't

Table 2 (con't)
IDA country performance ratings (CPR) and fuzzy CPR scores

	IDA-CPR	Fuzzy scores based on the scenarios in Table A2				
		(3)	(4)	(5)	(2)	(1)
Vietnam	3.76	3.88	3.95	5.59	5.60	5.74
Grenada	3.70	3.83	3.89	5.48	5.56	5.72
Burkina Faso	3.67	3.79	3.86	5.41	5.54	5.70
Benin	3.67	3.79	3.85	5.39	5.54	5.70
Mali	3.63	3.75	3.82	5.29	5.51	5.68
Serbia & Montenegro	3.56	3.66	3.74	5.03	5.44	5.64
Moldova	3.55	3.65	3.73	4.97	5.43	5.63
Rwanda	3.53	3.63	3.70	4.89	5.41	5.62
Albania	3.51	3.61	3.69	4.81	5.39	5.61
Lesotho	3.44	3.53	3.61	4.44	5.31	5.57
Bosnia-Herzegovina	3.41	3.49	3.58	4.28	5.28	5.55
Madagascar	3.37	3.45	3.53	4.02	5.23	5.52
Kenya	3.36	3.43	3.52	3.91	5.21	5.50
Guyana	3.26	3.31	3.41	3.22	5.08	5.42
Bolivia	3.23	3.28	3.38	3.01	5.04	5.40
Mozambique	3.17	3.20	3.30	2.54	4.93	5.34
Malawi	3.10	3.13	3.23	2.09	4.82	5.27
Indonesia	3.06	3.07	3.18	1.80	4.74	5.22
Ethiopia	3.03	3.04	3.15	1.64	4.69	5.19
Sao Tome-Principe	3.00	3.00	3.11	1.46	4.63	5.15
Kyrgyz Republic	2.98	2.98	3.09	1.35	4.59	5.13
Pakistan	2.95	2.94	3.05	1.18	4.52	5.08
Cameroon	2.91	2.89	3.01	1.02	4.44	5.03
Kiribati	2.89	2.87	2.99	0.93	4.39	5.01
Sierra Leone	2.80	2.76	2.88	0.62	4.17	4.87
Tajikistan	2.78	2.74	2.86	0.58	4.14	4.84
Niger	2.72	2.67	2.79	0.45	3.99	4.75
Yemen	2.72	2.67	2.79	0.44	3.99	4.75
Zambia	2.70	2.64	2.76	0.39	3.92	4.70
Gambia, The	2.67	2.61	2.74	0.35	3.86	4.66
Bangladesh	2.65	2.58	2.71	0.31	3.80	4.61
Nepal	2.64	2.57	2.70	0.31	3.79	4.61
Djibouti	2.62	2.55	2.68	0.27	3.72	4.56
Vanuatu	2.62	2.54	2.67	0.27	3.72	4.56
Tonga	2.60	2.52	2.65	0.25	3.67	4.53
Papua New Guinea	2.59	2.51	2.64	0.24	3.64	4.50
Solomon Islands	2.52	2.43	2.56	0.17	3.44	4.37
Mauritania	2.52	2.43	2.56	0.17	3.44	4.36
Congo, Republic of	2.49	2.39	2.52	0.14	3.35	4.30
Lao, PDR	2.37	2.26	2.39	0.08	3.02	4.04
Cambodia	2.36	2.24	2.38	0.08	2.99	4.02
Guinea-Bissau	2.29	2.16	2.30	0.05	2.78	3.85
Nigeria	2.25	2.12	2.26	0.04	2.67	3.76
Burundi	2.23	2.10	2.24	0.04	2.62	3.72
Guinea	2.02	1.87	2.02	0.01	2.05	3.19
Angola	1.87	1.72	1.87	0.01	1.69	2.81

Table 2 con't

7

Table 2 (con't)
IDA country performance ratings (CPR) and fuzzy CPR scores

| | IDA-CPR | Fuzzy scores based on the scenarios in Table A2 | | | | |
		(3)	(4)	(5)	(2)	(1)
Uzbekistan	1.86	1.72	1.86	0.01	1.67	2.79
Eritrea	1.75	1.61	1.75	0.00	1.42	2.50
Congo, Dem. Rep.	1.70	1.56	1.71	0.00	1.33	2.39
Comoros	1.70	1.56	1.70	0.00	1.32	2.38
Côte d'Ivoire	1.50	1.39	1.53	0.00	0.98	1.92
Haiti	1.50	1.38	1.52	0.00	0.97	1.91
Sudan	1.47	1.36	1.50	0.00	0.93	1.85
Chad	1.47	1.36	1.50	0.00	0.93	1.85
Central Africa Rep.	1.28	1.20	1.34	0.00	0.67	1.45
Togo	1.24	1.17	1.31	0.00	0.64	1.39
Zimbabwe	0.84	0.90	1.02	0.00	0.32	0.80

Note: The lines divide the scores to greater than 5, between 4 and 5, between 3 and 4, between 2 and 3, and less than 2.

To illustrate how scores would change once we allow for differences in the levels of ambiguity and thresholds, we derive scores assuming different values for α and β. In particular, we assume higher degree of vagueness and a *restrictive* (high) threshold for public sector management and institutions (cluster D). In Column (3) of Table 1 we assume a *high* level of ambiguity and high identification threshold (by assuming that the worst outcome is a score of 3), while in Column (4) we assume *very high* ambiguity and threshold (by assuming that the worst outcome is a score of 4). We show that the results for cluster D based on the two scenarios are very different, as can be observed in the last two Columns of Table 1. Depending on the levels of ambiguity and threshold, some countries may change quintiles. For example, in Column (3) Tajikistan would move to quintile 4 while Niger would move up to quintile 3.

This framework is useful to apply to IDA lending and aid allocation. IDA bases its country envelopes on the country's CPIA. Table 2 shows country performance ratings (CPR) scores change dramatically depending on the scenario used (see details in Table A2 in the Appendix).

3 Concluding remarks

We applied fuzzy transformations to the 2005 CPIA scores from 76 countries and tried to partition fragile from not-so-fragile states taking into account the inherent ambiguity in measuring policies and institutions, and assuming that aid effectiveness does indeed vary among states according to their policies and institutional performance. The fuzzy scores we derived are different from the CPIA scores. These differences imply that some countries, particularly the ones close to the border of their quintile (or close to the IDA cutoff points) may be incorrectly classified.

There are many possible sources of ambiguity in CPIA scores but three sources are quite obvious and some of them may be associated with poor data collection and low transparency, both of which tend to be predominant in most low-income countries. First, ambiguity could arise simply from the lack of robust and conclusive evidence on aid

effectiveness and the effect of some economic policies and institutional reforms on growth and poverty reduction. Second, ambiguity could result from the questions in the World Bank questionnaire used in collecting information on the clusters. Third, the respondent's perception of what he/she thinks as a true picture could also be a source of ambiguity. Indeed, a study done by the Africa region at the World Bank concluded the following.

> Using the 'natural experiment' provided by independent CPIA-type ratings from the African Development Bank, the paper estimates the standard deviation of a CPIA rating at 0.24 on the 1-6 scale. Our results suggest that it is reasonable to disclose ratings within a confidence interval of 0.5 centred on the estimate and to allow some flexibility in allocations in response to measurement uncertainty. CPIA scores can help to indicate where performance needs to be strengthened and how fast this can be done, taking into account both historical performance and what has been possible in other countries (World Bank 2004).

The assigning of CPIA rating can be extremely crucial to a country's access to aid. The CPIA scores are used to decide how IDA assistance is allocated. Indeed, the World Bank ranks IDA eligible countries with CPIA scores in governance and overall less than or equal to 2.5 as *severe*, those with rating between 2.5 and 3.0 as *core*, and countries, with rating between 3.0 and 3.2 as *marginal*. CPIA scores are also used by DAC for aid allocation purposes. It is possible that computing CPIA scores the correct way could contribute to better aid allocation and aid effectiveness.

References

Baliamoune-Lutz, M. (2006a). 'Aid Effectiveness: Looking at the Aid-Social Capital-Growth Nexus'. Paper presented at the WIDER Conference on Aid: Principles, Policies and Performance, 16-17 June.

Baliamoune-Lutz, M. (2006b). 'On the Measurement of Human Well-Being: Fuzzy Set Theory and Sen's Capability Approach'. In M. McGillivray and M. Clarke (eds), *Understanding Human Wellbeing*. Tokyo: United Nations University Press.

Baliamoune-Lutz, M., and M. McGillivray (2006). 'Fuzzy Wellbeing Achievement in Pacific Asia'. *Journal of the Asia Pacific Economy*, 11 (2): 168-77.

Branchflower, A., S. Hennell, S. Pongracz, and M. Smart (2004). 'How Important are Difficult Environments to Achieving the MDGs?'. PRDE Working Paper 2. London: Poverty Reduction in Difficult Environments Team, Policy Division, DFID.

Burnside, C., and D. Dollar (2000). 'Aid, Policies and Growth'. *American Economic Review*, 90 (4): 847-68.

Collier, P., and D. Dollar (2001). 'Can the World Cut Poverty in Half? How Policy Reform and Effective Aid Can Meet the International Development Goals?'. *World Development*, 29 (11): 1787-802.

Collier, P., and D. Dollar (2002). 'Aid Allocation and Poverty Reduction'. *European Economic Review*, 26 (8): 1475-500.

Easterly, W., R. Levine, and D. Roodman (2004). 'Aid, Policies, and Growth: Comment'. *American Economic Review*, 94 (3): 774-80.

McGillivray, M. (2006). 'Aid Allocation and Fragile States'. WIDER Discussion Paper 2006/01. Helsinki: UNU-WIDER.

Torres, M. M., and M. Anderson (2004). 'Fragile States: Defining Difficult Environments for Poverty Reduction' PRDE Working Paper 1. London: Poverty Reduction in Difficult Environments Team, Policy Division, DIFD.

World Bank (2004). 'Implementing Performance-Based Aid in Africa: The Country Policy and Institutional Assessment'. Africa Region Working Paper Series, 77. Washington, DC: World Bank..

Zadeh, L. A. (1965). 'Fuzzy Sets'. *Information and Control*, 8: 338-43.

Zimmermann, H. J. (1987). *Fuzzy Sets, Decision Making, and Expert Systems*. Boston: Kluwer Academic.

Appendix A

Table A1
Parameters for computing degrees of membership used in Table 1*

Cluster [a]	Best outcome	μ_h	Worst outcome	μ_l	α	β
A	5	0.833	2	0.334	4.6049	0.4838
B	6	0.999	2	0.334	11.4135	0.3939
C	5	0.833	1	0.167	4.8259	0.500
D (1)	6	0.999	3	0.500	13.8412	0.500
D (2)	6	0.999	4	0.667	18.6969	0.6296

Note: *   The scores shown in Table 1 are fuzzy scores derived using the parameters (raw scores) in Table A2 and then converting them to the 1-6 scale used by IDA by multiplying *the raw scores* by 6.

      [a]   CPIA clusters:

A: Economic management (macro management, fiscal policy, debt policy);

B: Structural policies (trade, financial sector, business and regulatory environment);

C: Policies for social inclusion/equity (gender equality, equity of public resource use, building human resources, social protection and labour, policies and institutions for environmental sustainability);

D: Public sector management and institutions (property rights and rule-based governance, quality of budgetary and financial management, efficiency of revenue mobilization, quality of public administration, transparency, accountability, and corruption in the public sector)

Source: www.iteresources.worldbank.org/IDA/

Table A2
Parameters for computing degrees of membership used in Table 2*

Scenario	Best outcome	μ_h	Worst outcome	μ_l	α	β
(1)	6	0.999	1	0.167	10.2329	0.3240
(2)	6	0.999	2	0.334	11.4135	0.39386
(3)	5	0.833	1	0.167	4.8259	0.500
(4)	5	0.833	2	0.334	4.6033	0.4839
(5)	6	0.999	0	0.001	29.9336	0.5384

Note: *   The scores shown in Table 2 are fuzzy CPR scores derived using the parameters (raw scores) in Table A2 and then converting them to the 1-6 scale used by IDA by multiplying the raw scores by 6.