

Small States: A Composite Vulnerability Index¹

Jonathan P. Atkins, Sonia Mazzi and Christopher D. Easter

Introduction

There is growing international recognition that high economic exposure, remoteness and isolation, and proneness to natural disasters have a debilitating effect on small economies, despite their relatively high per capita incomes. The purpose of this paper is to present a composite vulnerability index designed to help identify vulnerable states. Such an index could be used as an operational tool in determining whether small states should be accorded differential treatment by the international development community. It is designed to augment the per capita income criterion in decision-making processes.

Vulnerability and small states

Vulnerability, in the context of small states, is widely believed to be associated with *exposure to external economic forces and environmental hazards*. In the Commonwealth Secretariat's 1997 report, *A Future for Small States: Overcoming Vulnerability*, it was argued that 'vulnerability is the consequence of two sets of factors: (1) the incidence and intensity of risk and threat; and (2) the ability to withstand risks and threats (*resistance*) and to "bounce back" from their consequences (*resilience*)'. Such threats were perceived to emanate from three main sources: economic exposure; remoteness and insularity; and proneness to natural disasters.

The UN has distinguished two important considerations in the notion of vulnerability. Firstly, it has distinguished between *economic vulnerability* and *ecological fragility*, recognising that economic vulnerability finds its origins partly in ecological factors (for example, cyclones). That is, vulnerability indices 'are meant to reflect relative economic and ecological susceptibility to exogenous shocks'. Secondly, it makes a distinction 'between *structural* vulnerability, which results from factors that are durably independent from the political will of countries, and the vulnerability deriving from economic policy, which results from choices made in a recent past, and is therefore *conjectural*'. Vulnerability indices should

¹This paper was presented at the Commonwealth Secretariat/World Bank Joint Task Force on Small States conference held in St. Lucia in February 1999.

refer to 'structural vulnerability that depends on factors which are not under the control of national authorities when the shocks occur; the indicators should reflect exposure to shocks, that is to say, their magnitude and their probability'.¹

It is evident from the 1997 Commonwealth report findings that small states face particular threats from economic shocks and natural disasters. Despite many of these countries having relatively high incomes in developing country terms, their capacity to deal with these frequent shocks is limited. Moreover, because of their small size, the shocks referred to affect a greater proportion of the population of small states and have a significantly larger economic impact. At the same time, because of their income levels, some small states face graduation from Least Developed Country (LDC) status. The consequence is a loss of differential treatment in terms of their special access to financial resources, markets and technical assistance from multilateral agencies and donors.

In the case of natural disasters, many small states are located in regions where, for example, there is high incidence of cyclones, hurricanes and volcanic activity. Some of them, such as Maldives, Kiribati and Tuvalu, are low-lying islands or atolls which face the prospect of marine inundation in the event of further global warming and rise in sea-levels. Some are volcanic and suffer the threat of obliteration which may result from serious eruptions.

Globalisation has brought increased trade and capital flows. While *openness* to the world economy can be a source of many economic benefits, an economy characterised, for example, by limited diversification and, possibly, a dependence on a single export, such as bananas, sugar, textiles or tourism to generate foreign exchange earnings, can find itself vulnerable to adverse external shocks. With the implementation of the Uruguay Round agreements, and the prospect of the Lomé IV Convention expiring in the year 2000, small states find themselves increasingly marginalised in this more competitive trade environment. Turning to capital flows, investment does not necessarily follow openness, and an economy accessing external financial resources may become exposed to the consequences of events in the international financial markets. However, capital movements may depend more on economic policies than do trade movements, and access to external financial resources (loans, grants and transfers) may offer insurance during adverse periods.

¹The quotations are from the United Nations, *Development of a vulnerability index for small states: Report to the Secretary General*, draft document, 1998; and *How to include an index of vulnerability in the criteria for identifying the LDCs*, draft document CDP12.98/WG3/3, 8 September 1998.

Given this interpretation, one might use a vulnerability index to select certain countries for the purpose of bringing them to the attention of the international community. Under such circumstances, the graduation policies of the international financial institutions could pay more explicit attention to the acute vulnerabilities of their smaller members. For example, a country's vulnerability could be considered alongside per capita GDP as a basis for graduation decisions with a view to assisting a vulnerable country to achieve greater resistance and resilience to external shocks. The multilateral agencies could also review the way in which their activities impact upon countries identified as being vulnerable. For example, the European Union could adopt measures that would protect the interests of such countries in the arrangements which replace the Lomé IV Convention. Again, such a targeted initiative might assist in developing the resistance and resilience of the vulnerable countries.

To provide an objective basis for such proposals, it becomes necessary to establish a sound case for the differential treatment of small states and to develop criteria which extend beyond the single income measure currently applied for assessing their eligibility for special measures. It is in this context that the composite vulnerability index has been developed.

The definition of small states and basis for sample selection

While it is recognised that there may be alternative bases for identifying and classifying a small state, in this report small states are defined as countries with a population of 1.5 million or less.¹ In addition, three somewhat larger states – Jamaica, Lesotho and Papua New Guinea – are included in the small state category since it may be argued that they share many of the physical and economic characteristics of small states. This categorisation is also consistent with that used in the Commonwealth Secretariat's 1997 report, *A Future for Small States: Overcoming Vulnerability*. On the basis of this definition, the sample of countries examined here comprises 37 small states and 74 large states. These are listed in Box 1.

For comparative purposes a sample of large countries was also selected. Selection of all of the sample countries was principally on the basis of

¹Alternative measures of economic size which have been suggested are: total GNP, total population and total arable land. Earlier work at the Commonwealth Secretariat ('Classification of Economies by Size', Chapter 2 in B. Jalan (ed.), *Problems and Policies in Small Economies*, London: Croom Helm, 1982) showed that a composite index of all three indicators (unweighted) ranks countries in terms of size in much the same way as their ranking according to population alone. Hence, population can justifiably be used as a proxy for economic size, and ease of data availability provides further justification.

Box 1**Countries treated as ‘small states’ in this report**

Thirty-four countries with a population of 1.5 million or less are considered as small states in this report along with three larger states which share many of the physical and economic characteristics of small states in their respective regions (Commonwealth members in italics).

Africa: *Botswana*, Cape Verde, Comoros, Djibouti, Equatorial Guinea, Gabon, *Gambia*, *Lesotho*, *Namibia*, São Tomé and Príncipe and *Swaziland* (11)

Caribbean: *Antigua & Barbuda*, *The Bahamas*, *Barbados*, *Belize*, *Dominica*, *Grenada*, *Guyana*, *St. Kitts-Nevis*, *St. Lucia*, *St. Vincent and the Grenadines*, *Jamaica*, *Suriname* and *Trinidad & Tobago* (13)

Pacific: *Fiji*, *Kiribati*, *Papua New Guinea*, *Samoa*, *Solomon Islands*, *Tonga* and *Vanuatu* (7)

Indian Ocean: *Maldives*, *Mauritius* and *Seychelles* (3)

Other Asia: Bahrain (1)

Mediterranean: *Cyprus* and *Malta* (2)

Countries treated as ‘large states’ in this report

Seventy-four countries with a population of more than 1.5 million are considered as large states in this report (Commonwealth members in italics).

Africa: Algeria, Angola, Benin, Burkina Faso, Burundi, *Cameroon*, Central African Republic, Chad, Congo, Côte d’Ivoire, Egypt, Ethiopia, *Ghana*, Guinea, *Kenya*, Libya, Madagascar, *Malawi*, Mali, Mauritania, Morocco, *Mozambique*, Niger, *Nigeria*, Rwanda, *South Africa*, Senegal, *Sierra Leone*, Sudan, *Tanzania*, Togo, Tunisia, *Uganda*, Zaire, *Zambia*, and *Zimbabwe* (36)

South and Central America: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela (19)

Asia and Pacific: *Bangladesh*, Bhutan, China, *India*, Indonesia, Iran, Jordan, *Malaysia*, Myanmar, Nepal, Oman, *Pakistan*, Philippines, *Singapore*, *Sri Lanka*, Syria, Thailand, Turkey and Yemen (19)

data availability. Thus, for the purposes of the analysis, a number of small states have not been included in the sample due to a general scarcity of economic data; examples of such countries include Guinea Bissau, Nauru and Tuvalu. Inclusion in the sample was also determined by the political structure of the country, in the sense that dependent territories, such as Réunion, were not included in the sample. Further, Qatar and other oil-rich Gulf states (Kuwait, UAE, Saudi Arabia), the ‘transition’ economies (such as the CIS (Confederation of Independent States) of the former Soviet Union) and Hong Kong were specifically not included in the sample. While the exclusion of these states from the analysis may give some potential for sample selection bias, their inclusion would also bias the analysis in the sense that these economies have atypical and, in some cases transient, physical and/or economic characteristics.

Recent economic performance

An examination of the recent economic performance of small states indicates a number of important characteristics. Firstly, small states are a heterogeneous group in terms of per capita GNP – that is, while as a group they tend to have a higher per capita income than do large states, they appear among the poorest as well as the richest within the group of developing countries. Secondly, small states tend also to be a heterogeneous group in terms of growth in per capita GDP – some have appeared amongst the most successful developing countries and others amongst the least successful. Thirdly, small states are more homogeneous in terms of the volatility of per capita GDP growth over time,¹ having a tendency to experience a greater degree of volatility than do large states. It is this third characteristic of small states, a higher volatility of per capita GDP growth² (henceforth, output volatility), which is thought to be a

¹Measured by the standard deviation of annual rates of growth of constant price GDP per head. The choice of per capita constant price (PPP) GDP growth as opposed to GDP growth is consistent with an underlying interest in the economic well-being of the population of an economy subject to vulnerability, and is also consistent with a focus, for evaluation purposes, on international comparisons. The choice of standard deviation, rather than the coefficient of variation (standard deviation divided by mean stated as a percentage), as a measure of volatility follows from the characteristics of the growth data. The coefficient of variation should be used only for datasets involving positive numbers; otherwise negative or very small values could be obtained for the mean, which leads to meaningless values for the coefficient of variation.

²On the choice of GDP, rather than GNP, for a number of Pacific countries, for example, GNP may effectively dwarf GDP due to a variety of factors. For some countries it may be the result of aid flows themselves (extremes could be the Marshall Islands and Federated States of Micronesia with flows under their Compact with the USA). For others it could be remittance incomes (possibly Tonga, Samoa, Kiribati, Tuvalu and others) and income from Trust Funds based on investment overseas of revenues from mineral exploitation in the past (Nauru, Kiribati, Tuvalu

manifestation of the greater vulnerability of small states compared with large states. An Index of Output Volatility is shown in Table 1.¹ This index has been used as the basis for establishing a composite vulnerability index.

A composite vulnerability index

A composite index is one that combines a number of separate variables to create a single indicator. A well-known example of a composite index is the Human Development Index produced annually by the UNDP (UN Development Programme). In the case of the Composite Vulnerability Index the indicators selected must reflect the external economic forces and environmental hazards that generate vulnerability. Once selected, these indicators are combined or aggregated using an appropriate set of weights. The methodology adopted here follows a two-stage procedure. First, since vulnerability has been linked to greater output volatility, an economic model is statistically determined which explains output volatility in terms of specified economic and environmental causes of vulnerability. Second, the model so developed will be used to predict individual vulnerability scores for all countries for which data are available. These vulnerability scores will form the Composite Vulnerability Index. Annex 2 provides a full and more technical discussion of the methodology.

The analysis which led to the index presented here involved a statistical explanation of output volatility based on determinants of vulnerability reflecting the three broad areas previously noted:

are examples). Hence, volatility in growth in per capita GDP may not be such a robust and representative measure of vulnerability in so far as the impact is cushioned by these other flows. Conversely, there may be occasions when GDP is not showing much volatility but these income flows may do so (for example, because of the impact of a downturn on returns on investment (Asian financial crisis!). There are other factors which adversely affect assets owned overseas. Some years ago a cyclone in Guam severely and adversely affected a hotel owned by Nauru. Or there can be mismanagement of Trust Funds, a factor that has severely affected Nauru and caused it to seek loan assistance from the Asian Development Bank. Unfortunately, there are significant data problems in handling this issue – the GDP data themselves may not be particularly reliable for some small states and GNP data are likely not to be readily available, or not available at all. Thus, in the case particularly of some small island economies – some noted above are not contained in the sample – this limitation in adopting variability in per capita GDP growth as a manifestation of vulnerability needs to be noted. (We are grateful to David Edwards of the Asian Development Bank for advice on these matters.)

¹The Index of Output Volatility is simply the standard deviation of annual rates of growth of PPP GDP for 111 countries, 1980–92.

Table 1. Index of Output Volatility for a Sample of 111 Developing Countries (*small states are shown in italics*)

Country	Population (000)	Output Volatility Index	Rank	Real per capita GDP (PPP\$)	Rank
<i>Kiribati</i>	78	16.60	1	1,475	32
Chad	6,010	13.49	2	690	10
<i>Antigua and Barbuda</i>	65	13.38	3	5,369	86
<i>Tonga</i>	93	13.18	4	3,740	73
<i>Guyana</i>	816	11.87	5	2,140	45
<i>Djibouti</i>	557	11.60	6	775	14
Rwanda	7,554	11.42	7	740	13
<i>Equatorial Guinea</i>	379	11.26	8	1,800	39
<i>Solomon Islands</i>	354	11.21	9	2,266	49
<i>Swaziland</i>	809	11.17	10	2,940	58
Myanmar	44,596	10.48	11	650	7
<i>Botswana</i>	1401	10.21	12	5,220	85
<i>Namibia</i>	1461	10.13	13	3,710	72
Iran	64,169	10.11	14	5,380	87
<i>Belize</i>	204	9.63	15	4,610	82
<i>Cape Verde</i>	370	9.08	16	1,820	41
Congo	2,443	8.84	17	2,750	57
<i>Trinidad and Tobago</i>	1,278	8.75	18	8,670	101
Paraguay	4,701	8.32	19	3,340	67
Peru	22,886	8.32	19	3,320	66
Oman	1,992	7.77	21	10,420	104
<i>Gambia</i>	1,042	7.67	22	1,190	27
<i>Gabon</i>	1,248	7.64	23	3,861	77
<i>Suriname</i>	414	7.56	24	3,670	70
<i>Bahamas</i>	268	7.37	25	16,180	110
Jordan	4,936	7.03	26	4,380	80
Cameroon	12,522	7.01	27	2,220	48
Panama	2,538	7.00	28	5,890	93
Sierra Leone	4,297	6.93	29	860	18
<i>Samoa</i>	167	6.92	30	3,000	59
<i>Grenada</i>	92	6.89	31	3,118	61
<i>Fiji</i>	758	6.84	32	5,530	89
Syria	13,696	6.83	33	4,196	78
<i>Mauritius</i>	1,091	6.72	34	12,510	107
<i>St. Lucia</i>	139	6.59	35	3,795	74
Chile	13,822	6.58	36	8,900	102
Nigeria	105,264	6.48	37	1,540	33

Table 1 (continued)

Country	Population (000)	Output Volatility Index	Real per capita GDP		
			Rank	(PPP\$)	Rank
Uruguay	3,149	6.48	37	6,550	96
Zaire	41,231	6.39	39	300	1
Argentina	33,780	6.19	40	8,350	98
<i>Dominica</i>	71	6.12	41	3,810	76
Zimbabwe	10,739	6.12	41	2,100	43
<i>St. Vincent</i>	11	6.08	43	3,552	69
Togo	3,885	6.07	44	1,020	22
Yemen	13,196	6.07	44	1,600	34
Libya	5,048	6.05	46	6,125	94
Ethiopia	51,859	6.02	47	420	2
Tanzania	28,019	6.01	48	630	5
Sudan	26,641	5.98	49	1,350	30
<i>St. Kitts-Nevis</i>	42	5.97	50	9,340	103
<i>Seychelles</i>	72	5.90	51	4,960	84
Haiti	6,893	5.86	52	1,050	23
Benin	5,086	5.81	53	1,650	37
Venezuela	20,913	5.76	54	8,360	99
Dominican Republic	7,543	5.52	55	3,690	71
Ghana	16,446	5.52	55	2,000	42
Nicaragua	4,114	5.51	57	2,280	50
Mozambique	15,102	5.50	58	640	6
Côte d'Ivoire	13,316	5.36	59	1,620	36
Malaysia	19,247	5.29	60	8,360	99
<i>Bahrain</i>	535	5.22	61	15,500	109
Central African Rep.	3,156	5.10	62	1,050	23
Niger	8,550	5.10	62	790	16
Mexico	90,027	5.05	64	7,010	97
<i>Papua New Guinea</i>	4,110	5.03	65	2,530	55
China	1,196,360	4.84	66	2,330	51
Zambia	8,936	4.77	67	1,110	25
Malawi	10,520	4.65	68	710	12
Bangladesh	115,203	4.58	69	1,290	29
Mali	10,135	4.57	70	530	3
Morocco	25,945	4.52	71	3,270	64
<i>Lesotho</i>	1,943	4.44	72	980	20
Nepal	20,812	4.41	73	1,000	21

Table 1 (continued)

Country	Population (000)	Output Volatility Index	Rank	Real per capita GDP (PPP\$)	Rank
<i>Barbados</i>	260	4.34	74	10,570	105
Mauritania	2,161	4.27	77	1,610	35
Brazil	156,486	4.25	78	5,500	88
<i>São Tomé</i>	127	4.23	79	600	4
Costa Rica	3,270	4.21	80	5,680	91
El Salvador	5,517	4.18	81	2,360	52
Guinea	6,306	4.04	82	1,800	39
Burundi	6,026	3.96	83	670	8
Turkey	59,597	3.88	84	4,210	79
Thailand	57,585	3.78	85	6,350	95
Uganda	19,940	3.78	85	910	19
Kenya	26,391	3.77	87	1,400	31
<i>Vanuatu</i>	161	3.61	90	2,500	53
<i>Jamaica</i>	2,411	3.43	91	3,180	63
South Africa	39,659	3.38	92	3,127	62
Madagascar	13,854	3.37	93	700	11
Singapore	2,821	3.35	94	19350	111
Sri Lanka	17,897	3.30	95	3,030	60
Guatemala	10,029	3.18	96	3,400	68
<i>Maldives</i>	236	2.97	97	2,200	47
Senegal	7,902	2.94	98	1,710	38
Ecuador	10,980	2.92	99	4,400	81
Angola	10,276	2.91	100	674	9
Egypt	60,319	2.90	101	3,800	75
<i>Cyprus</i>	726	2.66	102	14,060	108
Bolivia	7,063	2.61	103	2,510	54
Tunisia	8,570	2.52	104	4,950	83
Honduras	5,335	2.43	105	2,100	43
<i>Comoros</i>	607	2.39	106	1,130	26
<i>Malta</i>	361	2.36	107	11,570	106
Algeria	26,722	2.32	108	5,570	90
India	901,459	2.12	109	1,240	28
Pakistan	132,941	2.07	110	2,160	46
Colombia	33,985	1.59	111	5,790	92
Philippines	64,800	4.31	75	2,590	56
Bhutan	1,596	4.30	76	790	16

◆ **Economic exposure**

This can be associated with an economy's trade and financial links with the international community, particularly dependence on international markets and susceptibility to external shocks. This economic exposure may be reflected in: trade openness and export concentration; capital openness and the degree of access to or reliance on external financial resource flows; dependence on the non-manufacturing sectors (services and tourism); and dependence on imports of key commodities (commercial energy).

◆ **Remoteness and insularity**

While all economies have the potential to be integrated into the international economy, some economies, by virtue of their location combined, possibly, with their size, can be disadvantaged in terms of cost indivisibilities in foreign trade, delays and enhanced uncertainties. It is only possible to reflect such factors indirectly through international transport costs.¹

◆ **Susceptibility to environmental events and hazards**

All economies are prone, to varying degrees, to the effects of environmental events and hazards that are beyond their control. While the most severe impact will occur as a result of natural disasters, an economy may also be affected by less severe climatic events.

The analysis tested a wide range of variables (see Annex 1) and model formulations in search of an explanation of output volatility which was rational and consistent with economic concepts. At the same time it was recognised that many other factors, either non-measurable (such as those relating to government) or for which the data are currently not available for some or all of the sample countries (such as labour remittances), could have a profound influence on output volatility.

The statistically preferred specification of the model demonstrates that output volatility can be explained, in part as expected, by three highly significant factors: a country's openness, as measured by export dependence (the average exports of goods and non-factor services as a percentage of GDP);² its lack of diversification, as measured by the UNCTAD

¹See Briguglio, L. (1995). 'Small Island Developing States and their Economic Vulnerabilities', *World Development*, 23(9):1615-32; and Briguglio, L. (1997). 'Alternative Economic Vulnerability Indices for Developing Countries'. Report prepared for the United Nations.

²On the issue of coverage of this indicator, it encompasses exports associated with export promotion zones. Export promotion zones refer to export processing zones, which usually

diversification index;¹ and, for small states, its susceptibility to natural disasters, as measured by the proportion of the population affected by such events as estimated over a relatively long period of time. These are not too dissimilar to those indicators proposed by the UN Committee for Development Policy.² The Commonwealth's Composite Vulnerability Index is derived from these three variables using weighted least squares techniques applied to the cross-sectional data. The weights attached to each indicator to aggregate to a single index are determined directly from the estimation procedure, being the estimated coefficients of the model. More detail about the model selected is presented in Annex 2. Diagnostic variables indicate the significance of the results and diagnostic checks on the model ensured it was correctly specified.

The results

The Composite Vulnerability Index (CVI) developed clearly shows that, in general, small states are more vulnerable to external economic forces and environmental hazards than are large states. From Table 2 it can be seen that of the countries showing the 30 highest CVI scores all, except two, are small states. In contrast, the 30 lowest CVI scores correspond to

involve local value added although most inputs are usually imported (that is, assembly type activities). Therefore, the exported product can only be a genuine export and would naturally be part of the export column in Table 6.3 (UNCTAD, *Handbook of International Trade and Development Statistics*, Geneva). However, 'pure re-exports' are totally different: goods that are dealt with (imported and re-exported) in transshipment zones, usually duty-free, do not fall under exports, even though the value added arising from the trading service is of course part of GDP, and will not be captured by this export dependence measure. (We are grateful to Pierre Encontre of UNCTAD for advice on this matter.)

¹The UNCTAD index measures the diversification of merchandise exports and takes a higher value if these are *less* diversified.

²The UN Committee for Development Policy has recommended potential components of an Economic Vulnerability Index (as reported in 'How to include an index of vulnerability in the criteria for identifying the LDCs?', draft document CDP12.98/WG3/3, 8 September 1998). For vulnerability to external shocks they recommend 'an index of export concentration for goods and services weighted with the share of such exports in GDP, or better (inasmuch as the extended concentration index asked from UNCTAD is not available) an index of instability in exports of goods and services weighted with the share of such exports in GDP'. It is suggested that one could conceive of a component to assess vulnerability with respect to capital movements, but that capital instability depends more on the economic policies followed than is the case with trade. For vulnerability arising from natural or ecological factors the committee recommends 'an indicator of risk of natural catastrophes drawn up on the basis of an index of the frequency of such catastrophes (measured over a long period of time) and weighted by the average proportion of the population affected'.

Table 2. The Composite Vulnerability Index and Other Indices Ordered According to Vulnerability Score for 111 Developing Countries (*small states are shown in italics*)

	Population	Real per capita GDP	Rank	Output Volatility Index	Rank	Composite Vulnerability Index	Rank
<i>Vanuatu</i>	161	2,500	53	3.61	90	13.295	1
<i>Antigua and Barbuda</i>	65	5,369	86	13.38	3	11.246	2
<i>Tonga</i>	93	3,740	73	13.18	4	10.439	3
<i>Bahamas</i>	268	16,180	110	7.37	25	10.433	4
<i>Botswana</i>	1,401	5,220	85	10.21	12	10.158	5
<i>Swaziland</i>	809	2,940	58	11.17	10	9.633	6
<i>Gambia</i>	1,042	1,190	27	7.67	22	9.331	7
<i>Fiji</i>	758	5,530	89	6.84	32	8.888	8
<i>Maldives</i>	236	2,200	47	2.97	97	8.654	9
Singapore	2,821	19,350	111	3.35	94	8.651	10
<i>Solomon Islands</i>	354	2,266	49	11.21	9	8.398	11
<i>Dominica</i>	71	3,810	76	6.12	41	8.122	12
<i>Guyana</i>	816	2,140	45	11.87	5	7.953	13
<i>Djibouti</i>	557	775	14	11.6	6	7.932	14
<i>Grenada</i>	92	3,118	61	6.89	31	7.848	15
<i>Bahrain</i>	535	15,500	109	5.22	61	7.748	16
<i>São Tomé</i>	127	600	4	4.23	79	7.690	17
<i>Jamaica</i>	2,411	3,180	63	3.43	91	7.484	18
<i>St. Lucia</i>	139	3,795	74	6.59	35	7.449	19
<i>Samoa</i>	167	3,000	59	6.92	30	7.371	20
<i>Equatorial Guinea</i>	379	1,800	39	11.26	8	7.029	21
<i>Malta</i>	361	11,570	106	2.36	107	6.857	22
<i>Belize</i>	204	4,610	82	9.63	15	6.652	23
<i>St. Vincent</i>	11	3,55	269	6.08	43	6.563	24
Libya	5,048	6,125	94	6.05	46	6.536	25
<i>Namibia</i>	1,461	3,710	72	10.13	13	6.527	26
<i>Mauritius</i>	1,091	12,510	107	6.72	34	6.510	27
<i>Seychelles</i>	72	4,960	84	5.9	51	6.375	28
<i>St. Kitts-Nevis</i>	42	9,340	103	5.97	50	6.362	29
<i>Papua New Guinea</i>	4,110	2,530	55	5.03	65	6.308	30
Angola	10,276	674	9	2.91	100	6.282	31
<i>Gabon</i>	1,248	3,861	77	7.64	23	6.229	32
Mauritania	2,161	1,610	35	4.27	77	6.068	33
<i>Lesotho</i>	1,943	980	20	4.44	72	5.985	34
Congo	2,443	2,750	57	8.84	17	5.961	35

Table 2 (continued)

	Population	Real per capita		Output Volatility		Composite Vulnerability	
		GDP	Rank	Index	Rank	Index	Rank
Malaysia	19,247	8,360	99	5.29	60	5.903	36
Jordan	4,936	4,380	80	7.03	26	5.743	37
<i>Barbados</i>	<i>260</i>	<i>10,570</i>	<i>105</i>	<i>4.34</i>	<i>74</i>	<i>5.670</i>	<i>38</i>
Côte d'Ivoire	13,316	1,620	36	5.36	59	5.626	39
Oman	1,992	10,420	104	7.77	21	5.582	40
Zambia	8,936	1,110	25	4.77	67	5.549	41
<i>Cyprus</i>	<i>726</i>	<i>14,060</i>	<i>108</i>	<i>2.66</i>	<i>102</i>	<i>5.474</i>	<i>42</i>
<i>Comoros</i>	<i>607</i>	<i>1,130</i>	<i>26</i>	<i>2.39</i>	<i>106</i>	<i>5.425</i>	<i>43</i>
Nigeria	105,264	1,540	33	6.48	37	5.416	44
Bhutan	1,596	790	16	4.3	76	5.390	45
Honduras	5,335	2,100	43	2.43	105	5.373	46
Paraguay	4,701	3,340	67	8.32	19	5.346	47
Guinea	6,306	1,800	39	4.04	82	5.282	48
<i>Trinidad and Tobago</i>	<i>1,278</i>	<i>8,670</i>	<i>101</i>	<i>8.75</i>	<i>18</i>	<i>5.264</i>	<i>49</i>
Yemen	13,196	1,600	34	6.07	44	5.259	50
Togo	3,885	1,020	22	6.07	44	5.248	51
Malawi	10,520	710	12	4.65	68	5.200	52
Algeria	26,722	5,570	90	2.32	108	5.198	53
Congo, D. R.	41,231	300	1	6.39	39	5.186	54
Nepal	20,812	1,000	21	4.4	173	5.173	55
Chad	6,010	690	10	13.49	2	5.120	56
Costa Rica	3,270	5,680	91	4.21	80	5.090	57
Mali	10,135	530	3	4.57	70	5.083	58
<i>Kiribati</i>	<i>78</i>	<i>1,475</i>	<i>32</i>	<i>16.6</i>	<i>1</i>	<i>5.082</i>	<i>59</i>
Sri Lanka	17,897	3,030	60	3.3	95	5.076	60
Tunisia	8,570	4,950	83	2.52	104	5.060	61
Sierra Leone	4,297	860	18	6.93	29	5.060	61
Benin	5,086	1,650	37	5.81	53	5.060	61
Ecuador	10,980	4,400	81	2.92	99	5.050	64
Ghana	16,446	2,000	42	5.52	55	5.044	65
Tanzania	28,019	630	5	6.01	48	5.035	66
Senegal	7,902	1,710	38	2.94	98	5.026	67
Chile	13,822	8,900	102	6.58	36	5.016	68
Panama	2,538	5,890	93	7	28	4.995	69
Iran	64,169	5,380	87	10.11	14	4.976	70
Zimbabwe	10,739	2,100	43	6.12	41	4.969	71
Niger	8,550	790	16	5.1	62	4.957	72

Table 2 (continued)

	Population	Real per capita		Output Volatility		Composite Vulnerability	
		GDP	Rank	Index	Rank	Index	Rank
<i>Cape Verde</i>	370	1,820	41	9.08	16	4.956	73
Cameroon	12,522	2,220	48	7.01	27	4.952	74
Kenya	26,391	1,400	31	3.77	87	4.935	75
Burundi	6,026	670	8	3.96	83	4.929	76
Burkina Faso	9,772	780	15	3.73	89	4.923	77
<i>Suriname</i>	414	3,670	70	7.56	24	4.921	78
Nicaragua	4,114	2,280	50	5.51	57	4.920	79
Mozambique	15,102	640	6	5.5	58	4.907	80
Venezuela	20,913	8,360	99	5.76	54	4.887	81
Uganda	19,940	910	19	3.78	85	4.876	82
Dominican Rep.	7,543	3,690	71	5.52	55	4.858	83
Syria	13,696	4,196	78	6.83	33	4.830	84
Central African Rep.	3,156	1,050	23	5.1	62	4.802	85
Rwanda	7,554	740	13	11.42	7	4.797	86
Pakistan	132,941	2,160	46	2.07	110	4.795	87
Ethiopia	51,859	420	2	6.02	47	4.786	88
Madagascar	13,854	700	11	3.37	93	4.785	89
Morocco	25,945	3,270	64	4.52	71	4.772	90
Bangladesh	115,203	1,290	29	4.58	69	4.744	91
Egypt	60,319	3,800	75	2.9	101	4.723	92
Bolivia	7,063	2,510	54	2.61	103	4.691	93
Sudan	26,641	1,350	30	5.98	49	4.655	94
Philippines	64,800	2,590	56	4.31	75	4.595	95
Haiti	6,893	1,050	23	5.86	52	4.474	96
Peru	22,886	3,320	66	8.32	19	4.461	97
El Salvador	5,517	2,360	52	4.18	81	4.434	98
Guatemala	10,029	3,400	68	3.18	96	4.431	99
Myanmar	44,596	650	7	10.48	11	4.392	100
Uruguay	3,149	6,550	96	6.48	37	4.378	101
Indonesia	191,671	3,270	64	3.76	88	4.301	102
Thailand	57,585	6,350	95	3.78	85	4.264	103
South Africa	39,659	3,127	62	3.38	92	4.222	104
Colombia	33,985	5,790	92	1.59	111	4.078	105
Turkey	59,597	4,210	79	3.88	84	4.076	106
India	901,459	1,240	28	2.12	109	3.782	107
China	1,196,360	2,330	51	4.84	66	3.744	108
Argentina	33,780	8,350	98	6.19	40	3.539	109
Brazil	156,486	5,500	88	4.25	78	3.433	110
Mexico	90,027	7,010	97	5.05	64	3.194	111

large states.¹ Population, per capita GDP and the Output Volatility Index, with individual country rankings, are also presented in the table. The elements of the CVI for each of the 111 countries are shown in Table 6 (Annex 3).

Ranking countries by their vulnerability using the CVI shows that Vanuatu – a small state currently facing graduation from LDC status – is predicted to be the most vulnerable of the 111 large and small countries examined. Its level of per capita GDP is also relatively low and the country is highly susceptible to natural disasters. Such evidence seems powerful in arguing a case against graduation. A further observation from the table is that Antigua and Barbuda, which is on the threshold of graduation from the International Bank of Reconstruction and Development (IBRD), ranks as the second most vulnerable country and registers the third highest output volatility index score.

Importantly, the degree of vulnerability is independent of income (per capita GDP). For example, the results demonstrate that small countries such as the Bahamas and Malta, with relatively high per capita incomes, are much more vulnerable than low-income, large states such as Kenya and Madagascar. Hence, the question is whether a vulnerable small state has the resilience to cope with the factors which create its output growth volatility, in terms of its own resources, capacity and capabilities.

Interpretation

As suggested above, a most striking feature of the CVI table is that 28 of the 30 countries showing the highest CVI scores are small states and all 30 of the countries with the lowest CVI scores are large states. The top five CVI scores correspond to Vanuatu, Antigua and Barbuda, Tonga, Bahamas and Botswana.^{2,3} These are discussed individually below, making

¹The CVI presented here is based on more recent evidence than that used to compute the CVI presented at the first meeting of the Joint Commonwealth Secretariat/World Bank Task Force on Small States. Specifically, more recent observations on export dependence and the UNCTAD diversification index have been used. While there are a number of repositionings in vulnerability rankings resulting from the update, the most noteworthy change is that the least vulnerable small state is now Suriname, a status held by Cape Verde in the earlier version of the index.

²Along with Vanuatu and Tonga, other Pacific islands categorised as small that have predicted CVI scores within the highest 30 include Fiji, Solomon Islands, Samoa and Papua New Guinea. In addition, the small Indian Ocean islands of Maldives, Mauritius and Seychelles have CVI scores within this group.

³Along with Antigua and Barbuda, and Bahamas, other Caribbean islands categorised as small that have predicted CVI scores within the highest 30 include Dominica, Grenada, Jamaica, St. Lucia, St. Vincent and St. Kitts-Nevis. In addition, the small states of Guyana and Belize have CVI scores within this group.

reference to the evidence in Table 2 and Table 6 (Annex 3).

Vanuatu, with a CVI score of 13.295, is predicted to be the most vulnerable state in the sample in the context of the factors that produced its output volatility that were considered in this study. Having a relatively high export dependence (58.5 per cent) and a high diversification index (0.902), the latter suggesting a substantial degree of concentration, its economy is highly exposed to external economic shocks. However, Vanuatu is particularly vulnerable to natural disasters – many of its islands are active volcanoes and it is susceptible to cyclones. With a natural disaster record of 727.17, its population is the most affected by such disasters of all the states covered in the sample. However, the Output Volatility Index (OVI) score is 3.61 which places it at a rank of 90, and is indicative of little observed variability in per capita GDP growth.¹

Antigua and Barbuda, Tonga, the Bahamas and Botswana all share high levels of output volatility, a very high degree of susceptibility to natural disasters and high diversification index scores. However, while Antigua and Barbuda and Botswana demonstrate a high level of export dependence, Tonga and the Bahamas do not. In the latter case, the absolute value of the Bahamas exports is high which, together with export concentration, can lead to relatively greater impacts from external shocks, explaining its predicted vulnerability despite its high real per capita income. The same may be true of Botswana with its dependence on mineral and agricultural exports, which face relatively volatile prices in international markets. For Antigua and Barbuda, and Tonga, which have much lower levels of exports, it is the factors other than openness that lead to vulnerability.

It should be noted that the natural disasters component of the index is based on historical evidence and takes no account of future events associated, say, with global warming and sea-level rise. If this component could be forward-looking then a country such as Maldives, with a very low incidence of natural disasters in the past, as measured by the percentage of population affected, might have recorded a much higher level of vulnerability. Nevertheless, with a high export dependence and highly concentrated merchandise exports it is predicted to be highly vulnerable (rank 9).

Singapore, classified as a large country, ranks tenth most vulnerable in terms of its CVI score and also exhibits a high OVI score (rank 12). Its predicted level of vulnerability is attributable to its very high level of

¹Annex 2 notes that Vanuatu was excluded from the analysis used to determine the composition of the Composite Vulnerability Index because of its extreme observation in susceptibility to natural disasters. This might in part explain the discrepancy between its CVI and OVI ranking.

export dependence (176 per cent), by far the highest level in the sample of 111 countries investigated. This leads to a high level of vulnerability despite a very high level of merchandise export diversification (a low diversification index value of 0.491). Clearly such a great reliance on the international markets does expose the economy to factors which are beyond its control, thereby leaving it vulnerable. Its output growth volatility may, in part, be due to this. However, this export-oriented and diversified economy has clearly benefited from export promotion policies since it has the highest per capita income of all the sampled countries.¹ Given the position of a high-income country such as Singapore, in terms of its CVI and OVI scores and ranking, it should be pointed out that these indices are designed to evaluate vulnerability, which is not meant to be interpreted as a measure of LDC status.

Although Suriname, Cape Verde, Kiribati, Trinidad and Tobago, and Comoros emerge as the five small states with the lowest CVI scores, none are low scores when compared with the whole sample. Suriname is estimated to experience the least vulnerability of all small states, ranking 78 out of 111. While Suriname's merchandise exports are not highly diversified (0.933) and are therefore vulnerable, it has a low export dependency ratio (12 per cent), and its population has not been affected by natural disasters. The African island state of Cape Verde is estimated to experience relatively low vulnerability when compared to other small states because, while it has suffered severe droughts in the past, its vulnerability to natural disasters is not very large (12.86), it records a relatively low dependency on exports (the ratio of exports of goods and services is 16 per cent) and its merchandise exports are not especially concentrated according to the UNCTAD Diversification Index (0.865).

Kiribati, Trinidad and Tobago, and Comoros, all island states, are little affected by, or are free from, natural disasters. Kiribati and Comoros also share other characteristics of Suriname and Cape Verde, in that they have extremely low dependence on exports but very high degrees of export concentration. However, whereas Suriname has a very high level of volatility in per capita GDP growth, that in Comoros is amongst the lowest. This could be a reflection of Comoros's dependence on France in its mainly agricultural trade (particularly vanilla, copra and cloves) and aid. Trinidad and Tobago reveals a reasonable degree of diversification

¹It is interesting to note that Singapore did not fit well in the study sample, exhibiting outlying behaviour in relation to many of the variables analysed. As a result, like Vanuatu, Singapore was excluded from the analysis used to determine the composition of the Composite Vulnerability Index (see Annex 2).

and a moderate level of export dependence. Trinidad and Tobago's very high OVI ranking (18) may be explained by its dependence on exports in markets subject to price volatility, particularly the oil market.

Finally, the five large states predicted to have the lowest CVI scores are India, China, Argentina, Brazil and Mexico. These are all characterised by very large diversified economies with, consequently, diversified merchandise exports and low levels of export dependence. While natural disasters may strike – sometimes with tragic consequences – low proportions of the population are affected. Haiti, the poorest republic in the Caribbean and defined here as a large state, has a relatively low CVI (rank 96). It is susceptible to natural disasters but because of its size this appears not to markedly impact on output volatility. Haiti's isolation from the international economy and associated shocks (it has one of the least open economies in the sample, with an export dependence of 8.5 per cent) further accounts for its relatively low vulnerability ranking – lower than might otherwise be expected.

Conclusion

To conclude, this paper has both demonstrated the feasibility of constructing an index of vulnerability to reflect the excess volatility in output growth and has highlighted the susceptibility of small states, in particular, to external economic forces and environmental hazards. The index is based on sound economic precepts and appropriate statistical procedures. As such, it could be used as an analytical and operational tool in assessing the case for special and differential treatment of vulnerable small states by the international community. The index might be applied in conjunction with other measures currently applied by international agencies and governments in order to broaden the single – income – criterion which has dominated eligibility for differential measures until now.

Environmental Vulnerability Index

A composite vulnerability index has also been developed. This combines into a single index deforestation, population pressure, water scarcity, marine inundation, threats to biodiversity and the incidence of natural disasters. This index covered a sample of 106 small and large countries. According to the results, with the exception of Bangladesh, the most vulnerable ten countries are small states. This category includes Seychelles (on the threshold of IBRD graduation) and Barbados, which has already graduated.

Annex 1. Sources and Definitions of the Data

REAL PER CAPITA GDP RANKING

Real per capita GDP

Formula: Converted into US dollars on the basis of the purchasing power parity (PPP) of the country's currency.
 Period: 1993
 Source: Human Development Report 1996

OUTPUT VOLATILITY INDEX

Output volatility

Symbol: *outvol*
 Formula: Standard deviation of annual rates of growth of constant price (PPP) GDP per capita
 Period: 1980–1992
 Source: Penn (Summers and Heston) data base (available on the Internet)

Average annual GDP growth rate

Formula: The annual percentage change in real GDP per head
 Period: 1980–1992
 Source: Penn (Summers and Heston) data base (available on the Internet)

COMPOSITE VULNERABILITY INDEX

Trade openness

Symbol: *topen*
 Formula: Average of imports and exports of goods and non-factor services as a percentage of GDP
 Period: 1990–1994
 Source: UNCTAD, Handbook of International Trade and Development Statistics 1995

Export Dependence

Symbol: *exdep*
 Formula: Average exports of goods and non-factor services as a percentage of GDP
 Period: 1991–1995
 Source: UNCTAD, Handbook of International Trade and Development Statistics 1996

Merchandise export concentration index

Symbol: *conc*
 Formula: UNCTAD's concentration index
 Period: 1994 (most countries)

Source: UNCTAD, Handbook of International Trade and Development Statistics 1995

Merchandise export concentration index weighted by ratio of merchandise exports to GDP

Symbol: *concadj*

Formula: UNCTAD's concentration index weighted by ratio of merchandise exports to GDP

Period: 1994 (most countries)

Source: UNCTAD, Handbook of International Trade and Development Statistics 1995

Merchandise export diversification

Symbol: *diver*

Formula: UNCTAD's diversification index

Period: 1995 (most countries)

Source: UNCTAD, Handbook of International Trade and Development Statistics 1995

Merchandise export diversification index weighted by ratio of merchandise exports to GDP

Symbol: *diveradj*

Formula: UNCTAD's diversification index weighted by ratio of merchandise exports to GDP

Period: 1994 (most countries)

Source: UNCTAD, Handbook of International Trade and Development Statistics 1995

Share of top three major exports and services in total exports of goods and services

Symbol: *Expdiv*

Formula: Share of top three major exports and services in total exports of goods and services

Period: 1995

Source: UN, Calculation of Preliminary Economic Diversification Indices for the Committee for Development Policy, mimeo: CDP12.98/WG3/12, 13 November 1998

Exports earnings instability

Symbol: *expinsth*

Formula: It is measured following the procedure of the Commonwealth Secretariat (1997) as the coefficient of variation.

Period: 1990–1994

Source: IMF, International Financial Statistics Yearbook 1997

Capital opennessSymbol: *capop*

Formula: Average of imports less exports of goods and non-factor services as a percentage of GDP

Period: 1990–1994

Source: UNCTAD, Handbook of International Trade and Development Statistics 1995

Capital opennessSymbol: *capop*

Formula: Net international financial flows (sum of official unrequited transfers, direct investment and other long term and other short term capital) as percentage of GDP

Period: 1990–1993 (most countries)

Source: IMF, International Financial Statistics Yearbook 1994 (Part 1)

Capital opennessSymbol: *insav*

Formula: Investment less savings as percentage of GDP

Period: 1990–1993 (most countries)

Source: IMF, International Financial Statistics Yearbook 1996

Net Transfers on DebtSymbol: *debttrans*

Formula: Net transfers on debt as percentage of GNP

Period: 1992–1996

Source: World Bank, Global Development Finance 1998

Debt as a percentage of GNPSymbol: *debtgnp*

Formula: All debt as percentage of GNP

Period: 1992–1994 (most countries)

Source: IMF, World Debt Tables 1996

Debt as a percentage of exports of goods and servicesSymbol: *debtexp*

Formula: All debt as percentage exports of goods and services

Period: 1994 (most countries)

Source: World Development Report 1996

Debt service as a percentage of exports of goods and servicesSymbol: *dserveexp*

Formula: Average of all debt as a percentage of goods and services

Period: 1992–1994

Source: World Development Report (various issues); Commonwealth Secretariat, Economic Review and Basic Statistics (various issues)

Long term debt as a percentage of GNP

Symbol: *ltdebtgnp*

Formula: Long term debt as percentage of GNP

Period: 1992–1994

Source: UNCTAD, Handbook of International Trade and Development Statistics 1995

Long term debt as a percentage of exports of goods and services

Symbol: *ltdebtexp*

Formula: Long term debt as percentage exports of goods and services

Period: 1992–1994

Source: UNCTAD, Handbook of International Trade and Development Statistics 1995

Share of manufacturing and modern private services

Symbol: SMMPS

Formula: Share of manufacturing and modern private services

Period: 1995

Source: UN, Calculation of Preliminary Economic Diversification Indices for the Committee for Development Policy, Mimeo: CDP12.98/WG3/12, 13 November 1998

Service exports as a percentage of all exports of goods and services

Symbol: *intspec*

Formula: Average service exports as a percentage of exports of all goods and services

Period: Various – late 1980s and early 1990s (three year average)

Source: IMF, International Financial Statistics Yearbook 1997; IMF, Balance of Payments Yearbook 1997

Service exports minus imports plus remittances as a percentage of GDP

Symbol: *intspec2*

Formula: Average service exports minus imports plus remittances as a percentage of GDP

Period: Various – late 1980s and early 1990s (three year average)

Source: IMF, International Financial Statistics Yearbook 1997; IMF, Balance of Payments Yearbook 1997

Service exports as a percentage of GDP

Symbol: *intspe3*

Formula: Average service exports as a percentage of GDP

Period: Various – late 1980s and early 1990s (three year average)

Source: IMF, International Financial Statistics Yearbook 1997; IMF, Balance of Payments Yearbook 1997

Tourism receipts as a percentage of GDPSymbol: *tourism*

Formula: Average of tourism receipts as a percentage of GDP

Period: 1992–1994

Source: Euromonitor, The World Economic Factbook 1996; Commonwealth Secretariat, Economic Review and Basic Statistics (various issues); World Bank, World Development Report (various issues)

Energy consumptionSymbol: *Energy*

Formula: Total energy consumption per capita

Period: 1995

Source: UN, Calculation of Preliminary Economic Diversification Indices for the Committee for Development Policy, Mimeo: CDP12.98/WG3/12, 13 November 1998

Commercial energy imports dependenceSymbol: *enerdep*

Formula: Average of imports of commercial energy as a percentage of domestic energy production and imports

Period: 1991–1994

Source: United Nations, Energy Statistics Yearbook 1994

c.i.f./f.o.b. conversion factorSymbol: *cif*

Formula: Average of c.i.f./f.o.b. conversion factor

Period: 1990–1995 (most countries)

Source: IMF, International Financial Statistics Yearbook 1996

Freight and insuranceSymbol: *freight*

Formula: Freight and insurance debits as a percentage of merchandise exports

Period: 1992–1994

Source: UNCTAD, Handbook of International Trade and Development Statistics 1995

Vulnerability to natural disastersSymbol: *vuln*

Formula: Per cent of population affected by natural disasters

Period: 1970–1996

Source: EM-DAT data set; Wells (*op. cit.*)

Agriculture's share of GDP

Symbol: *agric*

Formula: Average of agriculture's share of GDP

Period: 1991–1995

Source: World Bank, World Development Report (various issues); UNCTAD, Handbook of International Trade and Development Statistics 1995; World Bank, World Bank Atlas (various issues); Commonwealth Secretariat, Economic Review and Basic Statistics (various issues)

Money as a percentage of GDP

Symbol: *money*

Formula: Money and quasi money as a percentage of GDP

Period: 1995

Source: World Bank, World Bank Atlas 1997

Annex 2. Estimation of a Composite Vulnerability Index

The construction of the Composite Vulnerability Index followed a two-stage procedure. Firstly, since vulnerability has been linked to output volatility, an economic model is statistically determined which explains output volatility in terms of specified economic and environmental causes of vulnerability. Secondly, the model so developed is then used to predict individual vulnerability scores for all sample countries for which data are available. These individual vulnerability scores will form the Composite Vulnerability Index.

Deriving the Composite Vulnerability Index in this manner has a number of important advantages:

- ◆ it allows the index to be directly linked to output volatility which is consistent with the fundamental premise advanced in this report;
- ◆ it is based on well-known and understood statistical procedures;
- ◆ 'raw' data are used and, thus, the need to normalise data before aggregation is removed;¹
- ◆ no further procedure is necessary to determine the weights used to aggregate the various components of the composite index – these are estimated directly from the data in the first stage.

Analysis

The objective of the first stage of the analysis is to build a stochastic model explaining output volatility. The general approach for model building is to think of output volatility as a linear combination of variables associated with vulnerability plus a stochastic error term. The variables are chosen so that different aspects of vulnerability, identified as being potential causes of output volatility, are represented in the model. The conceptual model is shown in Box 2 with variables tested detailed in Annex 1.

From the point of view of constructing the model, three over-riding considerations need to be highlighted. Firstly, the statistical methodology used to fit the model of output volatility for the sample of small and large countries is based on minimising a 'weighted least squares' criterion. The reason for using weighted least squares instead of ordinary least squares is that output volatility has been shown to have different distributional

¹Normalisation procedures commonly adopted often lead to non-linear transformations of the data and can lead to extreme observations being highly influential in determining outcomes.

Box 2**A Conceptual Model of Output Volatility**

$$\text{Output volatility} = \text{Economic exposure} + \text{Remoteness and insularity} + \text{Susceptibility to environmental events and hazards} + \text{error term}$$

properties for small and large countries.¹ Using the weighted least squares procedure will allow the different variance properties of output volatility for small and large countries to be reflected in the model.

Secondly, in addition to revealing different variances, output volatility may present a different profile for small and large countries. Given the exploratory data analysis presented in earlier reports² it is possible that the variables affect output volatility in a different manner for small and large countries. This hypothesis must be considered in our model fitting procedure and for that reason it is necessary to define a 'categorical variable' *D* for use in the model which takes the value *one* if the country is small and *zero* otherwise.

Thirdly, least squares techniques are very sensitive to large departures of data from the bulk. That is, if the sample contains an extreme observation this single observation can be highly influential in determining the relationship between the given variable and output volatility predicted by the model. Thus, in order to avoid a few countries influencing the entire model fitting procedure and biasing the results, possible influential points have to be detected and countries associated with these points excluded from the model estimation procedure.³ The method adopted for this follows standard econometric graphical procedures, and utilises boxplots

¹See Table 1 and Figure 5 of Atkins, J., Mazzi, S. and Ramlogan, C. *A Study of the Vulnerability of Developing and Island States: A Composite Index*. Draft report prepared for the Commonwealth Secretariat, London, August 1998.

²See Sections II and V of Atkins, J., Mazzi, S. and Ramlogan, C. (1998).

³Of the initial 111 developing countries it was decided to exclude the data corresponding to 11 countries in order to carry out the computations; this avoided a few countries influencing the entire model fitting results. For example, Chad, Myanmar, Iran and Rwanda were observed to have extreme values of output volatility. Using the data of these countries in the estimation procedure would produce inflated estimates of the variance of output volatility of large countries. Thus, to avoid this outcome, these four countries were excluded from the estimation procedure. The 11 countries excluded from the analysis consisted of five small states – Bahrain, Kiribati, Maldives, Malta and Vanuatu – and six large states – Chad, Mexico, Myanmar, Iran, Rwanda and Singapore.

and bivariate plots. Note that the countries not included in the fitting of the model can be included in the composite index.

Weighted least squares results for the preferred model specification

After substantial testing using the variables specified in Annex 1, the preferred model specification was given by using susceptibility to natural disasters ($Vuln_i, D_i$), export dependence ($Exdep_i$) and UNCTAD's merchandise export diversification index (Div_i) as explanators of output volatility ($Outvol_i$). This estimated combination was preferred in the sense that it appeared to be most interpretable in economic terms and it resulted in the best statistical explanation of the variability of output volatility. The model was thus specified as:

$$Outvol_i = \beta_0 + \beta_1 Vuln_i, D_i + \beta_2 Exdep_i + \beta_3 Div_i + \varepsilon_i \quad (1)$$

and where: $i = 1, \dots, N$, and N is the number of countries that enter the sample; and the error terms ε_i are assumed to be uncorrelated with mean of zero and with

$$Var(\varepsilon_i) = \omega_s^2 \sigma^2, \text{ if } D_i = 1, \text{ and } Var(\varepsilon_i) = \omega_L^2 \sigma^2 \text{ otherwise.}$$

Estimating the weights ω_s and ω_L

In order to estimate ω_s and ω_L separate regressions for small and large countries were required. The results presented in Tables 3 and 4 show that the estimate for ω_s is 2.5459 and for ω_L is 1.6246. Whilst these two equations were auxiliary in order to derive the required weights, it is noteworthy that the regression results are far more significant for the small than for the large countries. This may be due to the fact that there is a substantial heterogeneity in the sample of large countries which contributes to more unexplained variation. The regression results for the preferred model are given in Table 5.

Table 3. Least Squares Regression Results for Small States

	Coefficient	Standard error	t-statistic	p-value ¹
Intercept	-9.7624	7.9407	-1.2294	0.2291
Vuln	0.0074	0.0029	2.5461	0.0167
Exdep	0.0615	0.0256	2.3976	0.0234
Div	15.2609	8.5089	1.7935	0.0837

Number of observations = 32; $\omega_s = 2.5459$; Multiple $R^2 = 0.3506$

F-statistic = 5.0389 (on 3 and 28 degrees of freedom), p-value = 0.0064

¹p-values corresponding to the t-statistics which are used to test the statistical significance of the parameters. Note that the p-value, being a probability, takes values between zero and one and the lower the p-value, the higher the significance of the parameter.

Table 4. Least Squares Regression Results for Large States

	Coefficient	Standard error	t-statistic	p-value
Intercept	2.3170	1.4026	1.6519	0.1034
Exdep	0.0201	0.0141	1.4280	0.1581
Div	2.5456	1.6288	1.5629	0.1229

Number of observations = 68; $\omega_t = 1.6246$; Multiple $R^2 = 0.0588$

F-statistic = 2.0299 (on 2 and 65 degrees of freedom), p-value = 0.1396

Table 5. Weighted Least Squares Regression Results for All States

	Coefficient	Standard error	t-statistic	p-value
Intercept	1.4142	1.3372	1.0576	0.2929
Vuln.D	0.0096	0.0023	4.0896	0.0001
Exdep	0.0322	0.0115	2.8043	0.0061
Div	3.3442	1.5745	2.1240	0.0362

Number of observations = 100; $\sigma = 1.0007$; Multiple $R^2 = 0.3286$

F-statistic = 15.6647 (on 3 and 96 degrees of freedom), p-value = 0

Composite Vulnerability Index

The vulnerability index of a country is defined to be the predicted value of its output volatility according to the preferred Equation (1) given above. A way to interpret the vulnerability index is to think of it as that part of output volatility explained by *Vuln*, *Exdep* and *Div*, being the expected value of *Outvol* given the three covariates. Since it is expected that there are other factors not accounted for by the chosen variables that influence output volatility, then discrepancies between the index and the observed output volatility of a country can be expected.

To compute the index, observations on an individual country are inputted into the equation to give a predicted vulnerability score for that country. This can then be repeated for all countries for which appropriate observations are available – even those that have previously been excluded from the econometric analysis because of apparent extreme behaviour. To illustrate the procedure, the vulnerability scores for Algeria (a large state) and Antigua and Barbuda (a small state) will be:

Preferred *Outvol* = 1.4142 + 0.0096 *Vuln.D* + 0.0322 *Exdep* + 3.3442 *Div* model

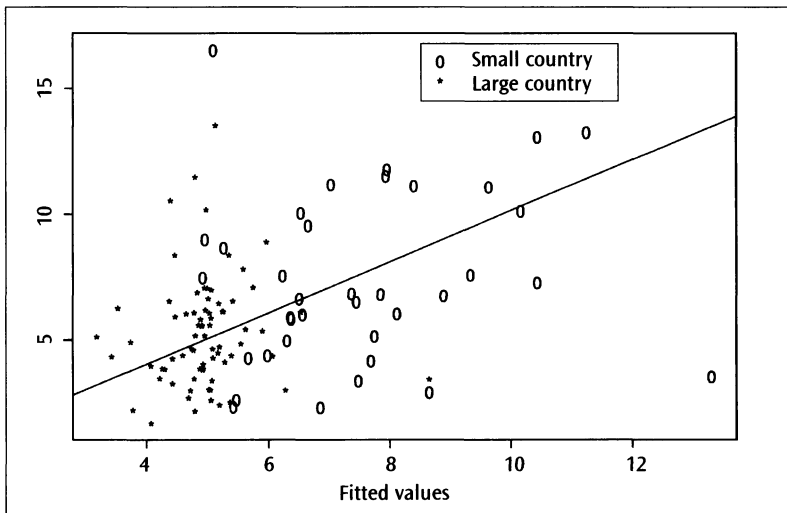
$$\begin{aligned}
 \text{Algeria} &= 1.4142 + 0.0322 (\text{Exdep}) + 3.3442 (\text{Div}) \\
 &= 1.4142 + 0.0322 (25.40) + 3.3442 (0.887) \\
 &= 5.198
 \end{aligned}$$

$$\begin{aligned}
 \text{Antigua and Barbuda} &= 1.4142 + 0.0096 (\text{Vuln}) + 0.0322 (\text{Exdep}) + 3.3442 (\text{Div}) \\
 &= 1.4142 + 0.0096 (430.77) + 0.0322 (90.50) + 3.3442 (0.832) \\
 &= 11.246
 \end{aligned}$$

where the figures in parenthesis are the observations recorded on that variable for the country in question. This procedure is followed for 111 countries.

Figure 1 comprises a scatter plot of the predicted values of output volatility for each country against their observed values of output volatility. The straight line represents the *least squares fit* of predicted versus observed values of output volatility based on the sample of countries used to obtain Equation (1). This line has an intercept which is statistically not significant and a highly statistically significant slope of 1.02. Ideally we would want to see all the points in the scatter diagram lying very close to the diagonal line – the 45° line – implying a zero intercept and slope of 1. However, in our case there is some dispersion and countries like Chad, Fiji, Iran, Myanmar, Rwanda, Singapore and Vanuatu seem to be particularly far from the line. Four of these – Chad, Iran, Myanmar and Rwanda – are the countries that present extreme values of output volatility and seem not to fit this population of developing countries quite so well as the other states. In addition, Singapore does not fit the sample, and Vanuatu

Figure 1. Plot of the Predicted Output Volatility against Observed Output Volatility for the Sample of 111 Countries



presents extreme values of *Vuln*. It should be recalled that the data corresponding to all these countries, with the exception of Fiji, are not used in the estimation of Equation (1).

Model diagnostics check: residual analysis

To assess the goodness of fit of the proposed model (Equation (1)) it is necessary to analyse the residuals. Figure 2 presents a plot of the sequence of the standardised regression residuals in ascending order according to population size. The most noteworthy feature of this plot is that Jamaica, a country with a population of over 2.4 million but declared small for the purposes of this analysis, shows a large residual. Other countries depicting large residuals are Cape Verde, Djibouti, Equatorial Guinea, Guyana, Namibia, Peru, and Trinidad and Tobago.

Figure 2. Sequence of Standard Residuals Ordered by Population Size

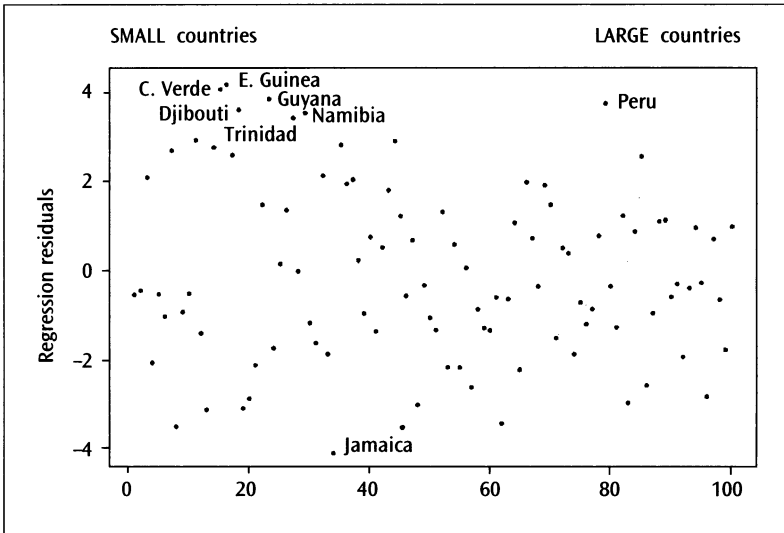


Figure 3 shows boxplots of the standardised regression residuals of small and large countries. These boxplots and the previous plot show that the regression residuals are approximately of the same magnitude for small and large countries. The boxplot of the residuals for small countries seems to be longer because of the influence of some extreme residuals.

Figure 4 shows a scatter plot of the fitted values versus the residuals. The straight line is the least squares line that fits the points. There is no outstanding pattern that can be recognised in this plot that would have pointed to lack of fit.

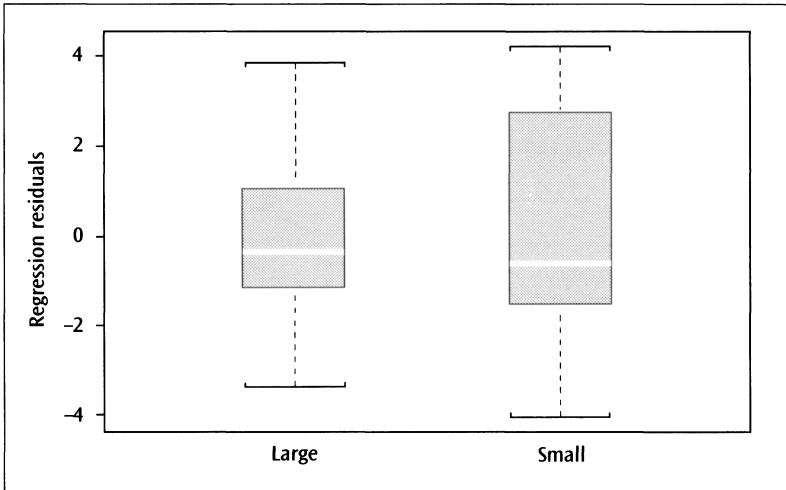
Figure 3. Boxplot of Standard Regression Residuals

Figure 5 comprises a scatter plot of the predicted values of output volatility for each country against their observed values of output volatility for each of the 100 countries included in the sample used to estimate Equation (1). Again, it provides support for the estimated model.

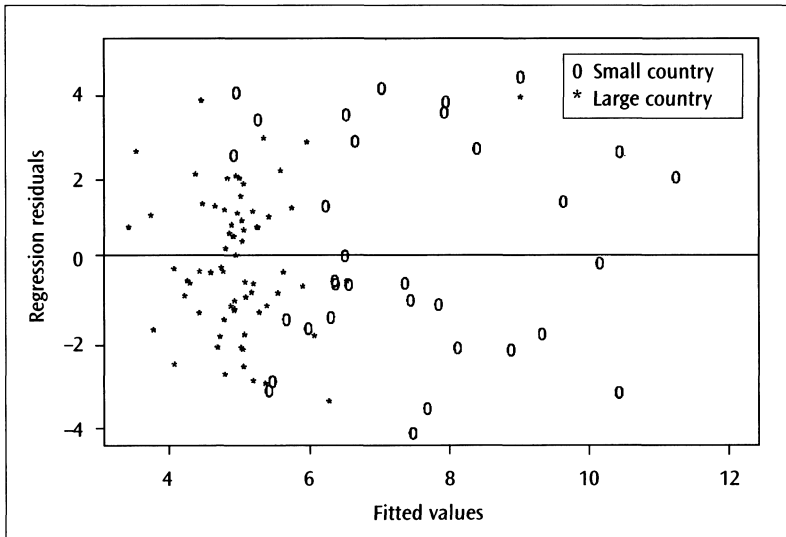
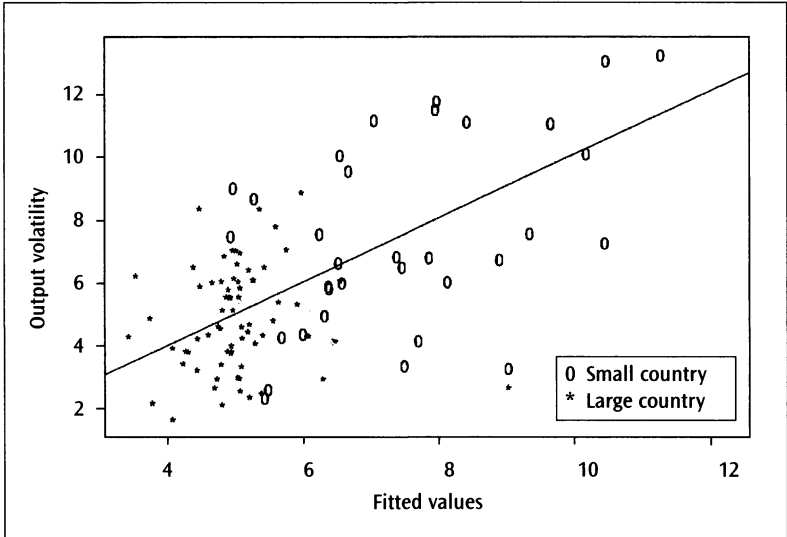
Figure 4. Scatter Plot of Fitted Values and Residuals

Figure 5. Plot of the Predicted Output Volatility against Observed Output Volatility for the Sample of 100 Countries



Annex 3

Table 6. Data on Factors Leading to Vulnerability and the Composite Vulnerability Index for 111 Developing Countries (*small states are shown in italics*)

	Population	Export Dependence	Vulnerability to Natural Disasters	UNCTAD Diversification Index	Composite Vulnerability Index	Rank
Algeria	26,722	25.40	6.34	0.887	5.198	53
Angola	10,276	56.25	41.68	0.914	6.282	31
<i>Antigua and Barbuda</i>	65	90.50	430.77	0.832	11.246	2
Argentina	33,780	7.40	60.34	0.564	3.539	109
<i>Bahamas</i>	268	45.33	491.28	0.850	10.433	4
<i>Bahrain</i>	535	106.60	0.93	0.865	7.748	16
Bangladesh	115,203	11.40	539.16	0.886	4.744	91
<i>Barbados</i>	260	53.20	0.46	0.759	5.670	38
<i>Belize</i>	204	55.40	28.19	0.952	6.652	23
Benin	5,086	24.00	99.41	0.859	5.060	63
Bhutan	1,596	35.00	4.11	0.852	5.390	45
Bolivia	7,063	19.00	92.17	0.797	4.691	93
<i>Botswana</i>	1,401	60.00	418.03	0.837	10.158	5
Brazil	156,486	9.00	63.01	0.517	3.433	110
Burkina Faso	9,772	12.50	147.66	0.929	4.923	77
Burundi	6,026	10.80	0.16	0.947	4.929	76
Cameroon	12,522	21.80	7.94	0.848	4.952	74
<i>Cape Verde</i>	370	16.33	12.86	0.865	4.956	73
Central African Rep.	3,156	16.00	1.22	0.859	4.802	85
Chad	6,010	16.33	241.6	0.951	5.120	56
Chile	13,822	29.40	24.76	0.794	5.016	68
China	1,196,360	22.20	223.52	0.483	3.744	108
Colombia	33,985	17.20	7.62	0.631	4.078	105
<i>Comoros</i>	607	18.20	38.71	0.913	5.425	43
Congo	2,443	49.60	5.62	0.882	5.961	35
Congo	41,231	27.00	4.66	0.868	5.186	54
Dem. Rep.						
Costa Rica	3,270	39.60	37.49	0.718	5.090	57
Côte d'Ivoire	13,316	36.80	0.2	0.905	5.626	39
<i>Cyprus</i>	726	48.25	0.13	0.749	5.474	42
<i>Djibouti</i>	557	61.00	177.58	0.852	7.932	14
<i>Dominica</i>	71	50.33	261.97	0.769	8.122	12

Table 6 (continued)

	Population	Export Dependence	Vulnerability to Natural Disasters	UNCTAD Diversification Index	Composite Vulnerability Index	Rank
Dominican Republic	7,543	24.60	79.83	0.793	4.858	83
Ecuador	10,980	29.00	31.66	0.808	5.050	64
Egypt	60,319	26.20	2.01	0.737	4.723	92
El Salvador	5,517	19.00	47.19	0.720	4.434	98
<i>Equatorial Guinea</i>	379	40.75	118.98	0.945	7.029	21
Ethiopia	51,859	10.00	199.6	0.912	4.786	88
<i>Fiji</i>	758	56.00	296.28	0.845	8.888	8
<i>Gabon</i>	1,248	52.60	0.82	0.931	6.229	32
<i>Gambia</i>	1,042	55.75	339.16	0.857	9.331	7
Ghana	16,446	20.40	138.46	0.889	5.044	65
<i>Grenada</i>	92	44.00	228.26	0.845	7.848	15
Guatemala	10,029	18.20	2.66	0.727	4.431	99
Guinea	6,306	22.40	1.22	0.941	5.282	48
<i>Guyana</i>	816	85.75	85.17	0.885	7.953	13
Haiti	6,893	8.50	114.35	0.833	4.474	96
Honduras	5,335	33.20	15.77	0.864	5.373	46
India	901,459	10.80	510.67	0.604	3.782	107
Indonesia	191,671	26.60	3.89	0.607	4.301	102
Iran	64,169	21.00	12.88	0.863	4.976	70
<i>Jamaica</i>	2,411	61.20	130.86	0.850	7.484	18
Jordan	4,936	52.60	1.9	0.788	5.743	37
Kenya	26,391	33.00	73.63	0.735	4.935	75
<i>Kiribati</i>	78	13.00	0.90	0.969	5.082	59
<i>Lesotho</i>	1,943	15.40	86.89	0.969	5.985	34
Libya	5,048	66.00	0	0.896	6.536	25
Madagascar	13,854	19.00	41.39	0.825	4.785	89
Malawi	10,520	24.20	192.82	0.899	5.200	52
Malaysia	19,247	85.40	0.94	0.520	5.903	36
<i>Maldives</i>	236	127.50	9.79	0.909	8.654	9
Mali	10,135	18.60	91.15	0.918	5.083	58
<i>Malta</i>	361	92.80	0	0.734	6.857	22
Mauritania	2,161	44.20	487.55	0.966	6.068	33
<i>Mauritius</i>	1,091	60.40	29.29	0.858	6.510	27
Mexico	90,027	15.40	5.54	0.384	3.194	111
Morocco	25,945	24.00	133.74	0.773	4.772	90
Mozambique	15,102	22.80	361.13	0.825	4.907	80

Table 6 (continued)

	Population	Export Dependence	Vulnerability to Natural Disasters	UNCTAD Diversification Index	Composite Vulnerability Index	Rank
Myanmar	44,596	1.80	15.63	0.873	4.392	100
<i>Namibia</i>	<i>1,461</i>	<i>55.00</i>	<i>56.56</i>	<i>0.837</i>	<i>6.527</i>	<i>26</i>
Nepal	20,812	18.80	74.23	0.943	5.173	55
Nicaragua	4,114	23.20	44.39	0.825	4.920	79
Niger	8,550	15.00	205.79	0.915	4.957	72
Nigeria	105,264	30.20	6.95	0.906	5.416	44
Oman	1,992	48.75	0.75	0.777	5.582	40
Pakistan	132,941	16.40	57.32	0.853	4.795	87
Panama	2,538	38.40	8.93	0.701	4.995	69
<i>Papua New Guinea</i>	<i>4,110</i>	<i>50.40</i>	<i>22.67</i>	<i>0.913</i>	<i>6.308</i>	<i>30</i>
Paraguay	4,701	32.80	18.55	0.860	5.346	47
Peru	22,886	10.80	93.17	0.807	4.461	97
Philippines	64,800	32.00	120.88	0.643	4.595	95
Rwanda	7,554	6.80	29.17	0.946	4.797	86
<i>Samoa</i>	<i>167</i>	<i>31.00</i>	<i>204.39</i>	<i>0.896</i>	<i>7.371</i>	<i>20</i>
<i>São Tomé</i>	<i>127</i>	<i>24.50</i>	<i>245.49</i>	<i>0.936</i>	<i>7.690</i>	<i>17</i>
Senegal	7,902	27.20	232.59	0.818	5.026	67
<i>Seychelles</i>	<i>72</i>	<i>61.00</i>	<i>0</i>	<i>0.896</i>	<i>6.375</i>	<i>28</i>
Sierra Leone	4,297	20.80	0.35	0.890	5.060	62
Singapore	2,821	173.75	0	0.491	8.651	10
<i>Solomon Islands</i>	<i>354</i>	<i>54.00</i>	<i>213.71</i>	<i>0.955</i>	<i>8.398</i>	<i>11</i>
South Africa	39,659	23.75	56.38	0.611	4.222	104
Sri Lanka	17,897	32.60	105.14	0.781	5.076	60
<i>St. Kitts-Nevis</i>	<i>42</i>	<i>59.00</i>	<i>21.43</i>	<i>0.850</i>	<i>6.362</i>	<i>29</i>
<i>St. Lucia</i>	<i>139</i>	<i>68.33</i>	<i>92.88</i>	<i>0.880</i>	<i>7.449</i>	<i>19</i>
<i>St. Vincent</i>	<i>11</i>	<i>47.75</i>	<i>74.8</i>	<i>0.865</i>	<i>6.563</i>	<i>24</i>
Sudan	26,641	5.00	184.22	0.921	4.655	94
Suriname	414	12.00	0	0.933	4.921	78
Swaziland	809	77.60	304.31	0.837	9.633	6
Syria	13,696	23.00	0.06	0.800	4.830	84
Tanzania	28,019	24.80	43.27	0.844	5.035	66
Thailand	57,585	37.40	51.73	0.492	4.264	103
Togo	3,885	28.60	22.4	0.871	5.248	51
<i>Tonga</i>	<i>93</i>	<i>27.00</i>	<i>532.13</i>	<i>0.911</i>	<i>10.439</i>	<i>3</i>
<i>Trinidad and Tobago</i>	<i>1,278</i>	<i>38.40</i>	<i>0.13</i>	<i>0.781</i>	<i>5.264</i>	<i>49</i>

Table 6 (continued)

	Population	Export Dependence	Vulnerability to Natural Disasters	UNCTAD Diversification Index	Composite Vulnerability Index	Rank
Tunisia	8,570	42.20	10.48	0.684	5.060	61
Turkey	59,597	16.60	3.95	0.636	4.076	106
Uganda	19,940	7.80	17.02	0.960	4.876	82
Uruguay	3,149	20.60	0.75	0.688	4.378	101
<i>Vanuatu</i>	<i>161</i>	<i>58.50</i>	<i>727.17</i>	<i>0.902</i>	<i>13.295</i>	<i>1</i>
Venezuela	20,913	28.00	1.09	0.769	4.887	81
Yemen	13,196	31.75	11.08	0.844	5.259	50
Zambia	8,936	31.60	67.03	0.932	5.549	41
Zimbabwe	10,739	34.80	188.18	0.728	4.969	71

Table 7. The Composite Vulnerability Index and Other Indices for 111 Developing Countries (*small states are shown in italics*)

	Population	Real per capita GDP	Rank	Output Volatility Index	Rank	Composite Vulnerability Index	Rank
Algeria	26,722	5,570	90	2.32	108	5.198	53
Angola	10,276	674	9	2.91	100	6.282	31
<i>Antigua and Barbuda</i>	65	5,369	86	13.38	3	11.246	2
Argentina	33,780	8,350	98	6.19	40	3.539	109
<i>Bahamas</i>	268	16,180	110	7.37	25	10.433	4
<i>Bahrain</i>	535	15,500	109	5.22	61	7.748	16
Bangladesh	115,203	1,290	29	4.58	69	4.744	91
<i>Barbados</i>	260	10,570	105	4.34	74	5.670	38
<i>Belize</i>	204	4,610	82	9.63	15	6.652	23
Benin	5,086	1,650	37	5.81	53	5.060	63
Bhutan	1,596	790	16	4.3	76	5.390	45
Bolivia	7,063	2,510	54	2.61	103	4.691	93
<i>Botswana</i>	1,401	5,220	85	10.21	12	10.158	5
Brazil	156,486	5,500	88	4.25	78	3.433	110
Burkina Faso	9,772	780	15	3.73	89	4.923	77
Burundi	6,026	670	8	3.96	83	4.929	76
Cameroon	12,522	2,220	48	7.01	27	4.952	74
<i>Cape Verde</i>	370	1,820	41	9.08	16	4.956	73
Central African Rep.	3,156	1,050	23	5.1	62	4.802	85
Chad	6,010	690	10	13.49	2	5.120	56
Chile	13,822	8,900	102	6.58	36	5.016	68
China	1,196,360	2,330	51	4.84	66	3.744	108
Colombia	33,985	5,790	92	1.59	111	4.078	105
<i>Comoros</i>	607	1,130	26	2.39	106	5.425	43
Congo	2,443	2,750	57	8.84	17	5.961	35
Congo Dem. Rep.	41,231	300	1	6.39	39	5.186	54
Costa Rica	3,270	5,680	91	4.21	80	5.090	57
Cote d'Ivoire	13,316	1,620	36	5.36	59	5.626	39
<i>Cyprus</i>	726	14,060	108	2.66	102	5.474	42
<i>Djibouti</i>	557	775	14	11.6	6	7.932	14
<i>Dominica</i>	71	3,810	76	6.12	41	8.122	12
Dominican Republic	7,543	3,690	71	5.52	55	4.858	83
Ecuador	10,980	4,400	81	2.92	99	5.050	64

Table 7 (continued)

	Population	Real per capita GDP	Rank	Output Volatility Index	Rank	Composite Vulnerability Index	Rank
Egypt	60,319	3,800	75	2.9	101	4.723	92
El Salvador	5,517	2,360	52	4.18	81	4.434	98
<i>Equatorial Guinea</i>	379	1,800	39	11.26	8	7.029	21
Ethiopia	51,859	420	2	6.02	47	4.786	88
<i>Fiji</i>	758	5,530	89	6.84	32	8.888	8
<i>Gabon</i>	1,248	3,861	77	7.64	23	6.229	32
<i>Gambia</i>	1,042	1,190	27	7.67	22	9.331	7
Ghana	16,446	2,000	42	5.52	55	5.044	65
<i>Grenada</i>	92	3,118	61	6.89	31	7.848	15
Guatemala	10,029	3,400	68	3.18	96	4.431	99
Guinea	6,306	1,800	39	4.04	82	5.282	48
<i>Guyana</i>	816	2,140	45	11.87	5	7.953	13
Haiti	6,893	1,050	23	5.86	52	4.474	96
Honduras	5,335	2,100	43	2.43	105	5.373	46
India	901,459	1,240	28	2.12	109	3.782	107
Indonesia	191,671	3,270	64	3.76	88	4.301	102
Iran	64,169	5,380	87	10.11	14	4.976	70
<i>Jamaica</i>	2,411	3,180	63	3.43	91	7.484	18
Jordan	4,936	4,380	80	7.03	26	5.743	37
Kenya	26,391	1,400	31	3.77	87	4.935	75
<i>Kiribati</i>	78	1,475	32	16.6	1	5.082	59
<i>Lesotho</i>	1,943	980	20	4.44	72	5.985	34
Libya	5,048	6,125	94	6.05	46	6.536	25
Madagascar	13,854	700	11	3.37	93	4.785	89
Malawi	10,520	710	12	4.65	68	5.200	52
Malaysia	19,247	8,360	99	5.29	60	5.903	36
<i>Maldives</i>	236	2,200	47	2.97	97	8.654	9
Mali	10,135	530	3	4.57	70	5.083	58
<i>Malta</i>	361	11,570	106	2.36	107	6.857	22
Mauritania	2,161	1,610	35	4.27	77	6.068	33
<i>Mauritius</i>	1,091	12,510	107	6.72	34	6.510	27
Mexico	90,027	7,010	97	5.05	64	3.194	111
Morocco	25,945	3,270	64	4.52	71	4.772	90
Mozambique	15,102	640	6	5.5	58	4.907	80
Myanmar	44,596	650	7	10.48	11	4.392	100
<i>Namibia</i>	1,461	3,710	72	10.13	13	6.527	26
Nepal	20,812	1,000	21	4.41	73	5.173	55

Table 7 (continued)

	Population	Real per capita GDP	Rank	Output Volatility Index	Rank	Composite Vulnerability Index	Rank
Nicaragua	4,114	2,280	50	5.51	57	4.920	79
Niger	8,550	790	16	5.1	62	4.957	72
Nigeria	105,264	1,540	33	6.48	37	5.416	44
Oman	1,992	10,420	104	7.77	21	5.582	40
Pakistan	132,941	2,160	46	2.07	110	4.795	87
Panama	2,538	5,890	93	7	28	4.995	69
<i>Papua New Guinea</i>	<i>4,110</i>	<i>2,530</i>	<i>55</i>	<i>5.03</i>	<i>65</i>	<i>6.308</i>	<i>30</i>
Paraguay	4,701	3,340	67	8.32	19	5.346	47
Peru	22,886	3,320	66	8.32	19	4.461	97
Philippines	64,800	2,590	56	4.31	75	4.595	95
Rwanda	7,554	740	13	11.42	7	4.797	86
<i>Samoa</i>	<i>167</i>	<i>3,000</i>	<i>59</i>	<i>6.92</i>	<i>30</i>	<i>7.371</i>	<i>20</i>
<i>São Tomé</i>	<i>127</i>	<i>600</i>	<i>4</i>	<i>4.23</i>	<i>79</i>	<i>7.690</i>	<i>17</i>
Senegal	7,902	1,710	38	2.94	98	5.026	67
<i>Seychelles</i>	<i>72</i>	<i>4,960</i>	<i>84</i>	<i>5.9</i>	<i>51</i>	<i>6.375</i>	<i>28</i>
Sierra Leone	4,297	860	18	6.93	29	5.060	62
Singapore	2,821	19350	111	3.35	94	8.651	10
<i>Solomon Islands</i>	<i>354</i>	<i>2,266</i>	<i>49</i>	<i>11.21</i>	<i>9</i>	<i>8.398</i>	<i>11</i>
South Africa	39,659	3,127	62	3.38	92	4.222	104
Sri Lanka	17,897	3,030	60	3.3	95	5.076	60
<i>St. Kitts-Nevis</i>	<i>42</i>	<i>9,340</i>	<i>103</i>	<i>5.97</i>	<i>50</i>	<i>6.362</i>	<i>29</i>
<i>St. Lucia</i>	<i>139</i>	<i>3,795</i>	<i>74</i>	<i>6.59</i>	<i>35</i>	<i>7.449</i>	<i>19</i>
<i>St. Vincent</i>	<i>11</i>	<i>3,552</i>	<i>69</i>	<i>6.08</i>	<i>43</i>	<i>6.563</i>	<i>24</i>
Sudan	26,641	1,350	30	5.98	49	4.655	94
<i>Suriname</i>	<i>414</i>	<i>3,670</i>	<i>70</i>	<i>7.56</i>	<i>24</i>	<i>4.921</i>	<i>78</i>
<i>Swaziland</i>	<i>809</i>	<i>2,940</i>	<i>58</i>	<i>11.17</i>	<i>10</i>	<i>9.633</i>	<i>6</i>
Syria	13,696	4,196	78	6.83	33	4.830	84
Tanzania	28,019	630	5	6.01	48	5.035	66
Thailand	57,585	6,350	95	3.78	85	4.264	103
Togo	3,885	1,020	22	6.07	44	5.248	51
<i>Tonga</i>	<i>93</i>	<i>3,740</i>	<i>73</i>	<i>13.18</i>	<i>4</i>	<i>10.439</i>	<i>3</i>
<i>Trinidad and Tobago</i>	<i>1,278</i>	<i>8,670</i>	<i>101</i>	<i>8.75</i>	<i>18</i>	<i>5.264</i>	<i>49</i>
Tunisia	8,570	4,950	83	2.52	104	5.060	61
Turkey	59,597	4,210	79	3.88	84	4.076	106
Uganda	19,940	910	19	3.78	85	4.876	82

Table 7 (continued)

	Population	Real per capita GDP	Rank	Output Volatility Index	Rank	Composite Vulnerability Index	Rank
Uruguay	3,149	6,550	96	6.48	37	4.378	101
<i>Vanuatu</i>	<i>161</i>	<i>2,500</i>	<i>53</i>	<i>3.61</i>	<i>90</i>	<i>13.295</i>	<i>1</i>
Venezuela	20,913	8,360	99	5.76	54	4.887	81
Yemen	13,196	1,600	34	6.07	44	5.259	50
Zambia	8,936	1,110	25	4.77	67	5.549	41
Zimbabwe	10,739	2,100	43	6.12	41	4.969	71