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Defining Country Size:

A Descriptive Analysis of Small and Large States

João António Brito^a

February, 2015

ABSTRACT

This paper defines the size of 215 countries using population and land area dimension. The statistical technique of cluster analysis was used to identify the groups of states that share the same characteristics of population and land area, and 83 countries were classified as small. From the descriptive analysis small size does not imply lower economic development/performance compared to large states. However, the economies of small states are more vulnerable. Proximity to developed markets, degree of economic freedom and openness to foreign markets were identified as the main factors explaining differences in economic performance among small states.

JEL classification: O40, O50, O57

Keywords: Country Size, Small States, Cluster Analysis and Economic Growth.

1 – INTRODUCTION

There are several studies that define countries by size (micro, small, medium or large) but there is no general consensus on the best indicator of country size and on the effects of small country size on economic variables.

The purpose of this paper is to define country size using population and land area, and investigate if small size is a barrier to economic growth through a descriptive and comparative analysis of some economic and environmental variables in small and large countries. We also examine some features that might explain the differences in economic performance across small countries.

Many theoretical studies argue that small states compared to large states are disadvantaged due to the negative effect of small size on the economic growth process. Particular characteristics of small states include: small market size, small population, dependence on a limited export market and exported products and scarcity of natural resources. But, paradoxically, many small states have a high level of economic growth and they are part of the group of countries with the highest GDP per capita worldwide.

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Using cluster analysis, we identified 83 small countries from a total of 215 countries. We found that the small size does not imply lower economic development. In fact small states have a higher level and growth rate of GDP per capita than large states. However, small states have higher economic vulnerability. Excluding natural resources, the main factors which could explain the differences in economic performance across small states are: proximity to developed markets, degree of economic freedom and openness to foreign markets.

The rest of the paper is structured as follows: section two defines country size; section three is a descriptive analysis of some variables in small and large states; section four examines economic and environmental vulnerability in small and large states; section five is a comparative study of economic performance among small states; section six suggests some policies and strategies for small states to overcome their limitations and concludes the paper.

2 – DEFINITION AND MEASUREMENT OF COUNTRY SIZE

In this section we provide a summary of some indicators of country size (micro, small, medium or large) and use cluster analysis to classify countries according to population and land area size.

2.1 – Introductory considerations

We found numerous criteria used to define country size such as population, land area, GDP, external trade or diplomatic resources, but there is no consensus about the best and most complete criteria to be applied. For Amstrup (1976) this is due two main reasons: first, size is a very vague concept and can easily lead to different interpretations; second, discussions on the concept often times are concerned with a single independent variable and neglect the dependent variable. However, population size (indicating the human capital stock) is the most common (used by: Armstrong et al., 1998; Armstrong and Read, 2003; Rose, 2006). According to Read (2001), the common use of population as a criterion to define the size of countries is justified by the wide availability of data and the ease with which limits can be established. However, we didn't find any theoretical or statistical justification for the use of a certain limit.

The population size used to define small states has varied over time. In the 70s and 80s it was 5 million (Jalan, 1982; Lloyd and Sundrum, 1982), in the 90s and the first decade of this century, it was 1.5 million (Commonwealth Secretariat, 1997) and 3 million (Armstrong et al., 1998). Crowards (2002) justifies these reductions in population size to define small states by:

- The increased number of states with decolonization (particularly small) - a high limit will include most countries in the small category;
- The widespread recognition that the characteristics of small size apply more comprehensively to a limited number of small states, since, considering, for example, a limit of 6.7 million inhabitants, we find relatively large economies with greater diversity and complexity;
- The increased size and complexity of individual economies, such that some states could be improperly classified as small.

Some authors criticize the use of the population as a measure of country size. In this regard, Downes and Mamingi (2001) make two arguments: first, as a measure of market size a large but very poor country (as are some African and East Asian countries), does not really represent a vast internal market; second, the size of the population does not reflect the quality of human resources existing in a country. Read (2001) also critique the use of the population as a measure of size, because, first, it is a continuous variable and there is no theoretical natural reason to explain the arbitrary choice of a structural limits and, secondly, the limits are not robust over time due to the different growth rates of populations.

There are studies that classify countries based on a combination of population, land area and GDP. GDP more than the indicator of country dimension is an indicator of economic level, and total land area can be a proxy for natural resources. Jalan (1982) identified small states as those with a population of up to 5 million, land area less than 65,000 km² and GDP lower or equal to \$3,000 million. Crowards (2002) defined small states with: population – 2.7 million; land area – 40,000 km²; and, GDP – \$ 2,500 million.

Thorhallsson (2006) criticizes the use of land area as a country size measure, because it has very limited involvement as a variable to explain the country influence. The author uses the number of people working in foreign services as an indicator of diplomatic resources and defines small states as those having less than 3,000 people working in foreign services. However, we can see that there is a strong correlation between the number of people working in foreign services and the domestic population size.

Another way to measure countries size is the use of military expenditure, which is a country's military capacity indicator. According to Thorhallsson (2006), "micro" states correspond to states with military expenditure lower than 400 million US dollars.

There are others studies that define country size by external trade. Small states are identified as having greater trade openness index (ratio of exports plus imports to GDP) than large states. Nevertheless, in terms of share of world trade, small states represent a low percentage, almost insignificant. Davenport (2001) classifies small states as those whose exports are less than 0.03% of world trade. According to Mattoo and Subramanian (2004), small states are those whose imports of goods and services are less than 0.05% of world trade.

It will be difficult to get an indicator that includes all the features that define countries (large, medium, small or micro), so the use of an indicator or indicators are linked to the researchers goals, and the groups of countries will be always homogeneous in some aspects and heterogeneous in others.

2.2 – Cluster Analysis

Cluster analysis is a statistical technique that classifies objects into groups (clusters), so that the objects belonging to the same group are very similar and those in different groups are distinct. There are various techniques, methods and measures that can be applied in clusters analysis depending on the type of data and the purpose of the study. In this study, because the number of objects is small, we use the hierarchical technique (which is the most appropriate

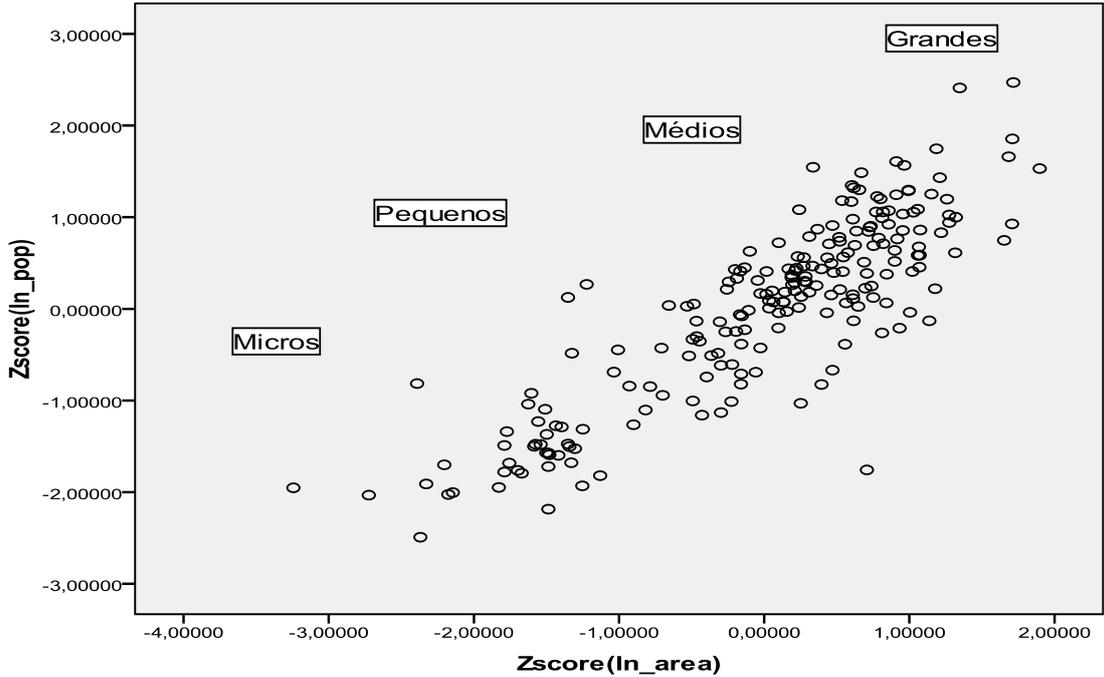
for small objects), the measure Squared Euclidean Distance and the method Average Linkage Between Groups. The statistical program used was SPSS 17.0.¹

The database source is World Development Indicators (WDI) for 215 countries during the year 2009. Some research on country size use a combination of population, land area and GDP to classify countries, but in our case, we consider only the land area and the population. This choice is due to the fact that GDP is considered primarily an indicator of the level of development and the object of our investigation is small states and not small economic states. Thus, using only land area and population to constitute groups of countries allow some variety of economic levels among the states in each group. This allows for the identification of some factors that can explain the differences in economic performance among small states which is one of the goals of this study.

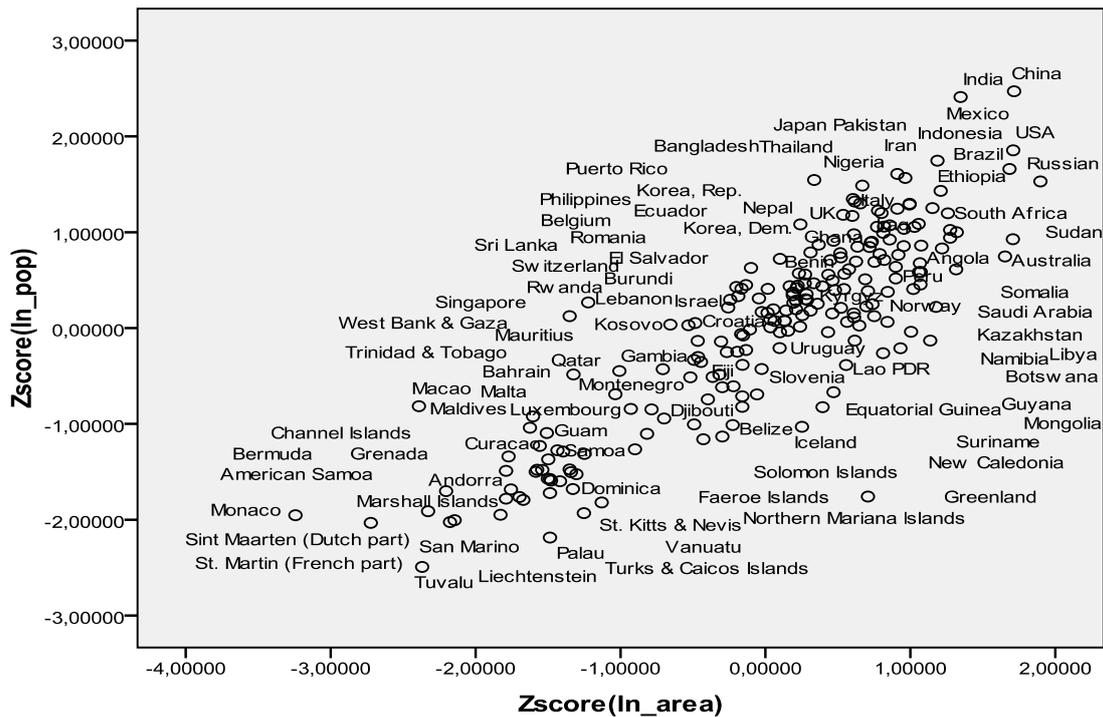
The results of the cluster analysis are presented in Table 1 (column 1). We identified 83 small states (we can consider 45 as “small” and 38 as “micro” states) and 132 large states (we can consider 127 as “medium” and 5 as “large” states). From our results we highlight the following: Botswana and Gabon with less than 2 million inhabitants, but due to the influence of their land area, were classified in the group of large states; Hong Kong and Singapore with a higher population than several states in the group of large states, but because their small land area, were included in the group of small states; and Greenland with a large land area, but with few inhabitants (56,323), was classified as a small state. In the group of small states the population is between 9,806 (Tuvalu) and 7,003,700 (Hong Kong) and the land area between 2 km² (Monaco) and 410,450 km² (Greenland).

Figure 1 illustrates an approximation of the four clusters identified by the combination of the land area and population. The variables were transformed into logarithms and then normalized, where Z-score (ln_pop) is the population size and Z-score (ln_area) the land area.

Figure 1: The clusters



¹ More details about the cluster analysis are on the appendix.



We analyzed the data for the year 1965 to observe the changes on the countries classification with time.² The results are presented in Table 1 (column 2). Of the 208 states, 66 were classified as small states. This difference of 17 states for 2009 is due to the inclusion of six countries (Curacao, Palau, Saint Martin-Dutch Party, West Bank & Gaza, Marshall Islands and Northern Mariana) in the database (which were classified as small), the United Arab Emirates that was classified as a small state in 1965 but in 2009 was classified as a large state, and the classification of 12 states (Albania, Armenia, Estonia, Slovenia, Guyana, Jamaica, Latvia, Lebanon, Macedonia, Moldova, Puerto Rico and Suriname) in the cluster of large states in 1965 but in 2009 was classified as small states.

We also classified the states using only one of the variables. The results are presented in Table 1 (column 2 and 3). Using only population we got 76 small countries, where the most populous has about 2.3 million inhabitants.³ In the case of land area, we found 83 small states, with the largest area of 33,800 km².⁴ Comparing the three criteria (only land area, only population and combination of population and land area) we found 66 states classified as small in all criteria, with the upper limits of 2.2 million people and 30,360 km².

We conclude that the use of cluster analysis with a combination of land area and population allows for a more homogeneous classification than indication of an upper limit of population. However, this technique has the disadvantage of being more difficult and complex to use. We consider the limit of 1.5 million people used by various institutions and studies to define small states to low because there are states with inhabitants above this limit but fit perfectly in the group of small states.

² We used 4 clusters.

³ We used 6 clusters.

⁴ We used 7 clusters.

Table 1: Classification of states by clusters

Countries	2009 (Pop+Area)				2009 (Pop)		2009 (Area)		1965 (Pop+área)	
	Small		Large		Small	Large	Small	Large	Small	Large
	Mic	SS	Med	LS						
Afghanistan			1			1		1		1
Albania		2				2	2			1
Algeria			1			1		1		1
American Samoa	3				3		3		2	
Andorra	3				3		3		2	
Angola			1			1		1		1
Antigua and Barbuda	3				3		3		2	
Argentina			1			1		1		1
Armenia		2				2	2			1
Aruba	3				3		3		2	
Australia			1			1		4		1
Austria			1			2		5		1
Azerbaijan			1			2		5		1
Bahamas, The		2			3		2		3	
Bahrain		2			4		3		2	
Bangladesh			1			1		5		1
Barbados	3				3		3		2	
Belarus			1			2		5		1
Belgium			1			2	2			1
Belize		2			3		2		3	
Benin			1			2		5		1
Bermuda	3				3		6		2	
Bhutan		2			4			5	3	
Bolivia			1			2		1		1
Bosnia and Herzegovina			1			2		5		1
Botswana			1		4			1		1
Brazil				4		1		4		4
Brunei Darussalam		2			3		2		3	
Bulgaria			1			2		5		1
Burkina Faso			1			2		1		1
Burundi			1			2	2			1
Cambodia			1			2		5		1
Cameroon			1			1		1		1
Canada			1			1		4		1
Cape Verde		2			4		2		3	
Cayman Islands	3				3		3		2	
Central African Republic			1			2		1		1
Chad			1			2		1		1
Channel Islands	3				3		3		2	
Chile			1			2		1		1
China				4		5		4		4
Colombia	1					1		1		1
Comoros		2			4		3		3	
Congo, Dem. Rep.			1			1		1		1
Congo, Rep.			1			2		1		1
Costa Rica			1			2		5		1
Cote d'Ivoire			1			1		1		1

Countries	2009 (Pop+Area)				2009 (Pop)		2009 (Area)		1965 (Pop+área)	
	Small		Large		Small	Large	Small	Large	Small	Large
	Mic	SS	Med	LS						
Croatia			1			2		5		1
Cuba			1			2		5		1
Curacao	3				3		3		w	W
Cyprus		2			4		2		3	
Czech Republic			1			2		5		1
Denmark			1			2		5		1
Djibouti		2			4		2		3	
Dominica	3				3		3		2	
Dominican Republic			1			2		5		1
Ecuador			1			2		1		1
Egypt, Arab Rep.			1			1		1		1
El Salvador			1			2	2			1
Equatorial Guinea		2			4		2		3	
Eritrea			1			2		5		1
Estonia		2			4			5		1
Ethiopia			1			1		1		1
Faeroe Islands	3				3		3		2	
Fiji		2			4		2		3	
Finland			1			2		1		1
France			1			1		1		1
French Polynesia		2			3		2		3	
Gabon			1		4			1		1
Gambia, The		2			4		2		3	
Georgia			1			2		5		1
Germany			1			1		1		1
Ghana			1			1		1		1
Gibraltar	3				3		6		2	
Greece			1			2		5		1
Greenland		2			3			1	3	
Grenada	3				3		3		2	
Guam	3				3		3		2	
Guatemala			1			2		5		1
Guinea			1			2		1		1
Guinea-Bissau		2			4		2		3	
Guyana		2			4			5		1
Haiti			1			2	2			1
Honduras			1			2		5		1
Hong Kong SAR, China		2				2	3		3	
Hungary			1			2		5		1
Iceland		2			3			5	3	
India				4		5		1		4
Indonesia			1			1		1		1
Iran, Islamic Rep.			1			1		1		1
Iraq			1			1		1		1
Ireland			1			2		5		1
Isle of Man	3				3		3		2	
Israel			1			2	2			1
Italy			1			1		1		1

Countries	2009 (Pop+Area)				2009 (Pop)		2009 (Area)		1965 (Pop+área)	
	Small		Large		Small	Large	Small	Large	Small	Large
	Mic	SS	Med	LS						
Jamaica		2			2	2				1
Japan			1			1		1		1
Jordan			1			2		5		1
Kazakhstan			1			2		1		1
Kenya			1			1		1		1
Kiribati	3				3		3		2	
Korea, Dem. Rep.			1			1		5		1
Korea, Rep.			1			1		5		1
Kosovo		2			4		2		3	
Kuwait		2				2	2		3	
Kyrgyz Republic			1			2		5		1
Lao PDR			1			2		1		1
Latvia		2			4			5		1
Lebanon		2				2	2			1
Lesotho		2			4		2		3	
Liberia			1			2		5		1
Libya			1			2		1		1
Liechtenstein	3				3		3		2	
Lithuania			1			2		5		1
Luxembourg		2			4		3		3	
Macao SAR, China	3				4		6		2	
Macedonia, FYR		2			4		2			1
Madagascar			1			1		1		1
Malawi			1			2		5		1
Malaysia			1			1		1		1
Maldives	3				3		3		2	
Mali			1			2		1		1
Malta	3				3		3		2	
Marshall Islands	3				3		3		w	w
Mauritania			1			2		1		1
Mauritius		2			4		3		3	
Mayotte	3				3		3		2	
Mexico			1			1		1		1
Micronesia, Fed. Sts.	3				3		3		2	
Moldova		2				2	2			1
Monaco	3				3		7		2	
Mongolia			1			2		1		1
Montenegro		2			4		2		3	
Morocco			1			1		1		1
Mozambique			1			1		1		1
Myanmar			1			1		1		1
Namibia			1		4			1		1
Nepal			1			1		5		1
Netherlands			1			2	2			1
New Caledonia		2			3		2		3	
New Zealand			1			2		1		1
Nicaragua			1			2		5		1
Niger			1			2		1		1

Countries	2009 (Pop+Area)				2009 (Pop)		2009 (Area)		1965 (Pop+área)	
	Small		Large		Small	Large	Small	Large	Small	Large
	Mic	SS	Med	LS						
Nigeria			1			1		1		1
Northern Mariana Islands	3				3		3		w	w
Norway			1			2		1		1
Oman			1			2		1		1
Pakistan			1			1		1		1
Palau	3				3		3		w	w
Panama			1			2		5		1
Papua New Guinea			1			2		1		1
Paraguay			1			2		1		1
Peru			1			1		1		1
Philippines			1			1		1		1
Poland			1			1		1		1
Portugal			1			2		5		1
Puerto Rico		2				2	2			1
Qatar		2			4		2		3	
Romania			1			1		1		1
Russian Federation				4		1		4		4
Rwanda			1			2	2			1
Samoa		2			3		3		3	
San Marino	3				3		6		2	
Sao Tome and Principe	3				3		3		2	
Saudi Arabia			1			1		1		1
Senegal			1			2		5		1
Serbia			1			2		5	w	w
Seychelles	3				3		3		2	
Sierra Leone			1			2		5		1
Singapore		2				2	3		3	
Sint Maarten (Dutch part)	3				3		6		w	w
Slovak Republic			1			2		5		1
Slovenia		2			4		2			1
Solomon Islands		2			4		2		3	
Somalia			1			2		1		1
South Africa			1			1		1		1
Spain			1			1		1		1
Sri Lanka			1			1		5		1
St. Kitts and Nevis	3				3		3		2	
St. Lucia	3				3		3		2	
St. Martin (French part)	3				3		6		2	
St. Vincent and the Grenadines	3				3		3		2	
Sudan			1			1		1		1
Suriname		2			4			5		1
Swaziland		2			4		2		3	
Sweden			1			1		1		1
Switzerland			1			1		5		1
Syrian Arab Republic			1			1		5		1
Tajikistan			1			2		5		1
Tanzania			1			1		1		1
Thailand			1			1		1		1

Countries	2009 (Pop+Area)				2009 (Pop)		2009 (Area)		1965 (Pop+área)	
	Small		Large		Small	Large	Small	Large	Small	Large
	Mic	SS	Med	LS						
Timor-Leste		2			4		2		3	
Togo			1			2		5		1
Tonga	3				3		3		2	
Trinidad and Tobago		2			4		2		3	
Tunisia			1			2		5		1
Turkey			1			1		1		1
Turkmenistan			1			2		1		1
Turks and Caicos Islands	3				3		3		2	
Tuvalu	3				6		6		2	
Uganda			1			1		5		1
Ukraine			1			1		1		1
United Arab Emirates			1			2		5	3	
United Kingdom			1			1		1		1
United States				4		1		4		4
Uruguay			1			2		5		1
Uzbekistan			1			1		1		1
Vanuatu		2			3		2		3	
Venezuela, RB			1			1		1		1
Vietnam			1			1		1		1
Virgin Islands (U.S.)	3				3		3		2	
West Bank and Gaza		2				2	2		w	w
Yemen, Rep.			1			1		1		1
Zambia			1			2		1		1
Zimbabwe			1			2		1		1

Note: “Mic” – group of micro states; “SS” – group of small states; “Med” – group of medium states; “LS” – group of large states; “w” – Without data in 1965; The numbers is the correspondent cluster and in each analysis equal numbers means the states correspond to the same cluster.

2.2.1 – Comparison of results

We compared our classification of small states with the others studies. Considering the limit of 1.5 million inhabitants to define small states suggested by the World Bank and the Commonwealth Secretariat, we had in our classification 17 more states in this category and only one case, Gabon, which is classified in our study as a large state has a population of less than 1.5 million.⁵ When we use the limit of 3 million people suggested by Armstrong et al. (1998) to define small states, we found that in our classification Armenia, Albania, Lebanon, Hong Kong, Moldova, Puerto Rico, Singapore and West Bank & Gaza are small states, but have more than 3 million inhabitants. On the other hand, Oman, Namibia, Mongolia, Gabon and Botswana, have populations less than 3 million but are included in the group of large states in our study. Considering Crowards (2002), who used the cluster analysis technique, but with the variables population, land area and GDP, and identified 79 small states, our results differ in the following respects: while in the Crowards study, Eritrea, Rwanda, Sierra Leone and Haiti are classified as small, in ours they are large states; on the other hand we classify

⁵ The 17 states are: Albania, Armenia, Gambia, Hong Kong, Jamaica, Kosovo, Kuwait, Latvia, Lebanon, Lesotho, Macedonia, Moldova, Puerto Rico, Qatar, Singapore, Slovenia and West Bank & Gaza.

Slovenia, Hong Kong, Singapore, Puerto Rico, Lebanon, Latvia and Kuwait as small, but in Crowards’s analysis they are classified as medium-sized states.

3 – ECONOMIC CHARACTERISTICS OF SMALL VS LARGE STATES

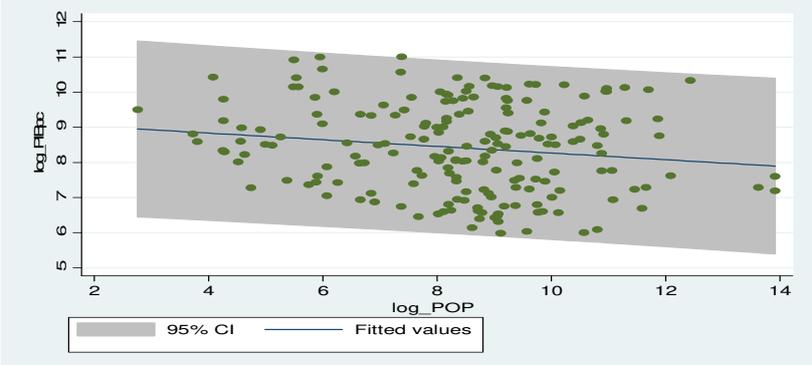
In this section we compare some economic variables in small and large states during the period 1980-2009. Our aim is to ascertain whether the behaviour of these economic variables differs significantly between the two groups of states.

3.1 – Introductory considerations

Small population size and land area are considered the main constraints to the economic growth of small states, since these factors translate to a small domestic market (population) and fewer natural resources (land area). The 83 small states of our study altogether occupy an land area of 1,545,741 km² and have a total of 76,913,220 inhabitants, corresponding to about 1% of global land area and population.

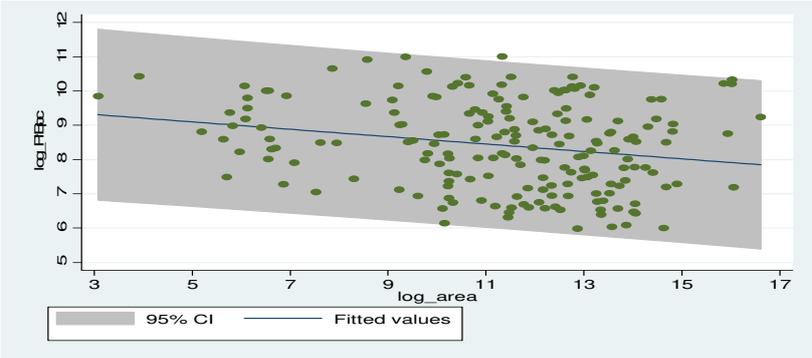
Figures 2 and 3 illustrate a slightly downward trend of the relationship between the level of GDP per capita and the country size (in terms of population and land area), for the period 1970-2010. This reveals that small country size is not a signal of lower economic development.

Figure 2: Average of GDP per capita and Population (1970-2010)



Source: Author calculation

Figure 3: Average of GDP per capita and area (1970-2010)



Source: Author calculation

3.2 – Economic characterization

Table 2 presents data on some economic variables for the period 1980-2009, for small and large states. We present some figures in order to better illustrate the evolution of the variables between the two groups of countries. Each observation is a five-year average, non-overlapping (1980-1984, 1985-1989, ..., 2005-2009). We also eliminated some observations because we considered them outliers, as in the case of FDI (% of GDP) in the Cayman Islands and the Marshall Islands. In these cases, the outliers significantly alter the average of the group. We now compare these variables between small and large states using the information in table 2 and the figures:

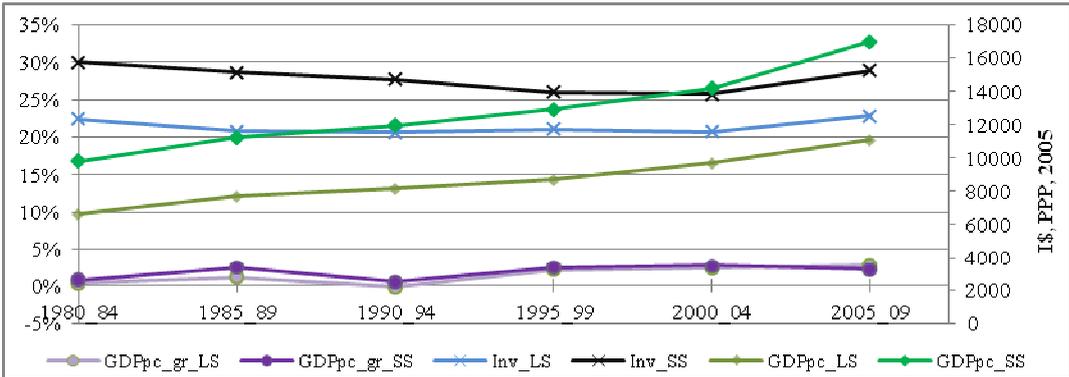
1) The average of annual growth rate of GDP per capita in the period 1980-2009, was higher in small states compared with large states. However, this difference between the two averages is statistically significant only at 10%. The difference in volatility of GDP per capita, measured by the standard deviation, between the two groups of states is not large. However, small states have a higher standard deviation. Figure 4 illustrates that the growth rate of GDP per capita was always higher in small states during the period 1980-2004, but in the last period, 2005-2009, the large states had higher growth performance.

2) The average level of GDP per capita is significantly higher in small states in the period 1980-2009. From figure 4, we see that the level of GDP per capita in small states was higher during the period 1980-2009, and with steeper trend. Even after eliminating the 5 states (Bermuda, Brunei, Kuwait, Qatar and Luxembourg) with the highest average level of GDP per capita in the period 1980-2009, small states still have a higher average level of GDP per capita compared to large states.

3) In the period 1980-2009, the average annual investment (% of GDP) was significantly higher in small states. Figure 4 shows that investment (% of GDP) has a decreasing trend in both groups of countries, but was more pronounced in the group of small states. Although in the last period, from 2005 to 2009, we found a reversal trend. The growth of investment (% of GDP) in the last period was higher in the group of small states, but as we noted above, large states had a higher annual rate of growth of GDP per capita in the last period, which indicates that the investments in small states were in less productive sectors. Therefore it is necessary that small states review their investment policies in order to transform their higher investments into higher growth rate of GDP per capita.

4) The Gini index was significantly lower in the group of small states in the period 1980-2009. This means that in small states there is greater equality in income distribution compared to large states. The enrollment rate in secondary school and the average unemployment rate are significantly higher in small states. This reveals that the higher levels of GDP per capita and human capital (measured by enrollment rates in secondary school) in small states have not translated to greater job creation. The high unemployment rates in the small states may be associated with the fact that the services sector is the main sector in small states and this sector does not employ a large amount of labour compared to the agricultural or industrial sector (sectors with the highest weight in group of large states).

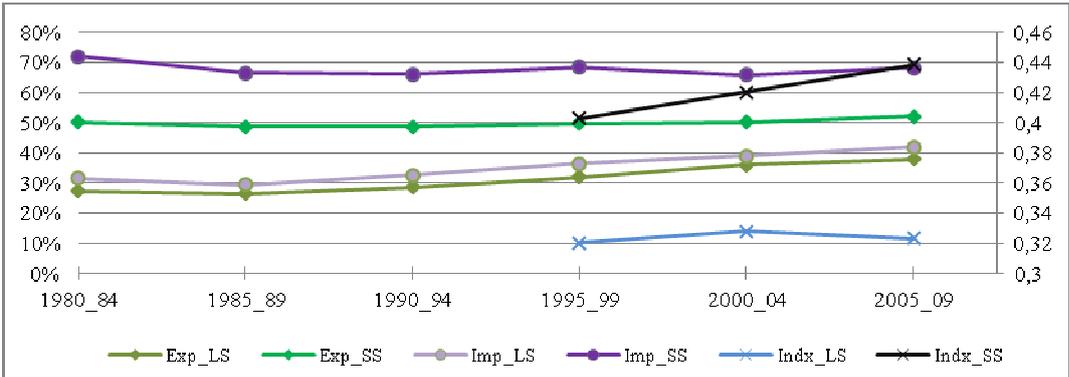
Figure 4: Level and Growth rate of GDP per capita and Investment (% GDP)



Notes: GDPpc_gr – growth rate of GDP per capita; Inv – investment; GDPpc – level of GDP per capita, _LS – group of Large States; _SS – group of Small States.

5) Analyzing the external trade, we concluded that the annual average of imports and exports (% GDP), are significantly higher in the group of small states. However, small states have higher trade deficits. From figure 5, it can be observed that imports and exports are always higher in the small states, though with decreasing trend. The high level of imports in small states could be explained by limited resources and a small internal market, which makes the domestic production of various goods and services that require the existence of economies of scale, economically unviable. The high level of exports can result from the need to offset the high volume of imports and gain access to larger markets which allows the small states to achieve economies of scale in certain products. The average annual export concentration index is significantly higher in small states and with an increasing trend (see figure 5). Small states are significantly more distant from major markets (US, Japan and the Netherlands) than large states, making external trade more difficult and costly.

Figure 5: Exports and imports (% of GDP)

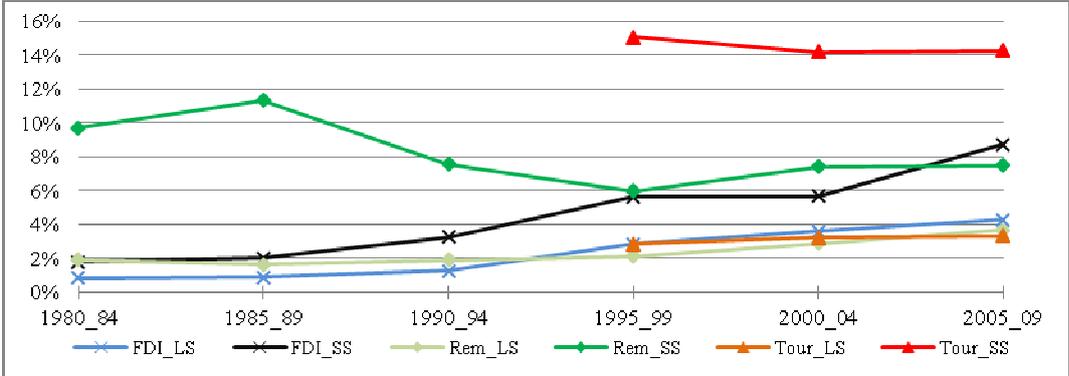


Notes: Exp – exports, Imp – imports, Indx – concentration exports index, _LS – group of Large States; _SS – group of Small States.

6) The chronic trade deficit of many small states has led to the influx of foreign capital in order to balance the current account. In the period 1980-2009, FDI, tourism and workers' remittances totalled an average of 27.17% of GDP in small states and only 7.97% of GDP in large states. The annual averages of these capital inflows were significantly higher in the group of small states. Figure 6 shows that remittances have a positive evolution in the group of large states. However in the group of small states the behaviour is decreasing, but with a slight improvement in the last decade. FDI shows positive development in both groups of

states, but with highest growth in small states. Tourism has been growing slightly in large states but has stagnated in small states.

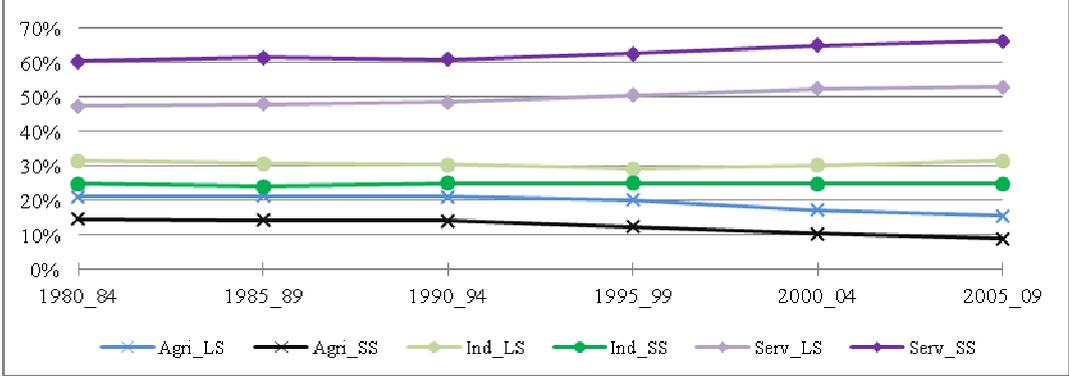
Figure 6: External Capital (FDI, remittances, aid and Tourism % of GDP)



Notes: FDI – Foreign Direct Investment; Rem – workers' remittances; Tour – tourism; _LS – group of Large States; _SS – group of Small States.

7) In the period 1980-2009, the average size of the services sector (% of GDP) was higher in small states while agriculture (% of GDP) and industry (% of GDP) were higher in large states. These differences between the average values of the two groups of states are statistically significant. From figure 7, we conclude that the three sectors have evolved identically in both groups of states, i.e., the services sector with an upward trend, the agricultural sector with a decreasing slope and the industrial sector stagnating.

Figure 7: Economic sectors (agriculture, industry and services % of GDP)



Notes: Agri – agriculture, Ind – industry, Serv – service, _LS – group of Large States; _SS – group of Small States.

8) Small states have strong dependence on government activities as a major source of income and employment. In the period 1980-2009, the average of annual government consumption (% of GDP) was significantly higher in the group of small states. The greater level of the government consumption in small states can be associated with the indivisibility of many public services by the number of inhabitants and the need for a minimum size for a normal function of the government (Briguglio, 1995). Rodrik (1998) argues that the greater government presence in small states is linked to the fact that the opening to foreign markets exerts enormous influence on government consumption in economies with enormous external risks, as the government seeks to mitigate the exposure to risk by increasing domestic consumption.

9) Social cohesion is presented in several studies as one of the main advantages of small states (Armstrong et al., 1998; Briguglio et al., 2006; Guillaumont, 2010). Using the linguistic diversity index as a proxy for social cohesion, we found that the average of the index is lower in smaller states, but this difference is statistically significant only at 10%. However, using civil war as a proxy for social cohesion, we found that of the 91 countries (10 small states and 81 large states) with information available, the average of the years with civil war in the period 1970-2010 in large states (11.33 years) is much higher than in small states (1.14 years). Thus, we conclude that in small states there is a greater social cohesion. Jenson (2010) shows that greater social cohesion leads to better institutions, and better institutions lead to higher growth.

Summary

With this analysis, we conclude that small size is not associated with poor economic and social performance. Small states compared to large states present higher levels and growth rates of GDP per capita, have higher investment (% of GDP), more equitable distribution of income and better quality of human capital. However, this performance does not translate into lower rates of unemployment in small states and in the final period, 2005-2009, investment in small states appears to be linked to less productive sectors. We noted also that small states are more open to foreign trade and have higher trade deficits, which have been offset in part by inflows of foreign capital (FDI, tourism, remittances and aid). The services sector (% of GDP) is higher in small states while the industrial and agricultural sectors (% of GDP) are higher in large states. Small states have a higher ratio of government expenditure (% of GDP) as a result of a minimum size for a normal function of the government and also the need for government intervention to stabilize the internal market. Additionally, the small countries have greater social cohesion.

Table 2: Economic indicators of the two groups of states (1980-2009)

Variables	Small States				Large States				T_test (p_value)
	Mean	Min	Max	Std. Dev.	Mean	Min	Max	Std. Dev.	
GDP pc real (% annual growth) ⁶	1,91	-47,73	76,75	7,47	1,52	-44,40	64,20	6,36	0.0631
GDP pc (2005, PPP, I\$) ⁷	12.978,5	616,74	118.835,4	14.755,9	8.738,4	160,80	65.878,9	10.873,3	0.0000
Investment (% GDP)	27,76	1,63	153,45	14,12	21,38	-2,42	70,23	7,56	0.0000
GINI Index	40,30	22,49	69,17	10,16	42,49	19,40	74,33	10,40	0.0313
Unemployment rates (%)	10,73	0,30	39,30	8,37	8,50	0,60	37,60	5,49	0.0000
Exports (% GDP)	49,94	1,47	295,75	37,31	31,63	0,11	186,35	19,85	0.0000
Imports (% GDP)	67,72	11,66	424,82	39,03	35,35	0,07	174,10	18,63	0.0000
Export concentration index ⁸	0,42	0,08	0,95	0,21	0,32	0,04	0,99	0,22	0.0000
FDI, influx (% GDP)	4,78	-55,07	90,46	7,74	2,39	-65,41	85,96	4,83	0.0000
Remittances (% GDP)	7,87	0,00	106,48	12,85	2,46	0,00	49,74	4,40	0.0000
Tourism (% GDP)	14,52	0,23	98,25	15,64	3,12	0,004	20,53	2,96	0.0000
Agriculture (% GDP)	12,33	0,00	63,96	13,05	19,30	0,49	93,98	15,76	0.0000
Industry (% GDP)	24,75	3,23	101,73	14,44	30,55	1,88	93,13	11,77	0.0000
Services (% GDP)	62,92	-3,31	95,37	17,00	50,17	4,14	79,58	13,31	0.0000
Government expenditure (% GDP)	21,66	2,75	84,51	12,26	15,55	1,38	69,54	6,59	0.0000
Distance (log_Km ²)	8,17	5,60	9,16	0,65	8,10	5,39	9,12	0,77	0.0011
Secondary (enrollment rate)	72,64	3,76	124,75	28,39	63,90	2.344	162.348	34.333	0.0000
Linguistic diversity index ⁹	0,41	0,00	0,97	0,28	0,48	0,00	0,99	0,31	0.0881

Sources: World Bank - World Development Indicators, UNCTAD, PWT (Penn World Tables) 7.1, UN – National Accounts Main Aggregates Database, Ethnologue Language of the World (Lewis, 2009).

Note: We carried out the t-test to assess the statistical significance of the difference between the means of two groups of states.

⁶ Source: PWT 7.1.

⁷ Source: PWT 7.1.

⁸ Concentration index of UNCTAD. Varies between 0 and 1. Values closer to 1 mean greater concentration of export. Period 1995-2009.

⁹ It refers only to the year 2009.

4 – VULNERABILITY

Small countries, particularly the island countries, are considered by some studies (Read, 2001 and 2010; Armstrong and Read, 2002; Guillaumont, 2010), as more economically, socially, politically and environmentally vulnerable than large states. The negative impact of vulnerability in the economic growth process has been analysed in several studies (Hochrainer, 2009; Briguglio et al., 2009). In this section we compare small and large states in terms of vulnerability.

4.1 – Vulnerability of small vs large states

Read (2001) presents three main sources of vulnerability in small states (economic, political/strategic and environmental), but due to data limitations, we analyze only the economic and environmental vulnerability.

i) Environmental Vulnerability

We compared the environmental vulnerability of small and large countries by the analysis of total number of affected people, total deaths and total economic damage caused by natural disasters. The data are from the Emergency Events Database (EM-DAT) for the period 1980-2009. The data for affected people and deaths were divided by the population in the year prior to the disaster. We also divide the estimated costs of damage by the GDP and compare the effects between the two groups of states.

During the period 1980-2009, 8,357 natural disasters occurred in the group of large states, representing an average of 63.3 disasters per country. In the group of small states there were 597 disasters, which correspond to an average of only 10.3 disasters per country. The annual average of deaths caused by natural disasters was 0.0009% of the population in small states and 0.0015% of the population in large states. This average is statistically significantly higher in large states.¹⁰ The annual average of affected people in small states (1.71% of the population) is not statistically significantly different from the average in large states (1.44% of the population).¹¹ The annual average of cost of damage from natural disasters is statistically significantly higher in small states (0.63% of GDP) compared to the large states (0.14% of GDP).¹²

ii) Economic Vulnerability

We compared the economic vulnerability of the two groups of states using the following variables:

- According to Briguglio (1995), trade openness (measured by ratio of exports and imports to GDP) is an indicator of economic vulnerability. The data analyzed above indicates that in small states the ratio of exports and imports to GDP is higher than in large states. Therefore, small states are economically more vulnerable. However, Armstrong and Read (2002) criticize the use of trade openness as an indicator of

¹⁰ T-test: $Pr(|T| > |t|) = 0.0878$ - Rejects the null hypothesis of equality of means.

¹¹ T-test: $Pr(|T| > |t|) = 0.2959$ - Accept the null hypothesis of equality of means.

¹² T-test: $Pr(|T| > |t|) = 0.0007$ - Rejects the null hypothesis of equality of means.

economic vulnerability because exports are a fundamental source of growth in small states, hence using this variable can lead to wrong conclusions.

- The economic growth volatility, measured by the standard deviation in growth rate of GDP per capita, is also used as a measure of economic vulnerability. In the period 1980-2009 the average of the standard deviation of growth rate of GDP per capita was higher in small states (6.57%) compared to large states (5.53%).

- Considering the economic vulnerability index developed by UNCDP (2000) we found that of the 30 most vulnerable states, 16 are small states, and of the 30 states with the lowest rate, none is small.

Summary

With this analysis, we conclude that despite the higher frequency of disasters in large countries, the negative impact of environmental vulnerability is not stronger in large countries compared to small countries. But the economic vulnerability is clearly higher in small states.

However, this finding that small states are more vulnerable than large states seems to be contradictory, since small states have higher levels and growth rates of GDP per capita, which suggests that the vulnerability does not affect a country's economic performance. However from an analysis of individual countries, we found that the 10 small states with the highest levels of GDP per capita for the period 2000-2009 are the states with the lowest UNCDP economic vulnerability index, the lowest average of affected people, deaths and costs of damage caused by natural disasters.¹³ On the other hand, the 10 states with the lowest levels of GDP per capita are the states with the highest values of the economic vulnerability index, affected people, deaths and cost of damage.¹⁴ Therefore we can conclude that the weak economic growth of some small states is associated with their high economic and environmental vulnerability.

5 – GROWTH PERFORMANCE OF SMALL STATES

We found some differences between small states in terms of the level of GDP per capita. Comparing the GDP per capita (PPP, 2005, I\$) between small states, in 2009 the country with lowest value (Comoros) corresponded only to 0.72% of the one with the highest value (Qatar). In this section we analyze some factors that might explain these differences in income levels between small states.

5.1 – Introductory considerations

In order to identify factors that might explain the differences in economic performance across the small states, we made a ranking of states based on the level of GDP per capita (PPP, 2005, I\$) for the period 2000-2009 (we didn't consider more recent data to avoid the crises effects). We formed two groups of states, the first with five states with the highest level of GDP per capita (which we will call 'high-income' or 'first group') and the second with five

¹³ The ten countries: Luxembourg, Qatar, Brunei Darussalam, Bermuda, Kuwait, Singapore, Iceland, Hong Kong, Macau and the Bahamas.

¹⁴ The ten countries: Kiribati, Solomon Islands, Moldova, Djibouti, ST and Principe, Lesotho, Gambia, Comoros, Guinea-Bissau and Timor-Leste.

states with the lowest level (which we will call 'low income' or 'second group').¹⁵ In the first group or high-income group we have Qatar, Luxembourg, Brunei Darussalam, Kuwait and Bermuda, and in the second group or low-income group we have Lesotho, Gambia, Timor-Leste, Comoros and Guinea-Bissau.

We analyzed economic growth in both groups of states for the period 2000-2009 and we found that the average of annual growth rate of GDP per capita were 2.5% and 0.15% for the first and second group respectively. In the high-income group, Qatar was the country with the highest average growth (6.77%) and in low-income it was Lesotho (2.94%).

5.2 – Small states: high vs low income

We analyzed some variables in order to identify some factors that might explain the economic growth differences between the two groups of states. The data are in table 3:

1) Many small states tie their exchange rate to a strong currency or belong to a strong monetary area. This provides some insulation from external vulnerability, reduces the volatility of the exchange rate and keeps inflation rates low (Armstrong and Read, 2003). The average annual inflation rate in the first group (5.73%) is lower than in the second group (6.63%), but this difference is not statistically significant. Most countries of both groups have their currencies pegged to more stable currencies or use strong currencies such as the Euro, US Dollar and the South African Rand, which helps maintain low inflation rates and facilitate trade.

2) According to Armstrong and Read (2000), proximity to a rich and dynamic region generates additional effects on growth of some small states. The states of the first group are located in favourable areas and are neighbours of high income states. Luxembourg is practically in the center of Europe, Brunei is in the Pacific region and neighbours China, Japan and the "Asian Tigers", Bermuda is close to the US, and Kuwait and Qatar are located in the Middle East and have as neighbours rich and developed countries like Saudi Arabia and United Arab Emirates. The second group: Lesotho, Comoros, Guinea-Bissau and Gambia are located in Sub-Saharan Africa region, which is one of the poorest regions of the world, and Timor-Leste is in the East Asian and Pacific region, and this region has a high income performance. Even after excluding the richest countries in the region, Timor-Leste continues to have a level of income per capita far below the regional average. Therefore, the low income of Timor-Leste is not associated with the surrounding market.

3) Armstrong and Read (2002) consider services (financial and tourism) and natural resources important to the economic success of small states and agriculture as an obstacle. From the sector analysis we found that the industrial and services sectors are larger in the first group, but this difference is not statistically significant. We also found that the agricultural sector is statistically significant larger in the second group. In the first group, the services sector accounts for about 82% and 90% of GDP in Luxembourg and Bermuda, respectively. The main services developed in these countries are tourism and financial services. Tourism in these countries is directed towards the social group with a high level of income. In Qatar, Brunei and Kuwait the industrial sector is the engine of the economy, arising from the existence of oil and natural gas and accounts for over 50% of GDP. In this group the

¹⁵ For economic ranking of the states we used the GDP per capita in PPP and not in common currency (US dollars), so that we can reflect price levels, which are important when comparing states with very different degrees of development. The source of our data is PWT.7.1 for the period 2000-2009.

agricultural sector is practically non-existent with an average of less than 1% of GDP. In the second group, the agricultural sector has an average of 31% of GDP. In these countries, the agricultural sector is traditional and for subsistence therefore undeveloped and under-exploited. In Comoros, Gambia and Guinea-Bissau, 70% to 80% of the population is involved in agriculture, which reveals the existence of low level of education in the workforce in these countries.

4) Analyzing the Human Development Index (HDI) we found that in the first group the average rate is very high, 0.844, and in the second group it is low, 0.474.

5) The average weight of natural resources (% of GDP) is significantly higher in the first group. The main natural resources in the first group are: Luxembourg (iron and wood), Bermuda (limestone), Brunei (oil and gas), Qatar (oil and gas) and Kuwait (oil). In the second group are: Lesotho (water, diamonds and other minerals), Guinea-Bissau (wood, offshore oil and phosphate), Gambia (no relevant natural resources), Timor-Leste (oil and gas) and Comoros (aromatic plants and vanilla). The natural resources in the first group are more valuable, which explains, in part, the economic success of some of these countries.

6) In order to overcome the obstacles associated with the small domestic market, small states should follow highly open trade regimes and be integrated into the international economy (Armstrong and Read, 2003). Exports are significantly higher in the first group and imports are higher in the second group. In the first group there is a positive trade balance of about 23% of GDP and in the second group the balance is negative (- 47% of GDP).

7) The average of export concentration index is lower in the first group, but this difference is not statistically significant. In the second group about 50% of imports or exports are concentrated in just two trading partners, representing higher risk and exposure to external shocks.¹⁶

8) Gwartney et al. (1998) argue that the higher the government consumption expenditure the slower will be economic growth, because it implies high taxes and loans. In the first group, the average level of government consumption is 18.09% of GDP and in the second group it is 25.68%. This difference is statistically significant. The higher level of government consumption in the second group is strongly influenced by the percentage of consumption in Timor-Leste and Lesotho. The high level of government consumption can be an obstacle to economic growth in the second group, especially to Timor-Leste and Lesotho.

¹⁶ Analyzing the trade relations of the two groups of states, we found that the main partners in exports/imports for the first group of states are: Luxembourg (Germany, France, Belgium, UK and Italy); Qatar (Japan, US, South Korea, Italy, Germany, UAE, Singapore, and India); Brunei (Japan, Indonesia, Australia, Singapore, Malaysia, USA, China and South Korea); Bermuda (USA, Canada, UK, Germany, Spain and Italy); and, Kuwait (Japan, South Korea, USA, Singapore, China and Germany). The main partners for the second group of states are: Lesotho (USA, India, Belgium and Southern African Customs Union - SACU); Comoros (France, South Africa, Pakistan and Singapore); Guinea-Bissau (India, Portugal, Senegal and Nigeria); Gambia (India, China, Senegal, France and UK); and, Timor-Leste (Germany, USA, Singapore, Australia and Indonesia).

Table 3: Comparison between small states (2000-2009)

	Countries	Agric. (%PIB)	Indust. (%PIB)	Serv. (%PIB)	Resource (%PIB)	Exp. (%PIB)	Imp. (%PIB)	Export. Conc.	Gov. (%PIB)	Inflac. (%)	GDP pc (ppp, 2005,\$)
First Group	Qatar	0,20	69,95	29,84	44,57	60,21	29,72	0,559	14,91	8,64	79.266,20
	Luxembourg	0,51	17,49	81,99	0,09	157,22	131,62	0,133	16,09	2,84	71.998,84
	Brunei	0,95	67,19	31,86	56,20	70,29	32,82	0,636	22,80	6,63	48.323,64
	Kuwait	0,33	58,26	41,41	52,22	58,06	30,52	0,652	18,87	7,76	44.649,33
	Bermuda	0,81	9,96	89,22		44,50	50,70	0,555	17,76	3,09	43.874,09
Second Group	Lesotho	9,59	34,28	56,13	4,45	52,76	127,55	0,412	36,35	7,48	1.221,64
	Gambia	24,84	14,21	60,94	3,56	28,44	39,51	0,316	9,08	6,12	1.184,20
	Timor-Leste	27,55	13,86	58,58	0,68	9,39	127,76	0,622	45,90	4,57	1.034,99
	Comoros	48,38	11,85	39,77	2,12	15,23	37,04	0,673	14,67	4,27	934,33
	Guinea-Bissau	46,97	13,38	39,65	12,67	16,58	27,40	0,791	15,39	10,50	792,05
t-test		0,0000	0,0000	0,3330	0,0000	0,0000	0,0672	0,2326	0,0031		

Sources: PWT7.1; World Bank – WDI; CIA – The World Factbook; UN – National Accounts Main Aggregates Database; IMF (2008 and 2011), UNDP – United Nations Development Programme, Human Development Reports.

Natural resources in Qatar, Brunei and Kuwait are one of the main drivers of economic growth in these states. However the existence of these resources is simply due to luck and not to policies and strategies. Hence we exclude these states and consider Singapore, Macau and Hong Kong, which are also among the states with the highest levels of GDP per capita but are not producers of oil and natural gas. We analyze the behaviour of some economic variables in these three countries:

1) In the period 2000-2009, the average growth rate of GDP per capita in Macau, Hong Kong and Singapore were 6.89%, 3.23% and 3.53%, respectively. The average weight of the services sector in these three countries was 81.58% of GDP. Tourism, financial services and gambling industry (especially in Macau) are the main services provided in these countries. The FDI, mainly linked to tourism (construction of hotels, resorts, casinos and second homes), is an important pillar of the growth process of these countries. The industrial sector has a considerable weight in the economy of Singapore with an average of 31.31% of GDP and the main industries are connected to electronics, chemicals and equipment for refineries. In Hong Kong and Macau the industrial sector is less significant, with an average of 9.16% and 14.67% of GDP respectively. The agricultural sector is insignificant in these states.

2) Macao, Hong Kong and Singapore are characterized by a certain macroeconomic stability. The average annual inflation rate for the three states was 1.22%, and the volatility of growth (measured by the standard deviation in the growth rate of GDP) was 5.24. The average weight of government consumption in these three states was 10.36% of GDP.

3) The average of exports and imports for the three states in the period 2000-2009 were 161.41% and 139.19% of GDP respectively. The export concentration index was low, with an average value of 0.233 for the three countries. Macau, Hong Kong and Singapore are located close to developed markets such as China, Japan and the USA. Hong Kong and Singapore are also ranked among the freest economies in the world. These factors are important for external trade, tourism and financial services.

With the exclusion of oil-producing states, we conclude that the rapid economic growth of the first group can be explained mainly by their location close to developed markets, high level of economic freedom and openness to foreign trade. Other important factors are the existence of high level of human capital, low level of government consumption, indexation of the national currency to a strong and stable currency, macroeconomic stability, integration into a developed monetary region, low concentration of exports, low influence of the agricultural sector and a well-developed services sector offering financial services and tourism to the high-income social groups.

6 – CONCLUSION

The conclusion is made up of two parts. First, we present some policies and strategies that small states can adopt to overcome some limitations. In the second part we conclude our descriptive analysis.

6.1 – Policies and strategies

This paper focuses on small states and given the peculiarities of small states, we present some policies and strategies that they can implement to maximize their strengths and reduce the effects of certain weaknesses. Using the report of the Commission on Growth and Development (2008) and other studies such as Bhaduri et al. (1982), Briguglio (1995), Peters (2001), Armstrong and Read (2002), Prasad (2003), Jayaraman (2006), Favaro (2008), Aiyar (2008) and some of our conclusions made in previous sections, we present some policies and strategies that small states can apply as follows:

- a) In the case of islands states, they should invest in ports and maritime infrastructure in order to encourage the development of marine business.
- b) Attract FDI by promoting political and macroeconomic stability, construction of adequate infrastructure, training of high quality human resources and implementation of monetary and fiscal policies attractive to foreign investment.
- c) Invest in infrastructure to promote tourism. Tourism can convert the traditional disadvantages of remoteness and isolation in advantages.
- d) Use outsourcing to reduce some costs in the public sector and overcome the lack of experience in some sectors.
- e) Investing in the Information and Communications Technologies (ICTs) sector. Improvements in this sector will help to minimize the disadvantages of distance and insularity. It will also make possible the provision of services such as telemedicine, distance education, knowledge sharing as well as the control and monitoring of natural disasters and environmental accidents.
- f) Approve laws and policies that encourage domestic competition in order to reduce the abuse by monopolistic companies and promote the efficient use of resources.

g) Promote international competitiveness through greater control of budget deficits, exploitation of strategic export niches, improving institutions and services, flexible specialization and promotion of entrepreneurship.

h) Reduce human and physical damage caused by natural disasters through the proper mapping of high risk areas, enactment and implementation of safer building codes and promotion of disaster information mechanisms.

i) Using the “hedging” instrument in international financial markets to help control risks associated with export revenues.

6.2 – Conclusion

We conclude by pointing out that there is no concept of small states that is widely accepted. Population size is the main indicator used due to the wide availability of data and ease of setting limits. Other indicators used are geographical area, total GDP, trade, military capacity and diplomatic resources. Studies indicate different limits for each indicator used.

We used cluster analysis with population and land area as the criteria to define countries and of the 215 countries analyzed we identified 83 as small. In the group of small states the lowest population is 9,806 (Tuvalu) and the highest is 7,003,700 (Hong Kong) and the lowest land area is 2 km² (Monaco) and the highest is 410,450 km² (Greenland). Cluster analysis can be more difficult to apply than the simple specification of a population limit, but we noticed greater consistency in identifying the countries groups with the combination of land area and population.

Small size of the population and land area are presented as major constraints to economic growth in small states. However we also saw that, on the average, small states compared to large states have higher levels and growth rates of GDP per capita, have more investment (% of GDP), are more open to external trade, have more equitable distribution of income and better quality of human resources. On the other hand, small states have higher unemployment rates and greater dependence on foreign capital. We conclude that despite the higher frequency of disasters in large countries, the negative impact of environmental vulnerability is not stronger in large countries compared to small countries. But the economic vulnerability is clearly higher in small states.

We also found that there are considerable differences in the levels and growth rates of GDP per capita among small states. The better economic performance of certain small states is explained mainly by their location close to developed markets, greater economic freedom and external openness.

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Appendix - Cluster Analysis

We used the SPSS 17.0 computer program for the cluster analysis. In this program, we find three techniques of clustering: hierarchical clustering – the process starts by defining a starting cluster for each of the sub-clusters produced in the pre-cluster step. All clusters are then compared, and the pair of clusters with the smallest distance between them is selected and merged into a single cluster. The process finishes when all clusters have been merged. This technique is used when we have a small number of objects (less than a few hundred); k-means clustering – the number of clusters is predefined by the analyst and is most useful when we want to classify a large number of subjects (thousands); and TwoStep clustering – is indicated for large data and mixed variables (continuous and nominal). In our study we use the hierarchical clustering, since our database is made up of 215 states.

There are several distance measures associated with the hierarchical technique, such as Squared Euclidean distance, Euclidean distance, Correlation between vectors of values, Cosine of vectors of values, Chebychev distance metric, City-block or Manhattan distance and Distance in an absolute Minkowski power metric. Among these measures the most used is the Squared Euclidean distance – which the distance between two items, i and j , is the sum of the squared differences between the values for the items:

$$D_{ij} = \sum_{k=1}^p (x_{ik} - x_{jk})^2$$

Where: x_{ik} – value of the variable k concerning the individual i , x_{jk} – value of variable k concerning the individual j .

Methodology

The hierarchical technique is the most appropriate for our database, 215 states. We use two variables, population and land area, to define the clusters.

The values were transformed into logarithms and then standardized by the option Z-scores of SPSS, because for our study is not relevant to consider the amplitude of the variables in the clusters.

$$Z_i = \frac{x_i - \bar{x}_n}{S}$$

Where: x_i – value of the variable; \bar{x}_n – mean; S – standard deviation

The Squared Euclidean distance and Average linkage between groups are the measure and method commonly used in cluster analysis through hierarchical technique. But, we apply the various measures and methods existing, to verify the robustness of the classifications and identify the cluster with greater homogeneity. We had similar classification when we changed the measures, except with the measure Correlation between vectors of values, which showed very heterogeneous groups. Having found similar results between the various measures, we opted for the Squared Euclidean distance. About the methods, we had the same classification for Average linkage between groups, Furthest neighbour, Centroid clustering and Ward's method. And, for Average linkage within groups, nearest neighbour and Median clustering, the classification was quite different from those of other methods and we verify a greater heterogeneity among the elements of the clusters. Thus, we applied the measure Squared Euclidean distance and the method Average linkage between groups.

Clusters numbers

We define an initial interval of 2-8 clusters and we use the criterion of R-Square (defined by Maroco, 2003) and ANOVA one-way to test the number of clusters more acceptable to our database. Following the results of the test performed:

N° of clusters	R- Square
2	0,592787
3	0,645596
4	0,818738
5	0,829203
6	0,834605
7	0,849154
8	0,852049

By the results above the best solution are 4 clusters, because the variation gains retained for more than 4 clusters are relatively small. We reinforce this conclusion with graph analysis and we also identified between 4 and 5 natural clusters. To test our results, we applied different methods and cluster analysis measures and we also eliminated some countries in our database to test the possible changes on classification. We found that there were no significant changes. We applied the K-means technique of cluster, although is not the most indicated for our study, and we had practically no difference with the classification by hierarchical technique.