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Measuring insularity as a state of nature.

Is there a case of bad geography?

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According to both empirical and theoretical literature the most immediate case of ‘bad’ geography is not having a direct access to the sea. A large proportion of less developed countries are landlocked economies. Being an island is also associated to a role for geography in the economy. Islands are surrounded only by sea, which is the main geographical difference from coastal countries. The total land discontinuity rises costs by cutting out some alternatives in the connection system of the island. But at the same time insularity may lead to growth opportunities mainly linked to tourism specialization. The first goal of this work is to collect available physical geography data on islands and elaborate measures of insularity for all countries in the world. Then we want to evaluate if and in which cases insularity can turn into ‘bad’ geography and when instead it appears to be associated with better economic performance at the country level. We find that two dichotomies are important: states which *are* islands (full insularity) perform worse than countries which *have* islands (partial insularity). Within the group of island-states, isolation is the crucial dimension associated with poor economic performance, less the dispersion of the land in many islands. Instead, being coastal *and* having islands is associated to better results than having only a direct access to the sea. It is the subsample of countries with islands the one which performs better in the heterogeneous group of coastal economies.

¹ The author wish to thank participants at The Periphery and its Host Economy (Pemabo 2012) conference 2-6 September 2012 Ísafjörður, Iceland for helpful suggestions on a first draft of this paper. Errors are our own.

1. INTRODUCTION

A large proportion of the least development countries are in a 'bad geography' condition in terms of accessibility to the world markets. *Bad* translates the lower inter-connectivity imposed by past and present physical geography into lower income, slower growth and less trade. The focus on how geography correlates with development started with Gallup, Sachs and Mellinger (1998) and from then variants of the new economic geography, new trade theory but also growth theories have been applied to highlight the nexus between geographic location, trade and country wealth.

The first goal of this paper is to measure insularity as a state of nature. Insularity by itself is not a condition of 'bad geography'. According to both empirical and theoretical literature the most immediate case of bad geography is not having a direct access to the sea. One out of four countries in the world are landlocked while in Africa this is the case for one out of three. With respect to insularity it is crucial its association with size and remoteness to turn it in a factor which may slow down development (Briguglio, 1993; 1995; 2004). In fact, having a direct access to the sea is *the* geographical condition which has been found to be the main advantage for the economy of a country: coastal countries are richer (Bloom and Williamson, 1997) and trade 30% more than landlocked countries (Limao and Venables, 2001).

In this paper we firstly aim at measuring different states of insularity. The second goal is to check whether the heterogeneity in the insularity state is associated to heterogeneous outcomes in terms of trade and income. The point we make is that extreme cases of insularity may be correlated with poor economic outcomes as it is case for landlocked countries. Other than such extreme cases, there are intermediate states of insularity which have to be measured and distinguished from the mere coastal country condition.

In a recent report the World Bank (2010) highlights that landlocked economies are affected primarily not by the high cost of freight services. More by the high degree of unpredictability in transportation time. In other words, it's mainly a question of the surrounding context. The need to transit in another country's territory can turn into a condition of 'bad geography' because both exogenous and endogenous factors are likely to rise the total costs of logistics rather than the isolated voice of transport costs. Some of such factors are out of the landlocked country control. The issue of unpredictability is pertinent also to the geography of islands. Islands are surrounded only by sea. The total land discontinuity rises costs by cutting out some alternatives in the connection system of the island and rising the level of uncertainty for the remaining ones. Being small and being remote should be considered under the light of such characteristic. This is the crucial physical difference they have with coastal countries.

To deepen our argument the first crucial issue is the measure of insularity. Till now the empirical literature has simply selected small islands countries (for example works on Small Islands Developing States). Alternatively, the trade literature isolates islands from the rest of countries with the use of a simple dummy when running a gravity model where some geographical conditions have to be controlled for (in the more recent model the effect is captured by the country fixed effect). The first task of this work is to collect available data on the islands and elaborate some measures of insularity for all countries in the world. The point is not easy since information on islands is quite rare and disperse. We used mainly two sources, the United Nation Environment Programme (Unep) and WorldsIslandInfo.

Starting from the basic information on number of islands and percentage of land on island we have constructed different measures aimed to capture the heterogeneity of insularity. If it is the case that the complete discontinuity of the land imposes a cost (limiting the connectivity with other countries) an increase in the number of islands raises costs. A second dimension which increases costs is distance. Therefore we consider the dispersion of the land in more than one island and a measure of their remoteness with respect to either the nearest mainland or the nearest other islands. These two dimensions can be used to order countries according to their degree of insularity. Putting the two dimensions together the world appears divided in three groups of countries: fully insular (island-states); partially insular and not insular.

The first critical dichotomy is between countries (as national states) which *are* islands and countries which *have* islands. In the first case islands are a country in the second they are regions, or smaller territorial units, belonging to a country. Within the group of island-states we aim at focusing the critical dimension with the insularity condition. According to the literature three dimensions concur to the economic fragility associated to the insular condition: smallness, remoteness and vulnerability. In this work we check on the dispersion of the territory (which is connected to size, the more dispersed the territory in many islands the smallest the average size) and on the remoteness with respect to the nearest land (isolation). Our results would suggest that the last point being the critical one. Island-states which are more isolated perform in a similar way to landlocked countries.

Countries which *have* islands (but are not islands) are instead a small group of all economies in the world. Their limited number is outweighed by a bigger share in terms of income. When looking at the distribution of income and trade within this small number of countries it is quite clear their better performance within the wide group of coastal countries. Our first results would suggest that it is this smaller sample of economies to cheer up the fortunes of coastal countries. They do better than countries with null or negligible degree of insularity when looking both at the distribution of per capita income and the size of trade.

Another tricky case is distinguishing two cases of not insular countries: states which do not have any 'relevant' insular territory but have access to the coast have a complete different geography condition than countries without a coastline (landlocked). We separate out two cases of null insularity (landlocked and coastal) from cases of negligible insularity (less than 2% of insular land of total territory). On average the three groups show significant differences in the distribution of the two variables taken in exam. Being landlocked is the worst case, coastal countries do better and having some land on island is associated to even higher income.

Our finding is that insularity is a condition that cannot be defined as a disadvantage tout court. More distant, more dispersed island-state reveal to suffer in terms of lower GDP per capita and less trade. Their position, in terms of income and trade distribution is similar to the one of landlocked economies. Size therefore has something to do with dispersion of the territory in many islands. Although we confirm that landlocked countries are weakest group, coastal countries are a quite heterogeneous group. Having some degree of insularity makes things better for economies. According to Armstrong et al, (1998) and Bertram and Karagediki (2004) there are several reasons why insularity may lead to growth opportunities, facility to build social capital, attractiveness for tourists and the possibility to be successful in the policy implementation.

The paper is structured in different parts. Section 2 reviews insularity characteristics and economic conditions in the literature. We then discuss available data and we provide novel measures for distinguishing different insular conditions in section 3. In section 4 we group all the countries in the world according to their insular measure and we study both the distribution of income per capita and trade across groups and its change in time. Section 5 concludes the paper.

2. DEFINITION IN THE LITERATURE

2.1 Being an island

According to the definition provided by Eurostat (1994), an island is a piece of land with specific characteristics:

- a) a surface area of at least 1 km²;
- b) permanently inhabited by a statistically significant population (more than 50 inhabitants);
- c) not linked to the mainland by permanent structures;
- d) separated from the European continent by a stretch of water at least 1 km wide;
- e) not containing a capital city of one of the Member-States.

The nature of the challenges faced by islands makes them peculiar with respect to the mainland states (Read, 2004). In the case of islands the burden given by peripherality is exacerbated by the insularity condition. As well as the geographical characteristics, the topography of islands has critical economic growth effects (Briguglio, 1995; Dommen, 1985).

As a consequence of their geographical, topographic and socio-economic characteristics, islands face a condition of substantial backwardness. The Gross Domestic Product (GDP) is below the EU average.

The peculiarity of the economic challenges faced by islands, together with a considerable variability in terms of economic performance exists among islands, fosters a debate among economists regarding the nature of the challenges faced by islands and their consequences in terms of economic performance.

2.2 Characteristics of insularity: smallness, remoteness, vulnerability

Identifying the economic challenges faced by islands is sometimes difficult. A debate exists regarding whether adverse effects on growth are caused by insularity per se rather than small size. According to one strand of literature, smallness per se does not represent a challenge, since there is evidence regarding some small states performing well. Rather, it is the combination of smallness with other geographical characteristics such as being an island, landlocked or mountainous that matters. However, according to another strand of literature (i.e. Armstrong and Read, 1995), the adverse effect of insularity on small size is negligible; on this perspective, it is smallness, rather than insularity per se that affects growth.²

In what follows, we will define the three dimensions concurring to define islands: smallness, remoteness and vulnerability.

Smallness

The major implication regarding smallness regards the limited size of domestic markets because it affects negatively the possibility of islands to have agglomeration economies, economies of scale and agglomeration dynamism.

Secondly, small economies also pay higher transportation costs because of the relatively small

² Armstrong & Read, 1995 analysis regarded Western Union, whereas Armstrong et al., 1996, 1998 and Armstrong & Read, 2000, 2002 analyse a global dataset.

volume of cargo, small cargo units, and the need for bulk breaking.

Remoteness

According to the definition of Borgatti (2007), remoteness can be defined as the average weighted distance between two countries with weights reflecting the absorptive capacity of the partner country.

The reasons behind the negative effect of remoteness on trade are connected to transport. Indeed, transport costs have decreased over time, thanks to advances in technology and the construction of new infrastructure, especially in the EU. However, still islands tend to face some costs that are difficult to reduce. The most important cost faced by islands is represented by high per-unit transport cost. This is mainly due first to the fact that islands are constrained to use air and sea transport³, which often operate in a monopoly condition.

The effect of remoteness, in the case of islands, is enhanced by smallness. As stated above, small economy would require relatively small and fragmented cargoes, with higher per unit costs. Moreover, it is likely that small islands would be excluded from the major sea and air transport routes, which may give rise to delays and make it difficult for islands to exploit the advantages of the more technologically advanced means of transport.

Vulnerability

Vulnerability, defined as the potential attribute of a system to be damaged by exogenous impacts (Briguglio, 1995), together with smallness and remoteness represents one of the main factors affecting islands' economic and social development

Islands are indeed more vulnerable than the mainland, being more expose to exogenous shocks (economic and environmental) over which they have relatively low resilience to withstand and recover.

2.3 Economic consequences of insularity

As Armstrong and Read (2004a, 2004b) point out, at least eight economic challenges can be identified, facing small states and islands: the small size of the domestic market; the limited resource base; the limited land area; a strong migrating phenomenon; a narrow domestic output, exports and import market; vulnerability (Briguglio, 1995; Atkins et al., 2000); the consequences of trade and fiscal policies may be exacerbated.

According to a wide strand of literature (Armstrong et al, 1998; Bertram and Karagediki, 2004) the insularity condition is not always related to poor economic performance. Indeed, there are several reasons why insularity may lead to growth opportunities:

islands' high degree of structural openness to trade and high dependence upon exports may lead to export-led growth strategies; pursuing a niche sectoral growth strategy, may lead to high standards of living as well as soon as adequate policies take place⁴ (Armstrong and Read, 1995, 2002; Armstrong et al., 1998); being an island represents per se a factor of attraction for tourists; in a small territory it is easier to build social capital.

2.4 Empirical evidence on consequences of insularity

As far as empirical evidence is concerned, there is not a clear view regarding the effects of insularity on islands economic performance. Indeed, even if island performance is far below EU

³ Dependency from maritime and air transport cause an agglomeration of firms nearby airport and port zones, where there is the concentration of all the logistical services for stocking, trading and distributing goods.

⁴ Policies supporting the key export sector as soon as things go well, and being able to rapidly moving to another niche sector when the first one has been well exploited.

average, especially in terms of unemployment and GDP per capita, empirical evidence does not find a clear negative effect of being an island on several indicators of performance.

3. MEASURES OF INSULARITY

At the country level data on the land characteristics along different dimensions are already available since their use in earth science.⁵ Data as PLACE provide national aggregates of geospatial data collection on population, landscape and climate estimates. Information like this has been used to describe land characteristics as in Puga (2012) where ruggedness refers to precise geographic characteristic of the land.

In this paper we aim at measuring different degrees of insularity. The first case in mind are islands but the novel part of our exercise is providing and testing a measure insularity for countries which *are not* islands but *have* islands. We construct a metric based on the information of each habited island in their territorial sovereignty, i.e. we start collecting data for each island belonging to a country but we sum up the available information in order to arrive to one line information at the country level. Existing empirical exercises single out the case of island-states in one homogeneous group. In the gravity equation, for example, islands and landlocked countries were supposed to trade less, other things equal. But the mere distinction of islands did not provide any further indication of how the insular state was key geographical factor impeding trade or other economic activity. In our view geography has a different implication for an island belonging to a bigger state (a region) and for an island-state. Here by looking at island-states we try to understand which first nature characteristic of being an island (isolation, dispersion, concentration of the land) is correlated with lower economic activity. By looking at partial insularity we aim at understanding whether in coastal states the presence of islands is associated with different economic results.

3.1 Data sources

At the international level, a complete database that shows for each state of the world the number of all islands included within its territory, the area of the island, the population and any other useful data do not exist. Therefore, to collect data about all islands in the world divided by each country isn't an easy task. However, there are four main websites that contain the largest and most extensive amount of information, data and statistics relating to the islands of the world:

- <http://www.worldislandinfo.com/>
- <http://islands.unep.ch/>
- <http://www.worldatlas.com/>
- <http://www.globalislands.net/>

These websites are the four recommended by IGU (International Geographical Union) Islands Commission such as the more complete and the more reliable websites in terms of data quality. For the aims of this study, we used mainly the first two sites because they presented more detailed information in terms of number of islands, area, and any other data useful as potential measures of insularity (eg. isolation index). A full presentation of the four data sources is present in Appendix A. Focusing on the first two sources, some differences are important:

- WorldIslandInfo is more detailed in terms of number of countries and surface (area in square km) of each island;
- Unep, while bringing a lower number of nations and a lower accuracy about the area of the

⁵ From CIESIN at Columbia University (<http://sedac.ciesin.columbia.edu/place/datasets.jsp>).

smaller size islands (very often the data is absent), it is more detailed in terms of number of islands for each nation, reports the isolation index for 552 islands, the shoreline and the coastal index for most of the islands. Furthermore, the information (although not updated) about whether the island is inhabited or not is present.⁶

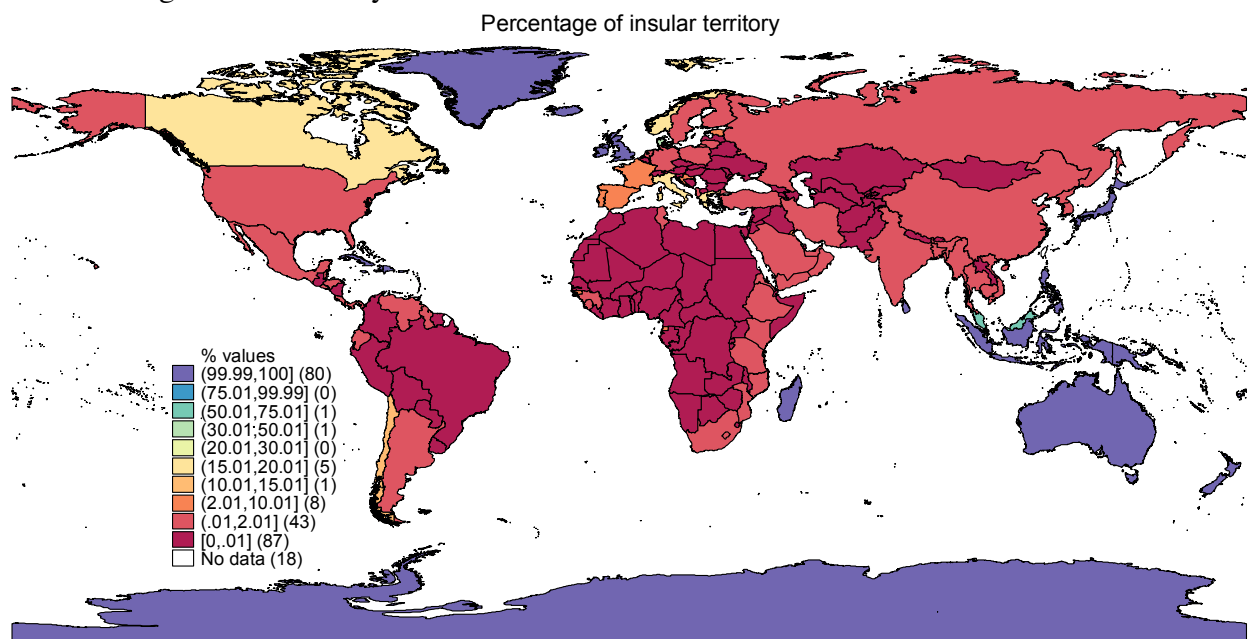
3.2 Measures related to Insularity

3.2.1 Number of islands and percentage island territory

For each country the initial available information that we could put together is:

- number of islands by country (ranges from a minimum of 0 to a maximum of 135 islands);
- percentage of the territory of the country represented by island territory (in square km);⁷

Map 1 - Percentage island territory



Own elaborations on UNEP and Worldislandinfo data

The values showed in the map for the second measure reveals mostly a dichotomy: violet (island-states) and red (20% or lower level of insularity) countries. There is no differentiation within islands and between them and countries which only have a part of their land on islands. Even more, the zero value is associated to very different cases (landlocked and coastal).

But starting from these two measures we can instead distinguish: state islands (100% territory on island which we will call full insularity); countries which are not but have islands (whose second indicator is less than 100, which we call partial insularity); countries whose insularity is negligible because they have a percentage of territory on island small (less than 2%); countries which do not have islands (coastal or landlocked).

More, from these two measures we have a clear indication of which dimensions of insularity are crucial: the number of islands is a measure of dispersion of territory (the level of insularity should increase with the number of islands), while the percentage of the territory on island can measure the ‘partial’ level of insularity for countries which have islands but are not island-states.

⁶ Appendix A explains also how the information from the two sources has been merged.

⁷ Data are available for country-islands and countries which have some of their territory in islands. Among this second group some countries have a negligible portion of territory on islands. As it will be clear later, they are more similar to coastal country.

3.2.2 Heterogeneity of island-states

We can use more information in order to capture differences across island-states. We can distinguish archipelagos⁸ and Small Islands Developing States⁹ (four SIDS are not island-state¹⁰).

At the island level more information, useful to distinguish different cases of insularity, is available from Unep: an isolation index, a coastal index, a threat index.¹¹ Table 1 below illustrates data for the 30 most isolated island-states in the world. Bouvet Island takes the maximum value of the isolation index at a country level, followed by St. Helena and the US Miscellaneous Pacific Islands. As said above, Unep website provide the isolation index for more than 500 islands, then it takes into account not a country point view but an island point of view: the more isolated island in the world is Easter Island with a isolation index of 149.00.

For state islands such indexes are indication on the severity of the insularity condition and therefore can be used evaluate the movement of income and trade with the increase of the insular condition. For countries with partial level of insularity we constructed averages of the isolation and coastal unweighted indexes. We also constructed weighted measures using the island's area (in km²) as weight, but there is not any significant change. Clearly such measures cannot be attributed to all the territory but only to the proportion which is insular.

Table 1 - Isolation and coastal index for 30 more isolated island-states in the world

Island	Isolation index	Coastal index
Bouvet Island	125.00	na
St. Helena	113.00	0.3992
US Miscellaneous Pacific Islands	112.00	na
French Polynesia	107.73	1.0654
Pitcairn	106.25	3.4698
Cook Islands	104.43	1.4648
Cocos (Keeling) Islands	103.00	na
Kiribati	101.45	na
Norfolk Island	101.00	0.8152
Nauru	97.00	0.8357
Niue	97.00	na
Micronesia	96.23	0.8861
American Samoa	94.14	1.7601
Marshall Islands	93.38	na
Tokelau	92.33	na
Bermuda	91.00	2.2137
Mauritius	91.00	0.3371
Samoa	87.00	0.1397
Wallis and Futuna Islands	87.00	0.6847
Guam	86.00	0.2819
Northern Mariana Islands	83.00	0.7548
French Southern Territories	82.38	0.5958
Tuvalu	82.11	3.7917
Palau	81.50	0.3841
Christmas Island	79.00	na
Tonga	77.32	1.9904
South Georgia and the South Sandwich Islands	76.45	0.1883
British Indian Ocean Territory	74.00	3.016
New Zealand	73.73	1.161
Seychelles	73.22	0.8036

Source: <http://islands.unep.ch/Tisolat.htm>

⁸ An archipelago is a landform which consists of a chain or cluster of islands. Archipelagoes usually occur in the open sea; less commonly a large land mass may neighbor them (Source: <http://www.wordiq.com/definition/Archipelago>).

⁹ Source: United Nations, <http://www.un.org/special-rep/ohrlls/sid/list.htm>.

¹⁰ Belize, Guinea-Bissau, Guyana, Suriname (Source: United Nations, <http://www.un.org/special-rep/ohrlls/sid/list.htm>).

¹¹ See Appendix A.

The island-states listed in the table above are all included in our insularity dataset (composed by 234 countries) which counts 84 island-states; in the following table we summarize the most important statistics.¹² As seen in Table 1 maximum value of the index is 125. 50 is the value that cuts the sample in half. 86 or above is the value reported by the 25% more isolated island states.

Table 2 - Isolation index (summary statistics)

Summary Statistics	
Isolation index	
Statistic	Island-states
Mean	59.16
Median	49.29
25% percentile	39.00
75% percentile	86.00

Source: Our insularity dataset

3.2.3 Dispersion of territory

The above indicators help to differentiate island countries. To differentiate countries which have a partial insular condition we constructed an indicators which put together the information on the amount of territory on island and that one on whether the territory is concentrated or dispersed in many islands. Such compositional index is given by two parts: the number of islands which constitute 95% of insular territory and the percentage of land in island.

An indicator as such will help to distinguish different levels of insularity:

- the second part will be less than 100 for countries which are not state islands (what we will call partial insularity) but their index will increase if the insular land is dispersed in many islands;
- all country islands (full insularity) will have a second part equal to 100 but the first part of the indicator will relate to the degree of dispersion of the total land on islands. In this way island countries will be distinguished on whether their land is concentrated or dispersed in several islands. In the second case the indicator will take a bigger values.¹³

In the table below we report the main summaries referring to the first part of the composite indicator. We can notice the differences if we take into account the entire sample (234 countries) or just the 84 island-states.

Table 3 - Number of islands representing 95% of insular territory (summary statistics)

Summary Statistics		
Number of islands representing 95% of territory		
Statistic	All sample	Island-states
Mean	3.09	4.08
Median	1.00	2.00
25% percentile	0.00	1.00
75% percentile	2.00	4.00

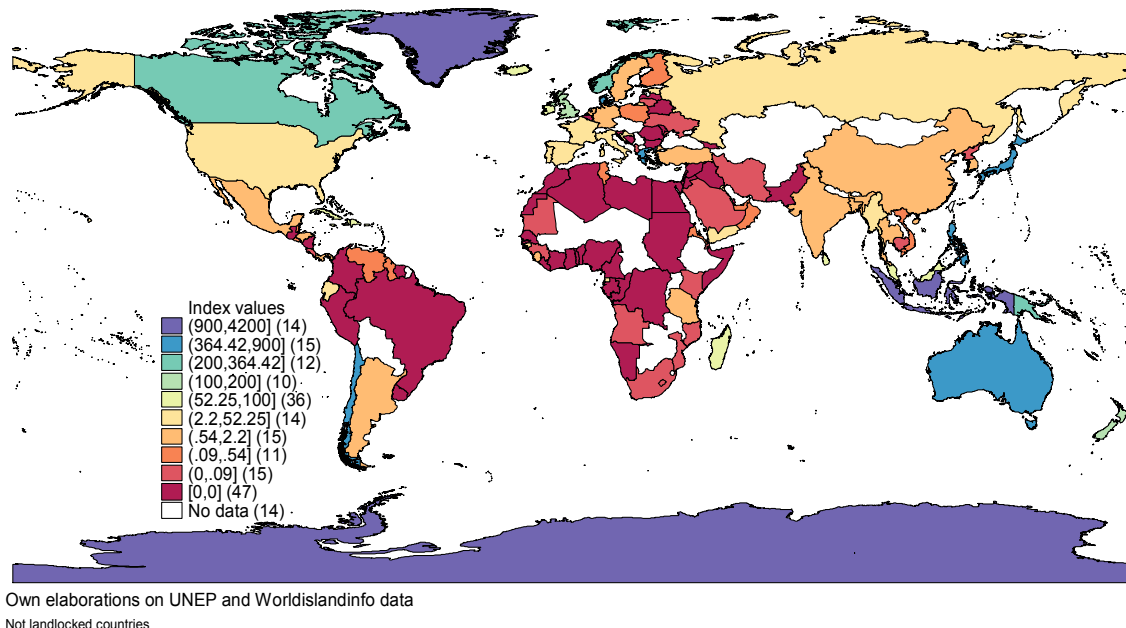
Source: Our insularity dataset

¹² It's important to point out that our calculations (graphs and tests) in paragraph 4 are not performed on the entire insularity sample because for some observations we don't have the information about GDP and/or exports per capita. The samples for which we have both insularity and GDP data and insularity and exports data are composed respectively by 201 countries and by 194 countries. We have lost mainly island-states, so the statistics applied to calculate the more isolated island-states are different because they come from calculations from a reduced sample. See Appendix D to know how the samples are composed.

¹³ Further indicator: divide the composite for the size of the country, so that to give a weight also to size.

Map 2 - Composite indicator for not landlocked countries

Composite indicator: number of islands that represent 95% of the island territory * percentage island territory



4. GDP, TRADE AND INSULARITY

4.1 Boxplot

The box plot, also known as whiskers plot, is a non-parametric graphical way to display robust statistics of many important aspects of a distribution.

The main idea is to depict the variables using five-number statistics: the smallest observation (MIN), lower quartile (Q1), median (Q2), upper quartile (Q3), and largest observation (MAX). It also shows the outliers. This five summaries are important to interpret in the right way the box plot.

The box contains 50% of the observations. The median is indicated by the line in the box, the upper edge (upper hinge) is the upper quartile and indicates the 75% of the dataset, the lower edge is the lower quartile and indicates the 25% of the distribution. Therefore 1/4 of the distribution is between the line (median) and the top of the box and 1/4 of the distribution is between this line and the bottom of the box. The ends of the vertical lines are also called "whiskers" and they show the minimum and maximum data values, unless outliers are present in which case the whiskers extend to a maximum of 1.5 times the inter-quartile range. The points outside the ends of the whiskers are outliers or suspected outliers. Given these features, boxplots display two common measures of the variability or spread in a data set: range and interquartile range. If we are interested in the spread of all the data, the range is represented by the horizontal distance between the smallest value and the largest value, including any outliers. If we ignore outliers, the range is illustrated by the distance between the opposite ends of the whiskers. The interquartile range is represented by the width of the box (Q3 minus Q1).

Using boxplots it's possible to compare datasets or distributions referring to different groups. Since our purpose is exactly to compare distributions referring to different groups, boxplots allow us to see the major trends in the dataset by portraying the scores for more than one group next to each other.¹⁴ We apply the box plot analysis in order to study GDP and exports distributions across

¹⁴ In comparing the boxplots across groups, a simple summary is to say that the "box" area for one group is higher or lower than that for another group. This comparison is analogous to saying that one group tends to have higher scores than another. To the extent that the boxes do not overlap, the groups are quite different from one another. We also conduct statistical tests in order to test whether

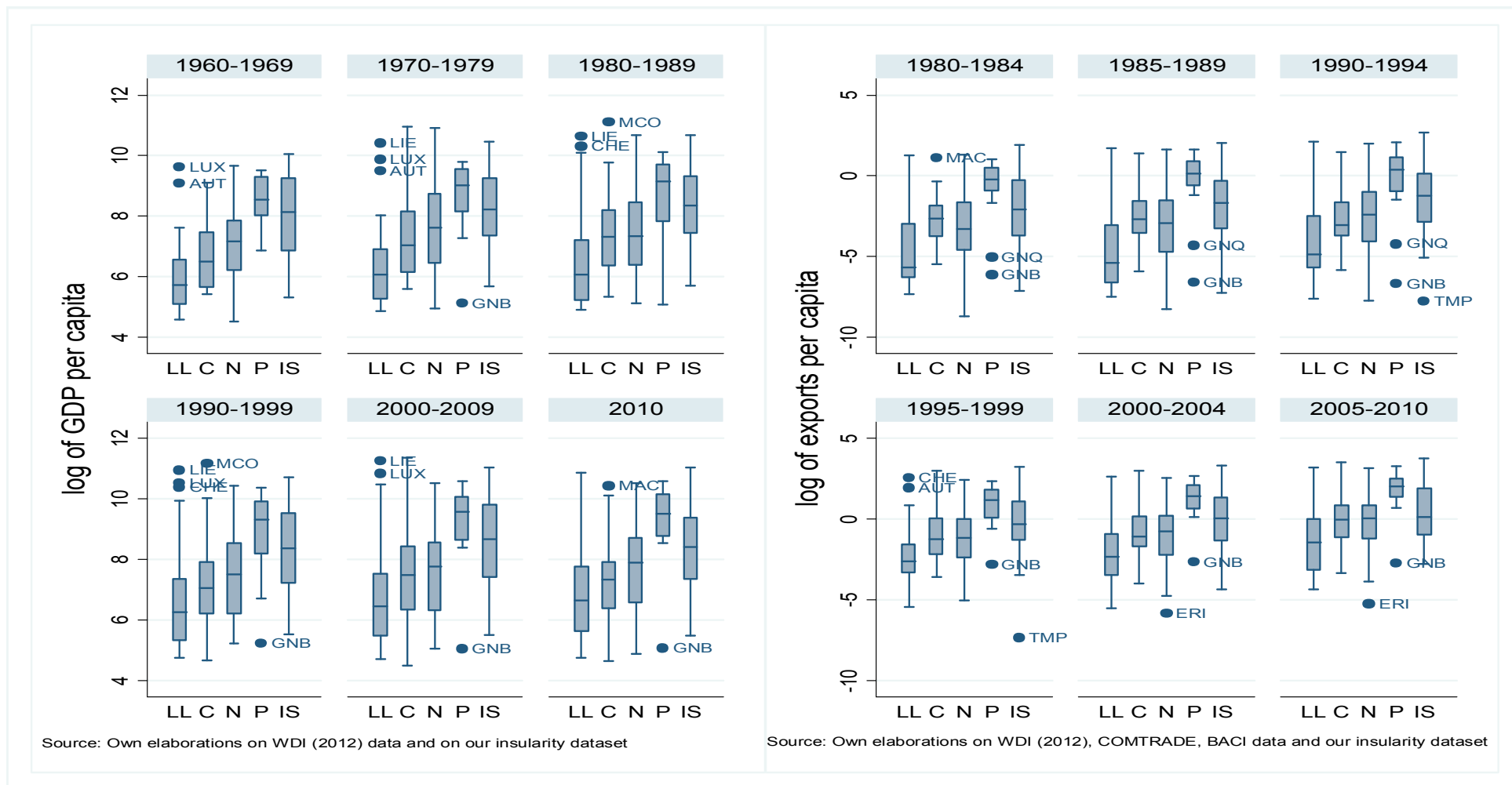
different conditions of insularity. We distinguish four groups of national states: landlocked, coastal countries (which do not have islands), countries with negligible insularity (a share of land in islands which is less than 2%), countries with have islands (what we call partial insularity, where at least 2% of total land is on islands; maximum value in our group is 60%, Malaysia) and island-states. While in the literature the main distinction is between landlocked and coastal countries, our idea is to distinguish within coastal countries group, according to the degree of insularity (none, negligible and partial) and to consider separately states which are islands. Graph 1 compares level of GDP per capita and level of exports per capita across the various groups; the table below reports number of countries in each group, in each time period according to data availability. GDP data are from the World Development Indicators (2012) while values of exports are from BACI database, but to compute exports per capita we used the information about population included in the WDI.

As already clear in the literature, countries performance improves when we switch from landlocked countries (i.e. zero level of insularity and no access to sea) to coastal economies. Some more facts are worth noticing: 1. looking at the median, within the heterogeneous group of coastal countries, economies which have islands perform better; 2. being an island is associated with lower trade than income (island-states are the group with the lowest trade levels); 3. dispersion in income distribution is quite high across all groups except countries with partial insularity; when looking at trade island-states show the greatest distribution spread; 4. there is a clear and evident time persistence in the shape of the distribution of distributions.

The statistical significance of our descriptive evidence is tested by performing a two sample Kolmogorov-Smirnov test. The test is a non-parametric test: by making non assumption about the distribution of data tries to determine if two groups compared differ significantly. The null hypothesis is that the two distributions belong to the same distribution, in other words are not statistically different. The alternative hypothesis is separated in two possibilities: if GDP or exports (per capita) for group 1 contains smaller values than for group 2 or the contrary.

Results of the test applied to both the distribution of per capita income and per capita exports confirm that the condition of being landlocked is the worst situation. Table 4, which reports test results on GDP per capita, shows that countries with a part of their territory on islands do better than the others: little by little that insularity decrease GDP level goes down. The ranking is $P > IS > N > C > LL$: when insularity level increases GDP increases, but to have just a part of the territory on island is better than have the 100%. In terms of exports per capita too, the landlocked condition is associated to a lower distribution. From table 5 we obtain a different ranking: $P > N > IS > C > LL$. Table 6 and 7 compare distributions relating to the same group over the years. In most cases we don't find statistically differences, but when we find them the previous value is always smaller.

Graph 1 - Level of GDP per capita and level of exports per capita (where: LL=landlocked; C=coastal; N=negligible; P=partial; IS= island-state)



	LEVEL OF GDP PER CAPITA						LEVEL OF EXPORTS PER CAPITA					
	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009	2010	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2010
LL	18	20	31	36	36	35	21	21	32	32	32	32
C	23	28	33	37	38	33	28	29	35	35	35	34
N	33	35	44	51	51	47	50	50	54	54	54	54
P	11	12	14	16	16	15	14	14	14	16	16	16
IS	22	36	46	53	54	43	50	50	54	54	56	56

Table 4 - Kolmogorov-Smirnov test on level of GDP: comparing groups in the same decade

			1960 -1969	1970-1979	1980-1989	1990-1999	2000-2009	2010
LL	COMPARED TO	C	<	<	<	<	<	n.s.d.
LL		N	<	<	<	<	<	<
LL		P	<	<	<	<	<	<
LL		IS	<	<	<	<	<	<
C		N	<	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
C		P	<	<	<	<	<	<
C		IS	<	<	<	<	<	<
N		P	<	<	<	<	<	<
N		IS	<	n.s.d.	<	<	<	n.s.d.
P		IS	n.s.d.	n.s.d.	n.s.d.	n.s.d.	>	>

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012) and our insularity dataset

Table 5 - Kolmogorov-Smirnov test on level of exports: comparing groups in the same period

			1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2010
LL	COMPARED TO	C	<	<	<	<	<	<
LL		N	<	<	<	<	<	<
LL		P	<	<	<	<	<	<
LL		IS	<	<	<	<	<	<
C		N	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
C		P	<	<	<	<	<	<
C		IS	n.s.d.	n.s.d.	<	<	<	n.s.d.
N		P	<	<	<	<	<	<
N		IS	n.s.d.	>	>	>	n.s.d.	n.s.d.
P		IS	>	>	>	>	>	>

where n.s.d.=not statistically different

Source: Own elaborations on WDI (2012), COMTRADE, BACI and on our insularity dataset

Table 6 - Kolmogorov-Smirnov test on level of GDP: comparing the same group over the decades

			LL	C	N	P	IS
1960-1969	COMPARED TO	1970-1979	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1960-1969		1980-1989	n.s.d.	<	n.s.d.	n.s.d.	n.s.d.
1960-1969		1990-1999	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1960-1969		2000-2009	n.s.d.	<	n.s.d.	<	n.s.d.
1960-1969		2010	n.s.d.	n.s.d.	<	<	n.s.d.
1970-1979		1980-1989	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1970-1979		1990-1999	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1970-1979		2000-2009	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1970-1979		2010	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1980-1989		1990-1999	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1980-1989		2000-2009	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1980-1989		2010	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1990-1999		2000-2009	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1990-1999		2010	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
2000-2009		2010	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012) and our insularity dataset

Therefore we can verify if groups distributions were statistically different from each other (test across groups, table 4 and table 5) and if the same distribution has changed over the decades or every five years (test across periods, table 6 and table 7). We indicate with the sign < and with the sign > if the distribution of the group or of the time period on the left column is respectively smaller/larger than the distribution of the group on the right side; n.s.d. denotes that the distributions of the two groups or of the two time periods are not statistically different.

Table 7 - Kolmogorov-Smirnov test on level of exports: comparing the same group over the periods

		LL	C	N	P	IS	
1980-1984	COMPARED TO	1985-1989	n.s.d.	n.s.d.	n.s.d.	n.s.d.	
1980-1984		1990-1994	n.s.d.	n.s.d.	n.s.d.	n.s.d.	
1980-1984		1995-1999	<	<	<	<	<
1980-1984		2000-2004	<	<	<	<	<
1980-1984		2005-2010	<	<	<	<	<
1985-1989		1990-1994	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1985-1989		1995-1999	<	<	<	n.s.d.	<
1985-1989		2000-2004	<	<	<	<	<
1985-1989		2005-2010	<	<	<	<	<
1990-1994		1995-1999	<	<	<	n.s.d.	<
1990-1994		2000-2004	<	<	<	<	<
1990-1994		2005-2010	<	<	<	<	<
1995-1999		2000-2004	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
1995-1999		2005-2010	<	<	<	<	<
2000-2004		2005-2010	n.s.d.	n.s.d.	<	n.s.d.	n.s.d.

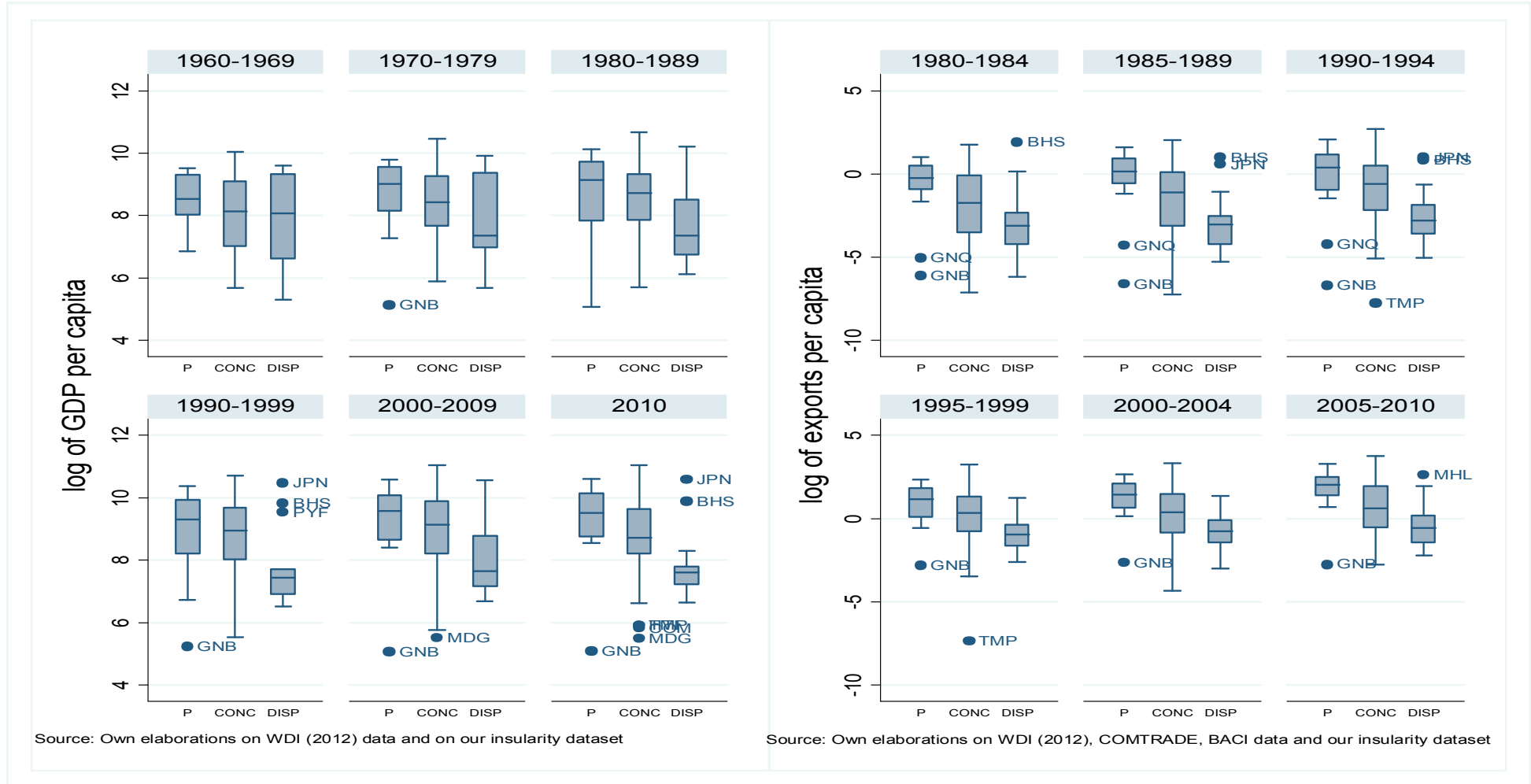
where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012), COMTRADE, BACI and on our insularity dataset

In the following graph we compare partial insularity with island-states using definition related to the dispersion of the land.¹⁵ We define an island-state as concentrated when its territory is composed by 4.56 (GDP) or 4.70 (exports) islands or less, and we classify it as dispersed when its territory is divided in more than 4.56 (4.70) islands. Both for GDP per capita level and for exports per capita level, having a land dispersed in more islands represents a disadvantage, except for Japan which is an outlier. Furthermore, partial insularity is always a better status than to be an island-state: overlooking the sea and having not negligible islands represents an advantage and it is associated to a better condition. Kolmogorov-Smirnov test across groups show us that for GDP level, especially in first decades, there are not statistically differences between a condition of partial insularity and to be a concentrated island-state, but when we compare dispersed island states with partial and with concentrated island-states, we notice that dispersed and fragmented territories do worse (table 8). For exports volumes we can see that the partial group has always a larger distribution than island-states group, even if in some periods partial and concentrated are not statistically different; but, within the island-states group the concentrated have a bigger distribution than the dispersed (table 9). Table 10 and 11 test whether distributions have changed in time: concentrated island-states show an improvement in the whole distribution when we look at exports per capita.

¹⁵ As said above, statistics here used to calculate the more concentrated and the more dispersed island-states take into account the reduced samples, i.e. the countries for which we have both insularity and performance (GDP or exports) information. Results do not change if threshold values used are the ones calculated for the all sample and presented in Tables 3.

Graph 2 - Level of GDP per capita and level of exports per capita (where: P=partial, CONC=not dispersed island-states, DISP=dispersed island-states)



	LEVEL OF GDP PER CAPITA						LEVEL OF EXPORTS PER CAPITA					
	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009	2010	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2010
P	11	12	14	16	16	15	14	14	16	16	16	16
CONC	16	28	34	38	38	29	37	37	38	38	40	40
DISP	6	8	12	15	16	14	13	13	16	16	16	16

Table 8- Kolmogorov-Smirnov test on level of GDP: comparing groups in the same decade

			1960 -1969	1970-1979	1980-1989	1990-1999	2000-2009	2010
P	COMPARED TO	CONC	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.	>
P		DISP	n.s.d.	n.s.d.	>	>	>	>
CONC		DISP	n.s.d.	>	>	>	>	>

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012) and our insularity dataset

Table 9 - Kolmogorov-Smirnov test on level of exports: comparing groups in the same period

			1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2010
P	COMPARED TO	CONC	>	n.s.d.	n.s.d.	n.s.d.	n.s.d.	>
P		DISP	>	>	>	>	>	>
CONC		DISP	>	>	>	>	>	n.s.d.

where n.s.d.= not statistically different

Source: Own elaborations on WDI(2012), COMTRADE, BACI and our insularity dataset

Table 10 - Kolmogorov-Smirnov test on level of GDP: comparing the same group over the decades

			CONC	DISP
1960-1969	COMPARED TO	1970-1979	n.s.d.	n.s.d.
1960-1969		1980-1989	n.s.d.	n.s.d.
1960-1969		1990-1999	n.s.d.	n.s.d.
1960-1969		2000-2009	<	n.s.d.
1960-1969		2010	n.s.d.	n.s.d.
1970-1979		1980-1989	n.s.d.	n.s.d.
1970-1979		1990-1999	n.s.d.	n.s.d.
1970-1979		2000-2009	n.s.d.	n.s.d.
1970-1979		2010	n.s.d.	n.s.d.
1980-1989		1990-1999	n.s.d.	n.s.d.
1980-1989		2000-2009	n.s.d.	n.s.d.
1980-1989		2010	n.s.d.	n.s.d.
1990-1999		2000-2009	n.s.d.	n.s.d.
1990-1999		2010	n.s.d.	n.s.d.
2000-2009		2010	n.s.d.	n.s.d.

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012) and our insularity dataset

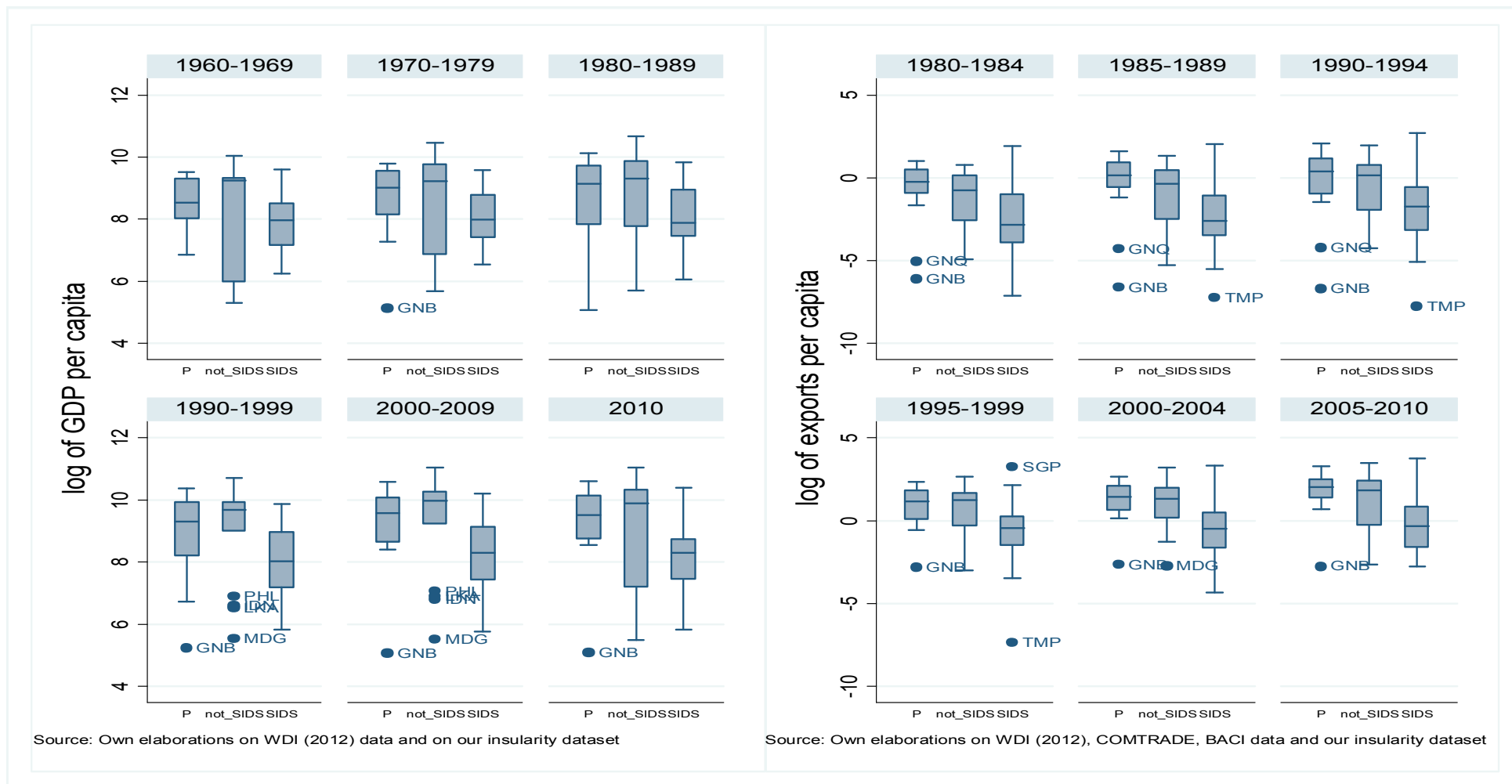
Table 11 - Kolmogorov-Smirnov test on level of exports: comparing the same group over the periods

			CONC	DISP
1980-1984	COMPARED TO	1985-1989	n.s.d.	n.s.d.
1980-1984		1990-1994	n.s.d.	n.s.d.
1980-1984		1995-1999	<	<
1980-1984		2000-2004	<	<
1980-1984		2005-2010	<	<
1985-1989		1990-1994	n.s.d.	n.s.d.
1985-1989		1995-1999	<	<
1985-1989		2000-2004	<	<
1985-1989		2005-2010	<	<
1990-1994		1995-1999	<	<
1990-1994		2000-2004	<	<
1990-1994		2005-2010	<	<
1995-1999		2000-2004	n.s.d.	n.s.d.
1995-1999		2005-2010	n.s.d.	n.s.d.
2000-2004		2005-2010	n.s.d.	n.s.d.

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012), COMTRADE, BACI and on our insularity dataset

Graph 3 - Level of GDP per capita and level of exports per capita (where: P=partial; SIDS=SIDS island-states; not_SIDS=not SIDS island-states)



	LEVEL OF GDP PER CAPITA						LEVEL OF EXPORTS PER CAPITA					
	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009	2010	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2010
P	11	12	14	16	16	15	14	14	16	16	16	16
SIDS	13	21	30	36	36	31	33	33	37	37	39	39
not SIDS	9	15	16	17	18	12	17	17	17	17	17	17

Table 12 - Kolmogorov-Smirnov test on level of GDP: comparing groups in the same decade

			1960 -1969	1970-1979	1980-1989	1990-1999	2000-2009	2010
P	COMPARED TO	SIDS	n.s.d.	n.s.d.	>	>	>	>
P		Not_SIDS	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
SIDS		Not_SIDS	n.s.d.	<	<	<	<	<

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012) and our insularity dataset

Table 13 - Kolmogorov-Smirnov test on level of exports: comparing groups in the same period

			1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2010
P	COMPARED TO	SIDS	>	>	>	>	>	>
P		Not_SIDS	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.	n.s.d.
SIDS		Not_SIDS	<	<	<	<	<	<

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012), COMTRADE, BACI and our insularity dataset

Table 14 - Kolmogorov-Smirnov test on level of GDP: comparing the same group over the decades

			SIDS	Not SIDS
1960-1969	COMPARED TO	1970-1979	n.s.d.	n.s.d.
1960-1969		1980-1989	n.s.d.	n.s.d.
1960-1969		1990-1999	n.s.d.	<
1960-1969		2000-2009	n.s.d.	<
1960-1969		2010	n.s.d.	n.s.d.
1970-1979		1980-1989	n.s.d.	n.s.d.
1970-1979		1990-1999	n.s.d.	n.s.d.
1970-1979		2000-2009	n.s.d.	<
1970-1979		2010	n.s.d.	n.s.d.
1980-1989		1990-1999	n.s.d.	n.s.d.
1980-1989		2000-2009	n.s.d.	n.s.d.
1980-1989		2010	n.s.d.	n.s.d.
1990-1999		2000-2009	n.s.d.	n.s.d.
1990-1999		2010	n.s.d.	n.s.d.
2000-2009		2010	n.s.d.	n.s.d.

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012) and our insularity dataset

Table 15 - Kolmogorov-Smirnov test on level of exports: comparing the same group over the periods

			SIDS	Not SIDS
1980-1984	COMPARED TO	1985-1989	n.s.d.	n.s.d.
1980-1984		1990-1994	n.s.d.	n.s.d.
1980-1984		1995-1999	<	<
1980-1984		2000-2004	<	<
1980-1984		2005-2010	<	<
1985-1989		1990-1994	n.s.d.	n.s.d.
1985-1989		1995-1999	<	<
1985-1989		2000-2004	<	<
1985-1989		2005-2010	<	<
1990-1994		1995-1999	<	<
1990-1994		2000-2004	<	<
1990-1994		2005-2010	<	<
1995-1999		2000-2004	n.s.d.	n.s.d.
1995-1999		2005-2010	n.s.d.	<
2000-2004		2005-2010	n.s.d.	n.s.d.

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012), COMTRADE, BACI and on our insularity dataset

In Graph 3 we distinguish between three different types of insularity: partial insularity, SIDS island-states and other island-states. Not all SIDS are island-states, there are four country that are not islands. SIDS countries are considered a separate group in the literature since their peculiar condition.¹⁶ Without surprise (graph 3) the not SIDS group has on average a better performance than SIDS both if we look at the GDP level or at the exports level. When moving to tests, we find that distributions in GDP level (table 12) and for exports level (table 13) for countries with a condition of partial insularity and island-states which are not SIDS are not statistically different, but both groups have a bigger distribution than SIDS island-states. In table 14 and in table 15 we compute K-S test across periods: there are not statistical differences in GDP, but when we find them previous value is always smaller than subsequent; for exports per capita differences across periods are more frequent.

In order to gain more insight on extreme geographic conditions, we compare landlocked countries and more isolated islands: we have four different comparison depending on whether we look at GDP / exports in levels or growth rates. In our reduced insularity-performance datasets we define an island-state as more isolated when it has an isolation index higher than 65 (for GDP) or 73.73 (for exports). This values identify the upper quartile of the isolation index distribution across island states.¹⁷ Since the specific attention given to landlocked countries in the literature our questions is whether the condition of remoteness of some island-states is analogous to the landlocked status. As said in the introduction, both empirical and theoretical literature argue that the most immediate case of 'bad' geography is not having a direct access to the sea, being landlocked. Our goal is to understand if the sub-group of isolated island-states behave differently from the landlocked countries group.

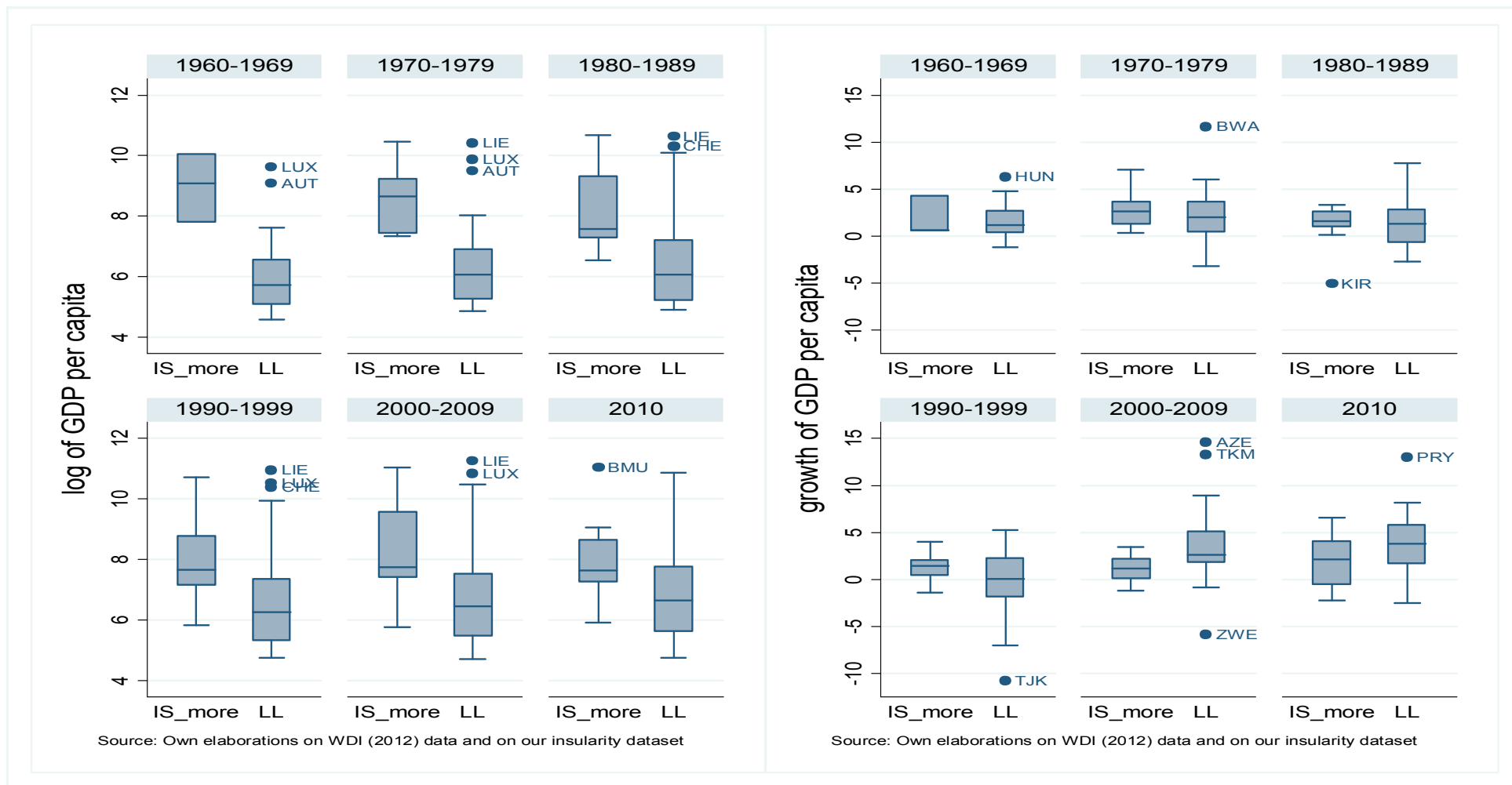
Graph 4 (left hand side) shows that for GDP level to be a landlocked country is ever a worse condition than to be an isolated island. First row of table 16 confirms that landlocked group distribution is smaller. When we look at GDP growth (right hand side of graph 4) it seems that landlocked countries grow more than island states; second row of table 16 tell us that the two distributions are not statistically different. Performing the test across periods we find for GDP a not statistical difference in distributions (table 18).

Results are similar when studying exports per capita levels. When we look at exports growth (right hand side of graph 5) outliers are influencing distributions for all groups. It's not clear which is the best status: to be landlocked seems to imply a similar growth rate than isolated island-states but landlocked group has more countries which perform as outliers; the second row of table 17 shows that distributions in some periods are not different and when different landlocked is smaller. Table 18 reports tests across periods: previous values are smaller than subsequent.

¹⁶ SIDS have to face further challenges in addition to the island-state condition, like sustainable development, growing population, limited resources, remoteness, susceptibility to natural disasters, vulnerability to external shocks, excessive dependence on international trade, fragile environments, high communication, energy and transportation costs, irregular international transport volumes, disproportionately expensive public administration and infrastructure (<http://www.unohrlls.org/en/sids/43>).

¹⁷ Changing the threshold (using, for example, mean or median) things don't change and we obtain the same results reported in graph 4 and in graph 5.

Graph 4 - Level and growth of GDP per capita (where: IS_more= more isolated island-states; LL=landlocked)

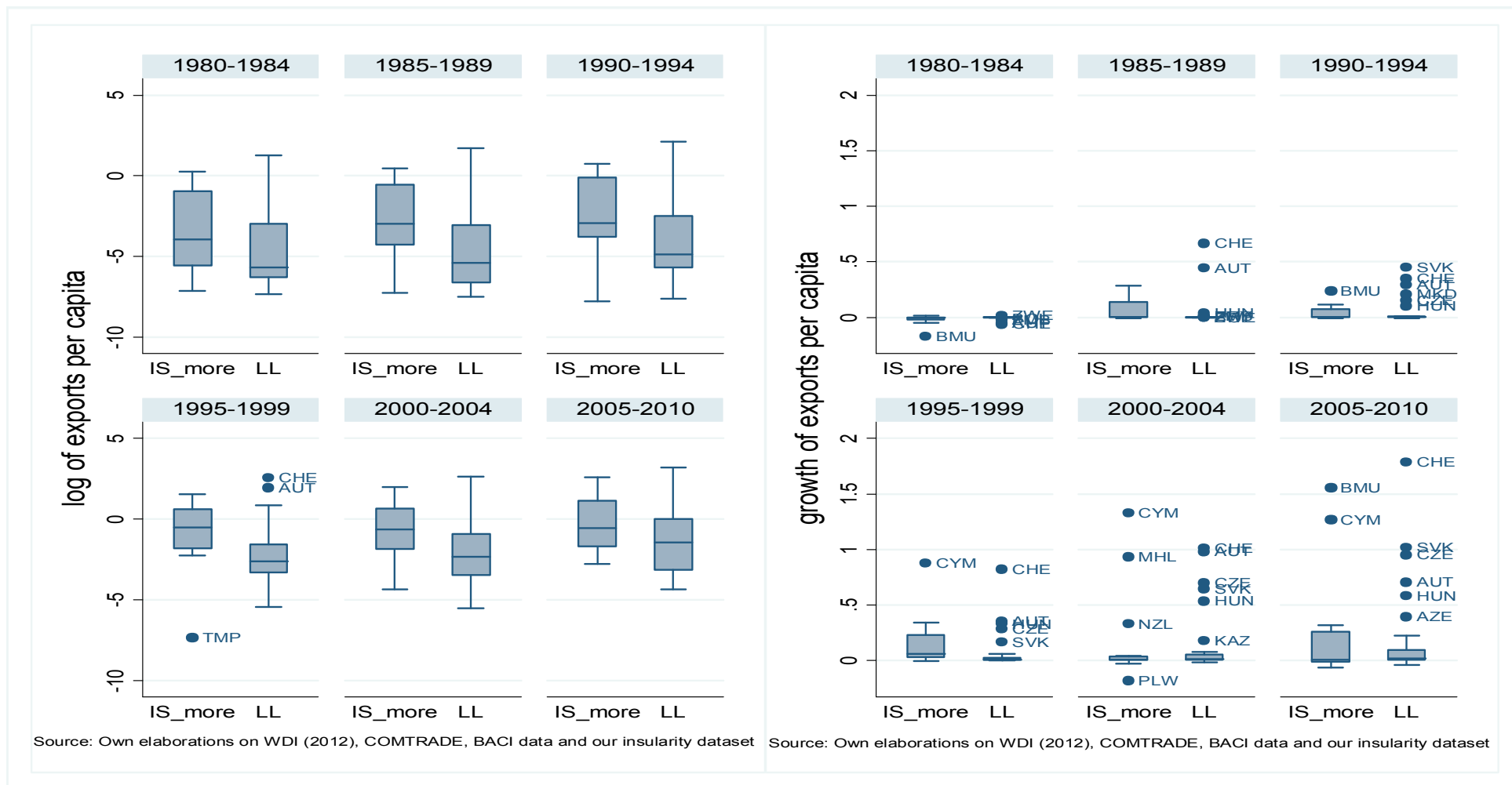


Source: Own elaborations on WDI (2012) data and on our insularity dataset

Source: Own elaborations on WDI (2012) data and on our insularity dataset

	LEVEL OF GDP PER CAPITA						GROWTH OF GDP PER CAPITA					
	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009	2010	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009	2010
LL	18	20	31	36	36	35	18	20	31	36	37	36
IS_more	3	6	10	14	15	12	3	7	11	14	14	12

Graph 5 - Level and growth of exports per capita (where: IS_more=more isolated island-state; LL=landlocked)



	LEVEL OF EXPORTS PER CAPITA						GROWTH OF EXPORTS PER CAPITA					
	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2010	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2010
LL	21	21	32	32	32	32	21	21	32	32	32	32
IS_more	11	10	14	14	16	16	10	10	14	14	16	16

Table 16 - Kolmogorov-Smirnov test on level and growth of GDP: comparing groups in the same decade

				1960-1969	1970-1979	1980-1989	1990-1999	2000-2009	2010
level of GDP	LL	COMPARED TO	IS_more	<	<	<	<	<	<
growth of GDP				n.s.d.	n.s.d.	n.s.d.	<	>	n.s.d.

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012) and our insularity dataset

Table 17 - Kolmogorov-Smirnov test on level and growth of exports: comparing groups in the same period

				1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2010
level of exports	LL	COMPARED TO	IS_more	n.s.d.	<	<	<	<	n.s.d.
growth of exports				n.s.d.	n.s.d.	n.s.d.	<	n.s.d.	n.s.d.

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012), COMTRADE, BACI and our insularity dataset

Table 18 - Kolmogorov-Smirnov test on level and growth of GDP: comparing the same group over the decades

			IS_more	
			level of GDP	growth of GDP
1960-1969	COMPARED TO	1970-1979	n.s.d.	n.s.d.
1960-1969		1980-1989	n.s.d.	n.s.d.
1960-1969		1990-1999	n.s.d.	n.s.d.
1960-1969		2000-2009	n.s.d.	n.s.d.
1960-1969		2010	n.s.d.	n.s.d.
1970-1979		1980-1989	n.s.d.	n.s.d.
1970-1979		1990-1999	n.s.d.	n.s.d.
1970-1979		2000-2009	n.s.d.	n.s.d.
1970-1979		2010	n.s.d.	n.s.d.
1980-1989		1990-1999	n.s.d.	n.s.d.
1980-1989		2000-2009	n.s.d.	n.s.d.
1980-1989		2010	n.s.d.	n.s.d.
1990-1999		2000-2009	n.s.d.	n.s.d.
1990-1999		2010	n.s.d.	n.s.d.
2000-2009		2010	n.s.d.	n.s.d.

where n.s.d.= not statistically different

Source: Own elaborations on WDI (2012) and our insularity dataset

Table 19 - Kolmogorov-Smirnov test on level and growth of exports: comparing the same group over the periods

			IS_more	
			level of exports	growth of exports
1980-1984	COMPARED TO	1985-1989	n.s.d.	n.s.d.
1980-1984		1990-1994	n.s.d.	n.s.d.
1980-1984		1995-1999	<	<
1980-1984		2000-2004	<	<
1980-1984		2005-2010	<	<
1985-1989		1990-1994	n.s.d.	n.s.d.
1985-1989		1995-1999	<	<
1985-1989		2000-2004	n.s.d.	n.s.d.
1985-1989		2005-2010	<	n.s.d.
1990-1994		1995-1999	<	<
1990-1994		2000-2004	<	n.s.d.
1990-1994		2005-2010	<	n.s.d.
1995-1999		2000-2004	n.s.d.	>
1995-1999		2005-2010	n.s.d.	>
2000-2004		2005-2010	n.s.d.	n.s.d.

where n.s.d.= not statistically different

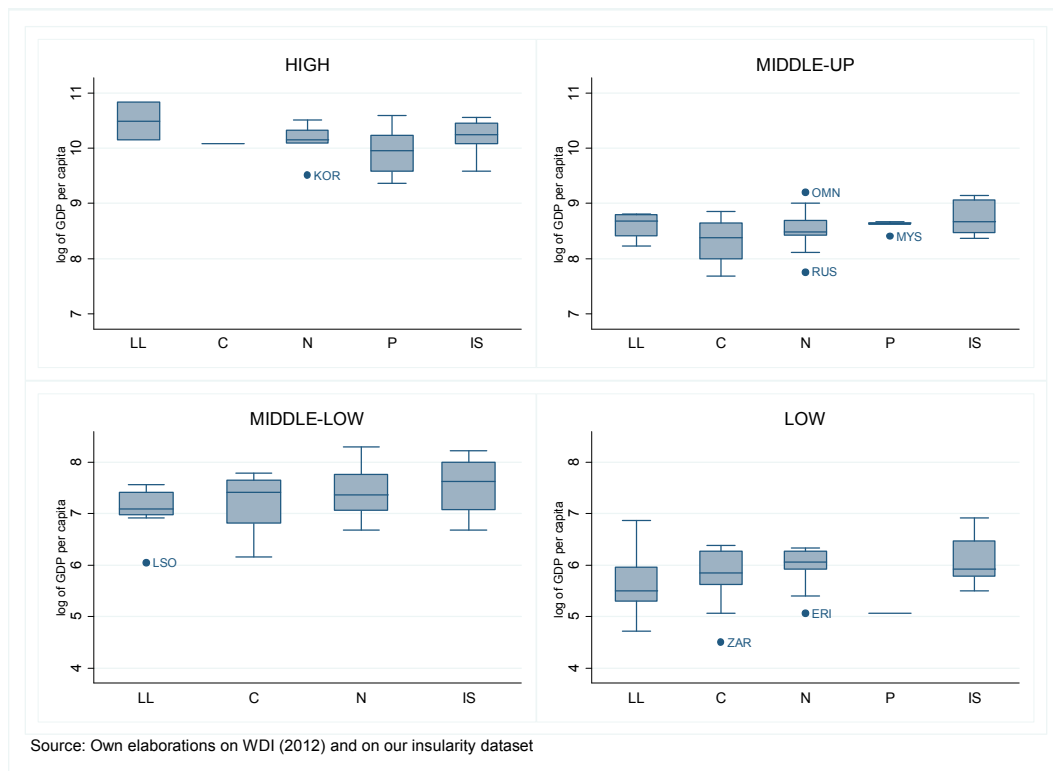
Source: Own elaborations on WDI (2012), COMTRADE and BACI dataset and on our insularity dataset

Our evidence would suggest that the condition of isolated island-state is similar to landlocked status: there are not great differences between to be a dispersed and isolated island-state and a country without sea overlooking; both are conditions of bad geography even if to a be a landlocked country is ever a worse condition.

4.2 Sensitivity analysis: subgrouping by World Bank income category

Results above illustrated would suggest a clear pattern in income and trade distributions' across groups of countries distinguished by the geography linked to their insularity condition. The natural question is whether our grouping is exactly capturing grouping in income categories. We use the last World Bank income category which classifies economies in the world as high income, upper-middle income, lower-middle income and low income.¹⁸ Is bad geography still important when income starts to grow? Geography matters with high level of income? In fact, as seen in previous boxplots, outliers for landlocked countries and island-states are countries with high income levels: Switzerland and Liechtenstein for landlocked group, Japan for island-states group.

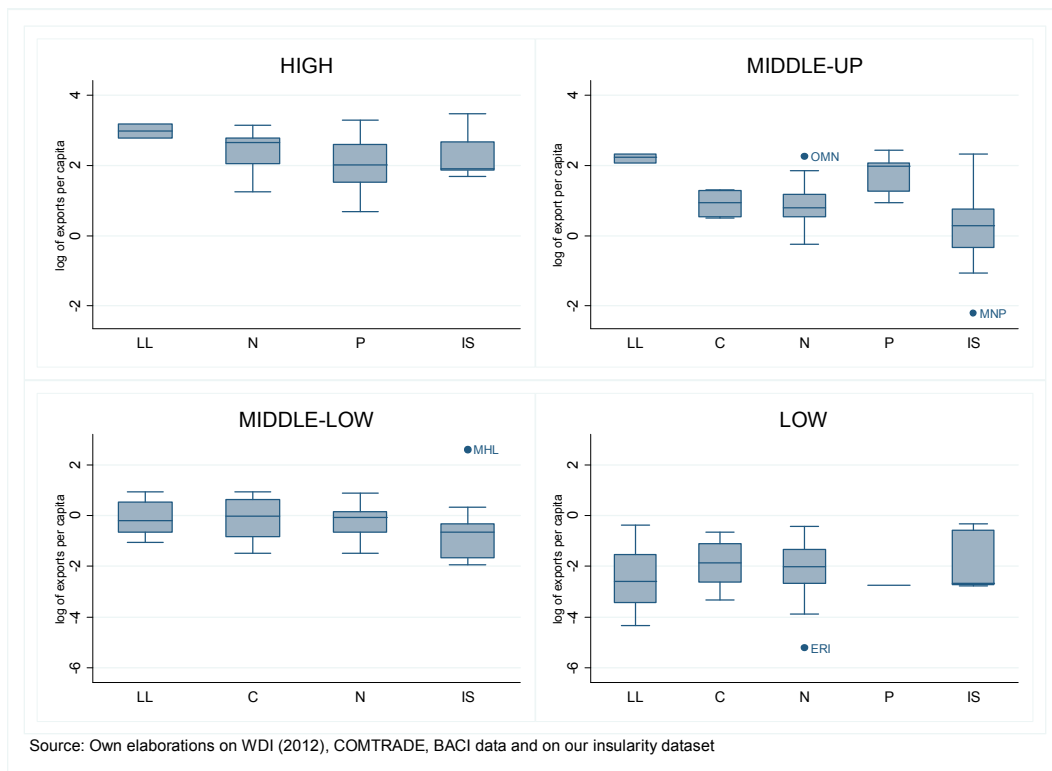
Graph 6 - Level of GDP per capita, period 2000-2009 (LL, C, N, P, IS)



Since World Bank income category refers, in our insularity dataset, to 2006, we take into account for GDP the decade 2000-2009 and for exports the period 2005-2010. As we can see from graphs 6 and 7, for high level of income geography lose its importance: all groups have close mean values to each other; unfortunately groups have not the same number of observations. When we look at low income countries geography matters and is relevant in performance.

¹⁸ For operational and analytical purposes, the World Bank's main criterion for classifying economies is gross national income (GNI) per capita. Based on its GNI per capita, every economy is classified as low income, middle income (subdivided into lower middle and upper middle), or high income (Source: <http://data.worldbank.org/about/country-classifications>). Countries with a GNI per capita above 10,725\$ were classified, in 2006, as "high income countries". For "low income countries" the threshold was under 876\$. Finally, if GNI per capita was included between 3,466\$ and 10,725\$ or between 876\$ and 3,465\$ the country was classified respectively as "upper-middle income country" and "lower-middle income country".

Graph 7 - Level of exports per capita, period 2005-2010 (LL, C, N, P, IS)



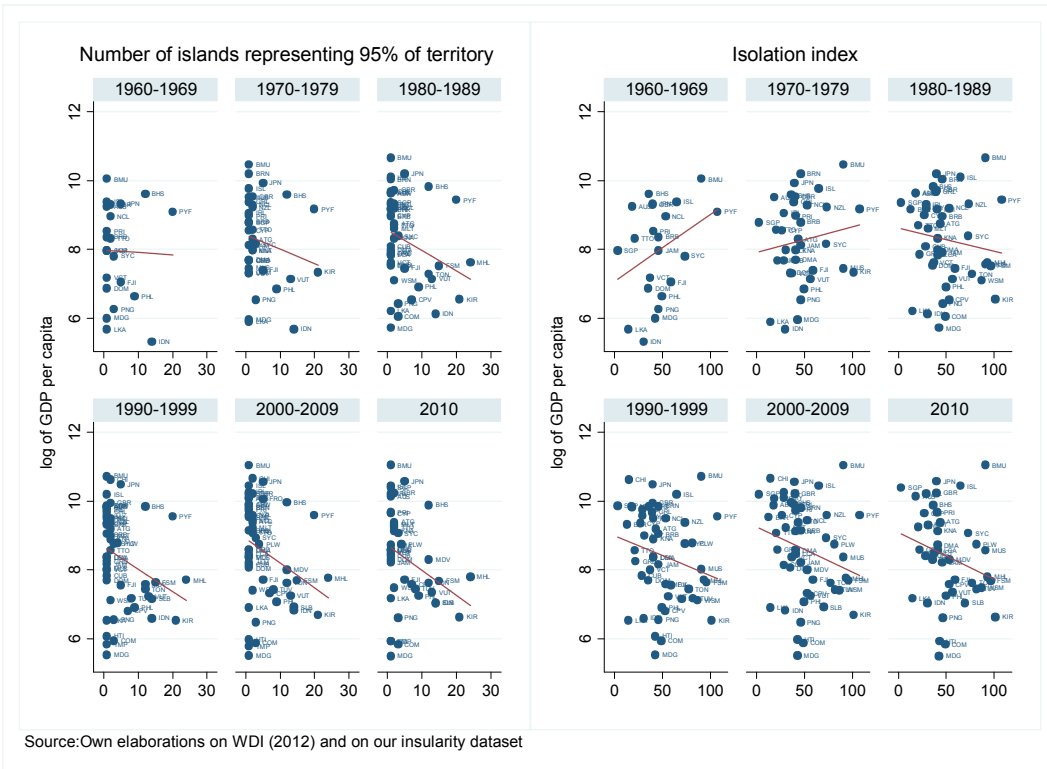
4.3 What matters in the full insularity condition?

What is the crucial issue with insularity? The evidence we provide is that islands are not the same. Clearly some do better than others. Previous descriptive would suggest that from the point of view of a country being an island is worse than having islands. In order to pick up the heterogeneity across insular states we used both definitions already used in the literature (SIDS) and we also tried to isolate characteristics which exacerbate the insular state. If being surrounded by the sea implies a higher cost for smaller economies, than having a land dispersed in many islands should be associated with higher costs. If instead the cost of being insular is linked to the remoteness status than a measure of isolation should work better.

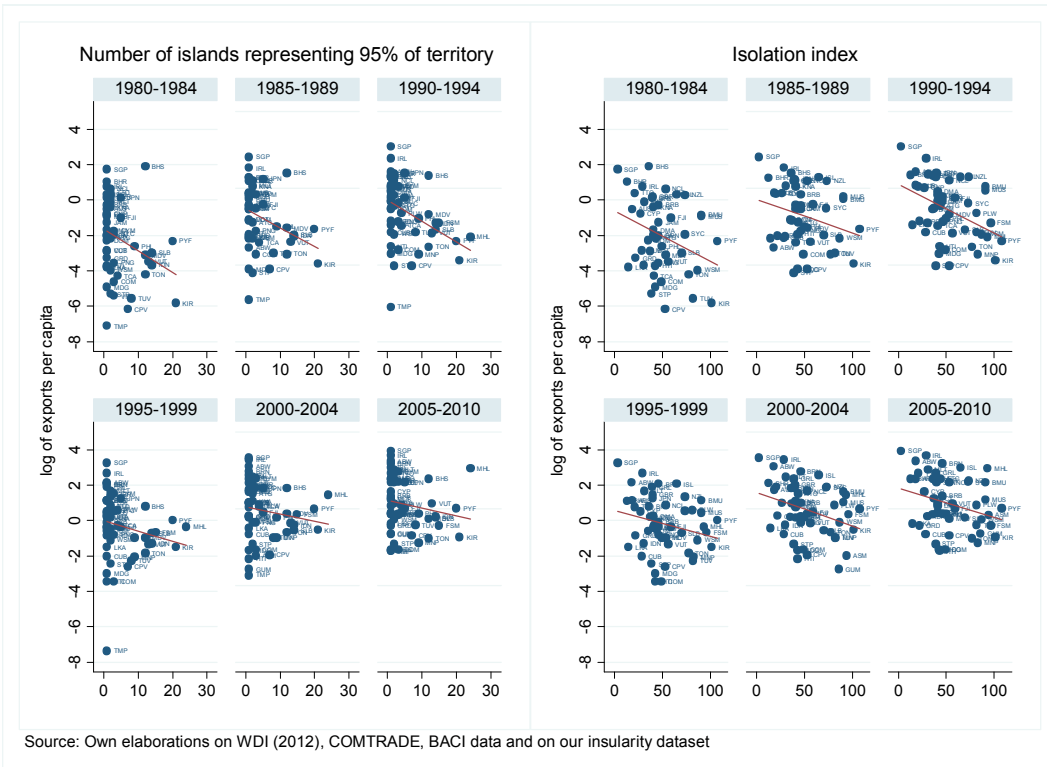
The following scatter graphs put together both measures with GDP per capita and trade. Simple correlations, as in graphs 8 and 9, would point for both aspects to be negatively correlated with both income and exports per capita. Things have also changed in time, in early years the characteristics linked to insularity we have chosen were associated to better performance but over time they started to negative effect. It is also true that for early decades data were not available. Such clear negative correlation is instead not evident when a simple measure of size (such as land area) is used. Same findings when we look at exports level (graph 9): insularity conditions linked to the dispersion of the land and more with the 'level' of remoteness produce in all periods a negative effect on trade. When this conditions are met, insularity can become a disadvantage for the country.¹⁹

¹⁹ When we look at GDP growth (graph 10) the negative effect is confirmed: insularity condition inhibits countries grow in all decades. For trade growth the effect is not so clear: in the first period is negative, then it became positive, in early Nineties is again negative, but from 1995 it assumes a positive sign. When we distinguish island states into archipelagos and SIDS results found with island states are confirmed: insularity has changed its effects over the years and tends to have a negative impact on performance. See Appendix D.

Graph 8 - Level of GDP per capita, dispersion measure and isolation index



Graph 9 - Level of exports per capita, dispersion measure and isolation index



5. CONCLUSIONS

There is an evident case of bad geography for countries which have no direct access to the sea. This paper provides novel evidence both on measures of insularity and the way they are related to main economic performance indicators. Starting from the basic information on number of islands and percentage of land on island we have constructed different measures aimed to capture the heterogeneity of the insular condition. If it is the case that the complete discontinuity of the land imposes a cost (limiting the connectivity with other countries) an increase in the number of islands raises costs. A second dimension which increases costs is distance. Therefore we consider the dispersion of the land in more than one island and a measure of their remoteness with respect to either the nearest mainland or the nearest other islands. These two dimensions can be used to order countries according to their degree of insularity. Putting the two dimensions together the world appears divided in three groups of countries: fully insular (island-states); partially insular and not insular.

The first critical dichotomy is between countries (as national states) which are islands and countries which have islands. In the first case islands are a country in the second they are regions, or smaller territorial unit, belonging to a country. Within the group of island-states we aim at focusing the critical dimension with the insularity condition. According to the literature three dimensions concur to the economic fragility associated to the insular condition: smallness, remoteness and vulnerability. In this work we check on the dispersion of the territory (which is connected to size, the more dispersed the territory in many islands the smallest the average size) and on the remoteness with respect to the nearest land (isolation). Our results would suggest that the last point being the critical one. Island-states which are more isolated perform in a similar way to landlocked countries.

Countries which have islands (but are not islands) are instead a small group of all economies in the world. Their limited number is outweighed by a bigger share in terms of income. When looking at the distribution of income and trade within this small number of countries it is quite clear their better performance within the wide group of coastal countries. Our first results would suggest that it is this smaller sample of economies to cheer up the fortunes of coastal countries. They do better than countries with null or negligible degree of insularity when looking both at the distribution of per capita income and the size of trade.

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Appendix A: Sources of data and insularity dataset creation

In order to build our insularity dataset we used mainly two sources of data:

- WorldIslandInfo;
- Unep

The WorldIslandInfo website (<http://www.worldislandinfo.com/>) is an attempt to provide the most accurate information on the world's islands. Thousands of maps, reference works, books, web sites, and articles have informed its creation. As sources routinely contradict each other, this forced to judge their accuracy with, approximately, the following weights:

1. detailed topographic maps, photos, visits;
2. official mapping, statistical agencies;
3. high-credibility reference sources (e.g., Encyclopedia Britannica), scientific articles;
4. journalism and high-quality travel reference (e.g., Moon and Lonely Planet);
5. popular books and television;
6. informal sources on the Internet and Web, and interviews.

The website provides several information about 475 islands for a total of 187 countries, divided into different sections, like:

- principal world islands and groups (not distinguished by country);
- 100 largest islands in the world, largest islands by continent;
- list of main islands for each country (with name and area in squared km or squared miles). This list includes just one island (the biggest and the most important) for each country;
- focus for selected countries (Australia, Canada, Chile, Indonesia, New Zealand, Russia, United Kingdom, United States). The focus lists the most important islands for each country mentioned above.

The Unep source belongs to the website <http://islands.unep.ch/>. It's a compilation of geographic, environmental, and socio-economic information on some 2000 islands and over 150 countries, territories and administrative units with islands developed by UNEP (United Nations Environment Programme). The islands coverage is very uneven: some regions and groups are covered in some detail, while others are characterized by a deficiency in the available data. This web site provides several data and information about islands by country, like:

- number of islands;
- islands' area;
- isolation index;
- coastal index;
- threat index;
- sea level rise risk;

Data and information are organized in several sections, like: islands by country, alphabetical indexes of islands, islands by land area, islands by altitude, islands by ocean.

Isolation, coastal and threat index provide useful information about islands ranking them by a specific geographical feature.

The isolation index is defined as the square roots of the distances to the nearest equivalent or larger island, the nearest island group or archipelago and the nearest continent are added to give an index of isolation. Where one of these do not exist, the next higher distance is repeated, except in the case of small satellite islands close to much larger land masses (Source: <http://islands.unep.ch/indicat.htm#Isolation>).

The coastal index is the length of the shoreline divided by the land area. Such information is available for a smaller number of islands (Source: [http://islands.unep.ch/indicat.htm#Coastal Index](http://islands.unep.ch/indicat.htm#CoastalIndex)). We have not used this index.

The threat index is the measure of the risk of natural or human catastrophes that could threaten human welfare, seriously damage the economy, and endanger endemic species or protected areas, thus increasing the importance of adequate conservation action (scale: 0 to 6). One point is given for each of the major categories of large scale catastrophic threats to the island environment: cyclones (hurricanes or typhoons), volcanic eruptions, earthquakes, tsunamis (tidal waves), landslides, severe drought, susceptibility to major fires, high risk of oil spills. (Source: <http://islands.unep.ch/indicat.htm#Vulnerability>). We have not used this index.

We used, also, even if partially, Worldatlas source. The web site <http://www.worldatlas.com/> provides several geographical information and data about islands. All maps, graphics, flags, photos and original descriptions are copyrighted by and created by Graphic Maps, a d/b/a of the Woolwine-Moen Group, unless otherwise are noted and/or directly linked to the source. Certain statistical data is gathered from numerous public domain reference materials, and every effort is made to be as accurate as possible when disseminating information on any worldwide destination or subject.

Since the aim of this work was to check how first nature geography is correlated to economic outcomes (GDP or exports), we proceeded as follows.

First we collected insularity information from our two main sources. Because information were not at an island level, we aggregated all information and data at a country level creating and organising a new dataset by country. The dataset included the following information:

- country landarea (source: DeAgostini);
- country landarea (source: Unep);
- number of islands (own elaborations on WorldIslandInfo data);
- number of islands (own elaborations on Unep data);
- total island area (own elaborations on WorldIslandInfo data);
- total island area (own elaborations on Unep data);
- percentage of country area represented by islands (own elaborations on WorldIslandInfo data);
- percentage of country area represented by islands (own elaborations on Unep data);
- dummy island-state: 1 if the country is an island-state (own elaborations);
- dummy archipelago: 1 if the country is an archipelago (own elaborations);
- dummy partial island-state: 1 if the country shares its territory with another country (own elaborations);
- dummy SIDS: 1 if the country is a SIDS (own elaborations);
- dummy partial insularity: 1 if the country have a percentage of insular territory higher than 1 and lesser then 100% (own elaborations);
- dummy coastal: 1 if the country overlooks the sea but have 0 islands (own elaborations);
- dummy negligible: 1 if the country has negligible islands (own elaborations);
- isolation index (own elaborations on Unep data);
- weighted isolation index: isolation index weighted on the island area (own elaborations on Unep data);
- coastal index (own elaborations on Unep data);

- weighted coastal index: coastal index weighted on the island area (own elaborations on Unep data);

We checked which countries were and were not included in GDP data (WDI, 2012) and in trade data (BACI) and according to this we used some tricks aggregating countries in order to have as much countries as possible.

Insularity dataset is composed by 156 countries (17 included only in WorldIslandInfo, 5 included only in Unep and 134 belonging to both). All 156 countries are observations for which we had insularity information.

After that, we merged the insularity dataset with the geographical Sedac-PLACEII dataset composed by 228 observations (countries) and including 76 variables about morphological land characteristics along several dimensions (elevation, climate zone, biome class, distance from coast). Making assumptions and using tricks we finally constructed and obtained a single insular-geographical dataset composed by 234 countries.

Finally, since our purpose, we merged the insular-geographical dataset (234 observations) with exports per capita dataset obtaining a dataset of 194 countries and with WDI database getting a dataset of 201 countries. It's important to point out that for 33 countries (mainly island-states) the information about their GDP doesn't exist.

The 194 observations in the trade-insular dataset are divided as follows: 57 island-states, 16 countries with partial insularity, 89 coastal countries (35 with zero insularity and 54 with negligible insularity), 32 landlocked countries.

The 201 observations in the GDP-insular dataset, instead, are divided in: 57 island-states, 16 countries with partial insularity, 91 coastal countries (38 with zero insularity and 53 with negligible insularity), 37 landlocked countries.

Appendix B: Assumptions and tricks about some countries

In collecting data about islands, our purpose was to create a dataset with as much countries as possible and to include countries for which we had the exports information or the GDP information; in other words our main aim was to make possible that BACI data and WDI data matched with insular-geographical data.

We noted that for 15 countries the information in BACI was absent, i.e. for these countries the information about trade didn't exist. In order to not exclude these observations from our dataset, we aggregated these countries in bigger countries or in groupings for which we had the trade data.

These 15 countries were:

1. France;
2. French Guiana;
3. Guadeloupe;
4. Martinique;
5. Mayotte;
6. Reunion;
7. Wake Island;
8. US Virgin Islands;
9. Puerto Rico;
10. Midway;
11. Svalbard and Jan Mayen Islands;
12. Faeroe Islands;
13. Taiwan;
14. Channel Islands;
15. Isle of Man

France, French Guiana, Guadeloupe, Martinique, Mayotte and Reunion were included in the aggregation "France + DOM + TOM".

Wake Island, US Virgin Islands and Puerto Rico were aggregated with the United States (also the US code doesn't exist) in "United States + Puerto Rico + Virgin Islands".

Svalbard and Jan Mayen Islands were included in Norway.

Faeroe Islands were included in Denmark.

Taiwan was included in China.

Channel Islands and Isle of Man were included in UK.

We noted that for Channel Islands, Faeroe Islands, Isle of Man, Puerto Rico and US Virgin Islands existed the GDP information, we added these observations to our dataset obtaining five more countries.

Appendix C: how insular-exports and insular-GDP dataset are composed

As said in Appendix A insular-exports dataset and insular-GDP dataset are composed respectively by 194 and 201 countries. In order to distinguish countries on insular-geographical features we used different dummies to separate countries into five main groups: island-states, countries with partial insularity, coastal countries, countries with negligible insularity, landlocked countries. Inside the group island-states we can distinguish: archipelagos, SIDS and states that share their island-state with another country.

The insular-exports dataset is composed as follows:

- **57 island-states** (Antigua and Barbuda, American Samoa, Aruba, Australia, Bahamas, Bahrain, Barbados, Bermuda, Brunei Darussalam, Cape Verde, Cayman Islands, Comoros, Cuba, Cyprus, Dominica, Dominican Republic, East Timor, Fiji, French Polynesia, Greenland, Grenada, Guam, Haiti, Iceland, Indonesia, Ireland, Jamaica, Japan, Kiribati, Madagascar, Maldives, Malta, Marshall Islands, Mauritius, Micronesia, New Caledonia, New Zealand, Northern Mariana Islands, Palau, Papua New Guinea, Philippines, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Seychelles, Singapore, Solomon Islands, Sri Lanka, Tonga, Trinidad and Tobago, Turks and Caicos Islands, Tuvalu, United Kingdom, Vanuatu, Virgin Islands (U.S.));
- **16 partial** (Canada, Chile, Croatia, Denmark, Equatorial Guinea, Estonia, France +DOM + TOM, Greece, Guinea-Bissau, Hong Kong, Italy, Kuwait, Malaysia, Norway, Svalbard and Jan Mayen, Portugal, Spain);
- **35 coastal** (Algeria, Belarus, Benin, Bosnia and Herzegovina, Bulgaria, Cameroon, Congo Democratic Republic, Congo, Cote d'Ivoire, Gabon, Gambia, Georgia, Ghana, Gibraltar, Iraq, Israel, Jordan, Latvia, Liberia, Macau, Moldova, Monaco, Morocco, Nicaragua, Nigeria, Pakistan, Peru, Qatar, Romania, Senegal, Slovenia, Suriname, Syria, Togo Uruguay);
- **54 negligible** (Albania, Angola, Argentina, Bangladesh, Belize, Brazil, Cambodia, China, Colombia, Costa Rica, Democratic People's Republic of Korea, Djibouti, Ecuador, Egypt, El Salvador, Eritrea, Finland, Germany, Guatemala, Guinea, Guyana, Honduras, India, Iran, Kenya, Lebanon, Libya, Lithuania, Mauritania, Mexico, Mozambique, Myanmar, Netherlands, Oman, Panama, Poland, Republic of Korea, Russian Federation, Saudi Arabia, Sierra Leone, Somalia, Southern African Customs Union, Sudan, Sweden, Tanzania, Thailand, Tunisia, Turkey, Ukraine, United Arab Emirates, USA + Puerto Rico + US Virgin Islands, Venezuela, Vietnam, Yemen);
- **32 landlocked** (Afghanistan, Azerbaijan, Austria, Armenia, Bhutan, Bolivia, Burkina Faso, Burundi, Central African Republic, Chad, Czech Republic, Ethiopia, Hungary, Kazakhstan, Kyrgyzstan, Lao People's Democratic Republic, Macedonia, Malawi, Mali, Mongolia, Nepal, Niger, Paraguay, Rwanda, Slovakia, Switzerland +Liechtenstein, Tajikistan, Turkmenistan, Uganda, Uzbekistan, Zambia, Zimbabwe).

The 57 island-states can be distinguished if they are archipelagos and/or SIDS and/or if they share their island-state with another country. Within the island-states group we can count:

- **30 archipelagos** (American Samoa, Bahamas, Bermuda, Cape Verde, Cayman Islands, Comoros, Fiji, French Polynesia, Indonesia, Japan, Kiribati, Maldives, Malta, Marshall Islands, Micronesia, New Caledonia, New Zealand, Northern Mariana Islands, Palau, Philippines, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Seychelles, Solomon Islands, Tonga, Turks and Caicos Islands, Tuvalu, Vanuatu, Virgin Islands (U.S.));
- **40 SIDS** (American Samoa, Antigua and Barbuda, Aruba, Bahamas, Bahrain, Barbados, Cape Verde, Comoros, Cuba, Dominica, Dominican Republic, East Timor, Fiji, French Polynesia, Grenada, Guam, Haiti, Jamaica, Kiribati, Maldives, Marshall Islands, Mauritius, Micronesia, New Caledonia, Northern Mariana Islands, Palau, Papua New Guinea, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao tome and Principe, Seychelles, Singapore, Solomon Islands, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu, Virgin Islands (U.S.));
- **10 partial island-states** (Brunei Darussalam, Cyprus, Dominican Republic, East Timor, Haiti, Indonesia, Ireland, Papua New Guinea, Malaysia, United Kingdom).

The insular-GDP dataset is composed as follows:

- **57 island-states** (Antigua and Barbuda, Aruba, Australia, Bahamas, Bahrain, Barbados, Bermuda, Brunei Darussalam, Cape Verde, Cayman Islands, Channel Islands, Comoros, Cuba, Cyprus, Dominica, Dominican Republic, East Timor, Faeroe Islands, Fiji, French Polynesia, Greenland, Grenada, Haiti, Iceland, Indonesia, Ireland Isle of Man, Jamaica, Japan, Kiribati, Madagascar, Maldives, Malta, Marshall Islands, Mauritius, Micronesia, New Caledonia, New Zealand, Palau, Papua New Guinea, Philippines, Puerto Rico, Samoa, Sao Tome and Principe, Seychelles, Singapore, Solomon Islands, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Tonga, Trinidad and Tobago, Tuvalu, United Kingdom, Vanuatu, Virgin Islands (U.S.));
- **16 partial** (Canada, Chile, Croatia, Denmark, Equatorial Guinea, Estonia, France +DOM + TOM, Greece, Guinea-Bissau, Hong Kong, Italy, Kuwait, Malaysia, Norway, Svalbard and Jan Mayen, Portugal, Spain);
- **38 coastal** (Algeria, Andorra, Belarus, Belgium-Luxembourg, Benin, Bosnia and Herzegovina, Bulgaria, Cameroon, Congo Democratic Republic, Congo, Cote d'Ivoire, Gabon, Gambia, Georgia, Ghana, Gibraltar, Iraq, Israel, Jordan, Latvia, Liberia, Macau, Moldova, Monaco, Morocco, Nicaragua, Nigeria, Pakistan, Peru, Qatar, Romania, Senegal, Serbia and Montenegro Slovenia, Suriname, Syria, Togo Uruguay);
- **53 negligible** (Albania, Angola, Argentina, Bangladesh, Belize, Brazil, Cambodia, China, Colombia, Costa Rica, Djibouti, Ecuador, Egypt, El Salvador, Eritrea, Finland, Germany, Guatemala, Guinea, Guyana, Honduras, India, Iran, Kenya, Lebanon, Libya, Lithuania, Mauritania, Mexico, Mozambique, Myanmar, Netherlands, Oman, Panama, Poland, Republic of Korea, Russian Federation, Saudi Arabia, Sierra Leone, Somalia, Southern African Customs Union, Sudan, Sweden, Tanzania, Thailand, Tunisia, Turkey, Ukraine, United Arab Emirates, USA + Puerto Rico + US Virgin Islands, Venezuela, Vietnam, Yemen);
- **37 landlocked** (Afghanistan, Azerbaijan, Austria, Armenia, Bhutan, Bolivia, Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Czech Republic, Ethiopia, Hungary, Kazakhstan, Kyrgyzstan, Lao People's Democratic Republic, Lesotho, Liechtenstein, Luxembourg, Macedonia, Malawi, Mali, Mongolia, Nepal, Niger, Paraguay, Rwanda, Slovakia, Swaziland, Switzerland, Tajikistan, Turkmenistan, Uganda, Uzbekistan, Zambia, Zimbabwe).

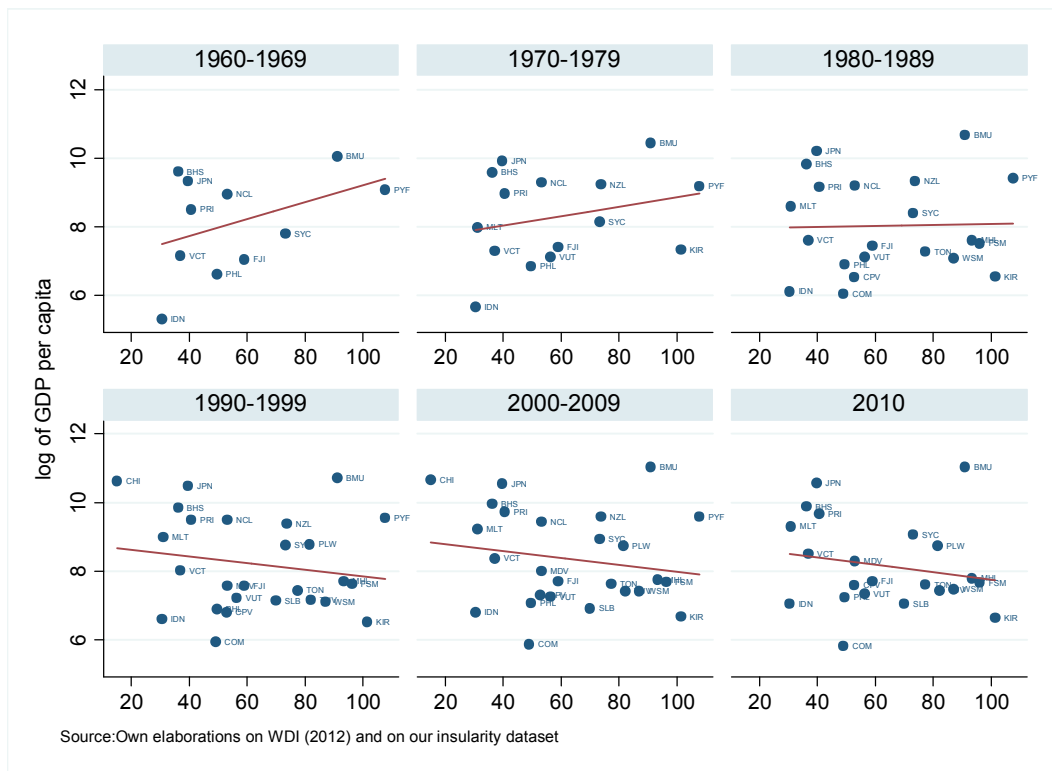
Within the island-states group we can count:

- **30 archipelagos** (Bahamas, Bermuda, Cape Verde, Cayman Islands, Channel Islands, Comoros, Faeroe Islands, Fiji, French Polynesia, Indonesia, Japan, Kiribati, Maldives, Malta, Marshall Islands, Micronesia, New Caledonia, New Zealand, Palau, Philippines, Puerto Rico, Samoa, Sao Tome and Principe, Seychelles, Solomon Islands, St. Vincent and the Grenadines, Tonga, Tuvalu, Vanuatu, Virgin Islands (U.S.);
- **38 SIDS** (Antigua and Barbuda, Aruba, Bahamas, Bahrain, Barbados, Cape Verde, Comoros, Cuba, Dominica, Dominican Republic, Fiji, French Polynesia, Grenada, Haiti, Jamaica, Kiribati, Maldives, Marshall Islands, Mauritius, Micronesia, New Caledonia, Palau, Papua New Guinea, Puerto Rico, Samoa, Sao Tome and Principe, Seychelles, Singapore, Solomon Islands, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Timor-Leste, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu, Virgin Islands (U.S.);
- **10 partial island-states** (Brunei Darussalam, Cyprus, Dominican Republic, East Timor, Haiti, Indonesia, Ireland, Papua New Guinea, Malaysia, United Kingdom).

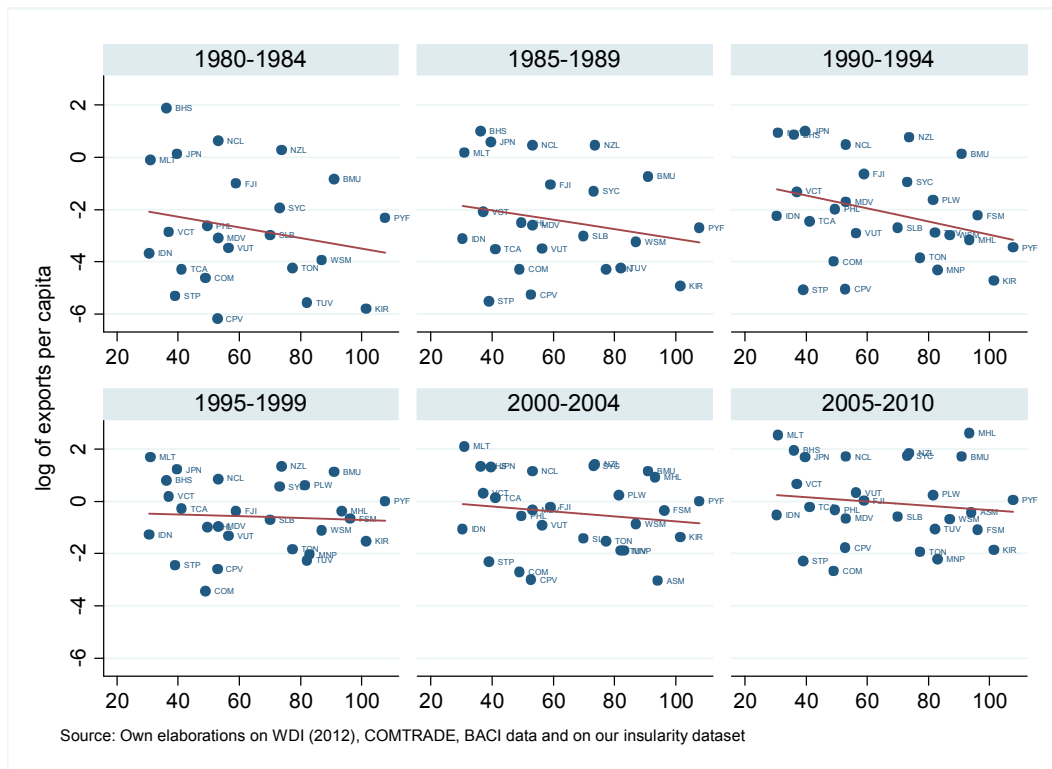
It's important to point out that two landlocked countries (Turkmenistan and Ethiopia) have islands.

Appendix D: Archipelagos and SIDS

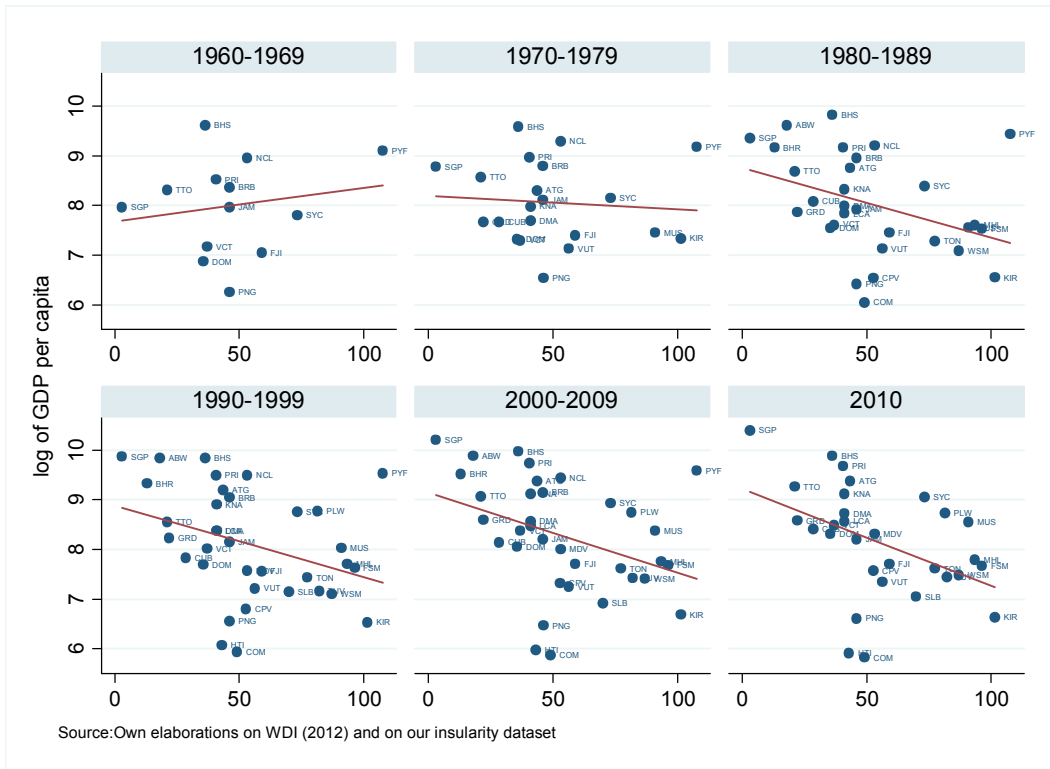
Graph D1 - Level of GDP per capita and isolation index (archipelagos)



Graph D2 - Level of exports per capita and isolation index (archipelagos)



Graph D3 - Level of GDP per capita and isolation index (SIDS island-states)



Graph D4 - Level of exports per capita and isolation index (SIDS island-states)

