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GEOGRAPHY, CULTURAL REMOTENESS AND ECONOMIC DEVELOPMENT: A REGIONAL ANALYSIS OF THE ECONOMIC CONSEQUENCES OF INSULARITY

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Geography, Cultural Remoteness and Economic Development: A Regional Analysis of the Economic Consequences of Insularity[1]

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Abstract

We study the relationship between economic development, geography and "cultural remoteness" (i.e. distance from the technological frontier(s) driving economic development) at a regional level focusing on the role of "insularity". The analysis covers all island regions worldwide and documents the presence of economic costs (measured in GDP *per capita*), due to insularity, in addition to those generally attributed to 'geographical remoteness'. Cultural remoteness, either measured in terms of linguistic or ethnic distance, is not the only cause that explains these costs.

Keywords: insularity, geographic remoteness, cultural distance, economic development
JEL classification: O10, 021, R11, R58

[1] Corresponding author: Massimo Del Gatto (Department of Economics - DEc); Viale Pindaro, 42; 65127 – PESCARA (ITALY); email: m.delgatto@gmail.com). A replication package (data + STATA codes) for the linguistic index used in the paper, together with the full set of computed bilateral distance measures (geographical, linguistic and ethnic distances), can be downloaded from the link http://docenti.unich.it/delgatto/delgatto_web/research.htm.

1. Introduction

According to the Euroislands 2010 report (EPSON, 2010), the GDP (gross domestic product) *per capita* of the European islands broadly equals 79.2% of the European average. Moreover, most islands display a level of development that is lower than that of the country to which they belong. Such data explain why the economic development of islands was explicitly introduced into the policies of economic and social cohesion of the European Union (EU). Indeed, distinctive policies for islands were first included at the time of the Maastricht treaty (1992) and later, in the treaties of Amsterdam (1997) and Lisbon (2007) (see, for example, the analysis of the EU policies concerning the economic sustainability of islands by Moncada *et al.*, 2010).

Whether the insularity by itself constitutes a limit to the development, or whether it should be placed in the context of other penalizing factors typical of areas (insular or not) with a low degree of accessibility, is a debated issue, the importance of which is growing from the policy point-of-view (see EU Commission, 2010 and 2014). Despite this, the empirical literature on economic aspects of insularity provides input that is far from being unequivocal. Being an island is usually associated with a lower level of economic development. However, this relationship weakens or becomes insignificant when considering some characteristics attributed to the condition of insularity. These include the distance from major markets (i.e. "remoteness") that influences the volume of trade and accessibility to outside investors (see: Read, 2004; Armstrong and Read, 2004; Borgatti, 2008), and the small size of the local market (i.e. "smallness") whose negative effects are exacerbated when linked to insularity (Armstrong and Read, 1995; Briguglio, 1995). In contrast, several authors highlight how some socio-economic features linked to insularity, such as cohesion and social homogeneity, may have a positive impact on development (Armstrong e Read 2000; Bertarm and Karagediki, 2004). Bertram (2004) shows that the GDP *per capita* of small islands is well explained by the closeness of the political link with their motherland, and the GDP *per capita* of the latter.

Research projects that study the relationship between insularity and economic performance commonly focus on small islands (Briguglio, 1995; Armstrong and Read, 1998; Bertram 2004; Bertram and Karagedikli, 2004; McElroy and Medek, 2012) or on microstates where islands constitute an important part (Armstrong *et al.*, 1998; Armstrong and Read, 1995). In addition, the analysis is frequently performed at the level of a single country (Briguglio, 1995; Dimou, 2006). Exceptions are Armstrong and Read (1995) and Feyrer and Sacerdote (2009). The former put together European microstates and regions with high degree of autonomy (among which many islands) of various countries. The latter use a sample of small islands belonging to different states, showing that the type of colonization the islands underwent (which is largely country-specific) plays an important role in the explanation of their current GDP levels.

This paper aims to contribute to the debate on the relationship between economic development and insularity by performing an analysis at a regional level including all island regions worldwide. The objective is to establish whether and how being an island continues to be explanatory of "within country" lags, even after controlling for a number of features that may be typical not only for islands but also for non-insular regions. Such conditions include geographical distance, "cultural" distance, either measured in terms of linguistic or ethnic distance, and size. The analysis is inspired by literature on the so-called "deep determinants" of economic development (Diamond, 1997; Easterly and Levine, 2003, 2012; Acemoglu *et al.*, 2001, 2002; Olsson and Hibbs, 2005; Spolaore and Wacziarg, 2013a), which concentrates on aspects that go beyond purely geographical characteristics, with the idea that cultural traits strongly associated with economic development exist and tend to be extremely persistent over time.

Within this literature, Spolaore and Wacziarg (2009, 2013a, 2013b) depict history as a process characterized by a succession of diverse technological frontiers. Technology and innovation flow from a frontier to the rest of the world, but are first adopted by populations that are culturally (i.e. genetically) similar to those present within the frontier i.e. the ones who are capable of encoding the innovations and adapting them to a new context more easily. This is because the intergenerational transmission (vertical transmission) of values typical of a given population is a complex phenomenon and occurs first of all in the familial sphere. This limits the dissemination of values between populations (horizontal transmission), with its level reducing with increasing "cultural" distance. For this reason, cultural distance functions as a barrier to economic development. Whilst such a relationship has been hitherto postulated and studied at the country level (Spolaore and Wacziarg, 2009; Fearon, 2003; Desmet *et al.*, 2009), our paper addresses the question from the regional perspective, thus introducing elements of novelty in the analysis.

Firstly, the regional dimension makes it possible to focus on the economic effects of insularity and remoteness excluding the action of country-specific factors that contribute to the generation of international differentials in economic development. Moreover, the regional perspective allows alternative formulations of the notion of a technological frontier, subsequently used for testing the robustness of the results. In fact, while 'Spolaore and Wacziarg (2009) connect the differences in GDP *per capita* across countries to their distance from a "global" technological frontier (located in the UK or in the USA), a regional level of analysis makes it possible to focus on internal (i.e. within-country) distance to evaluate the extent to which the distance to a "local" frontier is able to explain the within-country variability of GDP *per capita*. Such a dimension can be investigated by identifying internal frontier regions inside countries. This latter view is supported by several papers that describe the diffusion of technology as a process that expands itself from one (or several) frontier(s) towards the periphery through a complex network of relationships in which primary and secondary nodes can be distinguished (Diamond, 1997; Acemoglu *et al.*, 2005; Putterman and Weil, 2010; Spolaore and Wacziarg, 2013b).

Our results associate the condition of being an island to delays in GDP *per capita*, even after excluding the effects of "remoteness", both geographical and cultural (linguistic or ethnic). The analysis thus points towards the existence of additional economic costs, other than the generally known effects of geographical "remoteness" (especially in context of European regional policy), that can be attributed to the state of *insularity*. However, the analysis enables defining the nature of such additional costs only in residual terms compared to those associated with a region's cultural distance from the technological frontier(s). While this corroborates the idea that islands are worthy of particular attention when defining regional policies, it also reinforces the necessity to learn more about the nature of such "additional costs" in order to better define the concept of insularity.

This article is organized as follows. Section 2 illustrates the data and the methodology used for devising the distance measures. Section 3 shows the analysis and explains how local technological frontiers were identified. Section 4 provides conclusions to the study. The details of constructing bilateral distance variables between regions are given in Appendix A, while Appendix B contains the sources used for every country included in the analysis.

2. Methodology and Data

The database was constructed from diverse sources.

First, it is important to underline that the unit of analysis is the region, while insularity is studied with reference to island regions, as identified in "Fifth Report on Economic, Social and Territorial Cohesion" (i.e. EU Commission, 2010), which defines island regions as "one or more regions that consist of one or more islands".[2] The choice of studying the effect of insularity concentrating on island regions, other than being consistent with the EU approach, minimizes the degree of heterogeneity and measurement errors associated to the size of administrative units. Moreover, it enables us to include the entire category of island regions, worldwide, in the analysis.[3]

The sample used includes the whole set of island regions, worldwide, and all the other regions of the countries to which they belong.

The final database is composed of 474 regions[4], distributed in 22 countries, of which 76 are island regions. Among these, 45 are continental island regions, while 31 comprise the so-called "overseas islands", which are special administrative entities compared to the ordinary regions of the countries to which they belong. This definition (see Appendix A) mirrors the classification used in official EU documents, according to which the European islands are divided into three categories: overseas countries and territories, most remote regions, and continental EU islands (Moncada *et al.*, 2010). Three of the 22 countries encompass archipelagos (Japan, Indonesia and the Philippines). In such cases, the regions of the mainland, localized on principal islands were kept separate from the insular regions localized on minor islands[5].

The analysis uses three measures of bilateral distance between regions: geographical, linguistic and ethnic distance. The second and the third measures are used to describe the idea of *cultural distance* between regions.

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[2] On the basis of such a definition, an island-region can alternatively correspond to a single island, be composed of a few islands or be part of an island that contains other regions.

[3] Commonly, the regions also possess a level of administrative autonomy, albeit to varying degrees, which allows us to rule out the possibility that the level of their development depends exclusively on national and supranational policies.

[4] The regions are considered as the second administrative level of their respective countries included in the analysis.

[5] The distinction between major and minor islands is based on the surface. Shikoku, Kyushu, Hokkaido, Ryukyu are Japan's minor islands. The minor islands of Indonesia comprise Maluku, East Timor, Bali, East Nusa Tenggara, West Nusa Tenggara, while those of the Philippine are Visayas and Sulu.

The *geographical distance* is calculated, utilizing the GIS software, as the geodesic distance between the centroids of any two regions (see Picard, 2010).[6]

The *linguistic distance* is the measurement of the linguistic differences between populations that live in the two regions. We use the approach conceived by Fearon (2003), also adopted by Desmet *et al.* (2009), to construct this indicator. It is based on the study of a phylogenetic linguistic tree and measures the similarity between two tongues in terms of the number of common branches[7]. Fearon (2003) proposed the following index to measure the distance between two languages *i* and *j*:

$$\tau_{ij} = 1 - \left(\frac{l}{m} \right)^{\alpha}$$

where l is the number of shared branches between i and j, m is the maximum number of shared branches between any two languages contained in the database, and α is a parameter with an assigned value of 0.5[8].

The linguistic distance between A and B regions is calculated with the given formula:

$$\sum_{k=1}^{K} \left[Q_i^A Q_j^B \tau_{ij} \right]_k$$

where Q_i and Q_j denote the number of, respectively, language i and language j speakers with respect to the regional total and K represents all possible combinations of languages spoken in A and B. The index varies between 0 (maximal linguistic similarity) and 1 (maximal linguistic inequality).

In order to construct the index of linguistic distance, we initially crossed the database provided by Alesina and Zhuravskaya (2011), from where we derived the regional distribution of languages, with the phylogenetic linguistic tree taken from "*Ethnologue: Languages of the World*".[9] The index obtained in this way is more detailed and precise than the one used by Alesina and Zhuravskaya (2011). Indeed, our indicator includes 220 languages as opposed to 177 considered by Alesina and Zhuravskaya (2011), and is constructed on the basis of indigenous languages. In contrast, Alesina and Zhuravskaya (2011) treat

[6] For homogeneity with other measurements, the variable was subsequently rescaled in order to fall between 0 and 1.

[7] The phylogenetic tree is a diagram that shows the relationship between groups of progeny derived from a single parent. The term "branches" describes the points where languages divide.

[8] See Desmet *et al.* (2009), p.1301, for explanation concerning the meaning and estimation of the parameter.

[9] Alesina and Zhuravskaya (2011) report on the linguistic, ethnic and religious composition at the national level, for a large number of countries; the primary sources of data are the census of individual countries. *Ethnologue: Languages of the World* is a catalogue published by SIL international Publications that contains about 7000 languages cataloged by country. Language descriptions include: origin, geographical distribution, estimated number of speakers and corresponding ethnicities, as well as numerous other details such as conservation status and the presence of dialects.

‘autochthonous’ languages at par with languages of recent immigration (e.g. Chinese and Filipino in Italy), rather than distinguishing them.

As stated above, the linguistic distance is used to give the idea of cultural distance between regions. However, it should to be noted that in some cases linguistic similarity may fail to reflect cultural similarity. This is evident in the case of populations that, following colonization, underwent the process of linguistic assimilation, but not a process of cultural integration (as illustrated by some indigenous populations of South America).

To circumvent such instances, the analysis takes into consideration another proxy of cultural distance, specifically, the *ethnic distance*, calculated by replacing the linguistic composition of each region in equation (2) with the corresponding ethnic composition.[10] The latter was obtained as follows. For the regions contained within the Ethnologue, both linguistic and ethnic distributions were acquired from it, whereas, for the regions whose linguistic distribution was obtained from Alesina and Zhuravskaya (2011), the ethnic distribution was taken from a number of sources as detailed in Appendix B.

Appendix A describes in detail the way in which we dealt with the principal problems encountered during the construction of the database.

The full (474x473) bilateral distance matrix can be downloaded from the first author’s website, together with a replication package with all the data and the STATA codes for the linguistic index.

We also use data on GDP *per capita*, area and population.

GDP *per capita* is the dependent variable used for the analysis. The regional distribution is largely taken from a database created by La Porta *et al.* (2013). The database includes GDP at purchasing power parity (PPP) *per capita* as of 2005 for 438 out of the 474 regions included in our study. For 31 of the remaining regions, GDP *per capita* is obtained from various sources[11]. For 5 of them we report missing information.

Area, expressed in square kilometers, was calculated using a GIS software.

Population, used for computing the linguistic index (see Appendix A) and the GDP per capita in some cases, was obtained from the national Census Bureau (see Appendix B).

3. Analysis and results

In the following analysis, we ask to what extent the regional levels of GDP *per capita* could be explained by insularity, after taking into account the degree of geographical remoteness and, in particular, the degree of cultural remoteness, measured in terms of distance from the frontier of economic development.

To investigate on this, we use the values of GDP *per capita* as a dependent variable in a simple regression in which the independent variables consist of: a (0,1) dummy identifying the island regions; a (0,1) dummy that identifies the “overseas” island regions (determined as described in section 2); the area of the region (calculated in km^2 using the GIS software); the distance from the frontier region. Depending on the specification adopted, the latter corresponds to the geographic or cultural distance, expressed as linguistic or ethnic distance.

[10] The linguistic and ethnic distributions tend to be identical in colonizing states and are different in the colonized ones.

[11] CIA World Factbook; IMF World Economic Outlook Database; OECD Regions at a Glance (2011).

Two interacting variables are then introduced to control for possible additional effects associated with being a particularly small or remote overseas island. All regression computations include country level fixed-effects and exclude the Galapagos Islands (outliers in terms of GDP), as well as the five regions with missing GDP. This leaves us with 468 observations (regions).

The main variables are described in Table 1. The GDP *per capita* levels vary significantly between countries and the majority of island regions are below their national average. This is clearly seen in Figure 1, which shows the GDP *per capita* of the island regions as a percentage of the national average (considered 100). In most island regions, the figure is less than one hundred, with some notable exceptions such as the Galapagos Islands in Ecuador, with a GDP *per capita* almost four times the national average, or the Bermuda, Bay and Cayman Islands.

The *Geodist*, *Lingdist* and *Ethndist* variables refer to geographical, linguistic and ethnic distances, respectively (as described in the previous section). These are expressed, for each region, as distance from the local technological frontier identified within each country. These calculations were based on the view representing the diffusion of technology as a process that departs from one (or more) frontier(s) and propagates to the suburbs through complex relational networks where one can locate primary and secondary nodes (Diamond, 1997; Acemoglou *et al.*, 2005; Spolaore and Wacziarg, 2013b). Consistent with the objective of the present study, this approach introduces a second (within- country) level of analysis as opposed to the idea of one (unique) global technological frontier (GBR or USA) introduced by Spolaore and Wacziarg (2009). Operationally, the identification of the frontier regions follows the approach of Acemoglu *et al.* (2005). Based on Bairoch *et al.* (1998) data on the evolution of populations within major world cities from the Middle Ages to the modern age, Acemoglu *et al.* (2005) describe modern economic development as the result of a process that started in the port cities of the Atlantic countries of Northern Europe.

Consistent with this view, local technological frontiers should have two characteristics: the first of growing faster than other areas and the second of reaching a large size in the modern age. Thus, we use the urbanization data reported by Acemoglu *et al.* (2005) to identify the cities, in each country, with the highest rate of urbanization in 1850. These cities were selected from ones that, between 1500 and 1850, had a growth rate higher than the median value of the distribution. Given that the database published by Acemoglu *et al.* (2005) contains cities only in Europe and Asia, we identified the frontier cities in other countries by defining the most populous cities in 1850.[12] However, it should be noted that the choice of using a single frontier region per country is intended as an approximation of a continuous process of technological exchange. Clearly, innovation can come simultaneously from a number of frontiers, and not necessarily within the national borders.

Preliminary graphical analysis in Figure 2 indicates that the regional distribution of GDP *per capita* appears rather heterogeneous. Some countries, such as Italy, show a clear adverse effect due to the geographical distance from the frontier region (of the country), with islands fairly well aligned on the ideal regression line. In other cases, the existence of the

[12] The frontier cities identified are: Melbourne; Montreal; Copenhagen; Tallinn; Helsinki; Paris; Thessaloniki; Turin; Amsterdam; Lisbon; Madrid; Stockholm; London; New York; Canton; Bombay; Jakarta; Tokyo; Manila; Quito; Tegucigalpa; Dodoma.

"remoteness" effect evidently depends on whether or not the island regions, especially overseas ones, were included. This is particularly evident for the Netherlands and the USA.

The results of the ordinary least squares (OLS) estimates with country fixed-effects are shown in Table 2.[13] The effect of remoteness is measured in terms of geographic (*Geodist*), linguistic (*Lingdist*) and ethnic (*Ethndist*) distances. The first, third and fifth columns show that the distance from the country frontier adversely affects the GDP *per capita*. In the second, fourth and sixth columns we add the two dummy variables that take the value of 1 for the island regions (i.e. "Island (dummy)" variable) and for the overseas island regions (i.e. " Overseas Island (dummy)" variable). The graphical analysis depicted in Figure 2 shows how the overseas islands represent a rather "different reality" from the other regions of the country of reference, albeit not always with a lower GDP. In these cases, therefore, we also consider the effect of the interaction with the region's size (area) and with the region's distance from the frontier, to see if the smaller or more remote overseas islands are further penalized. The regression output detects a significantly negative influence of being an island on the level of wealth of the regions, even after controlling for the effect of distance. In fact, the significance of "remoteness", in both a geographical and a cultural (linguistic and ethnic) sense, disappears when the condition of being an island, and even more an overseas one, is taken into account. In this respect, it is also worth noting that being a relatively small and/or more remote overseas island, increases the delay.

The robustness of the results in Table 2 with respect to the concept of frontier is tested in two ways. First, we move from a local to a global frontier as identified by Spolaore and Wacziarg (2009) in the USA and UK. In our case, this results in considering, for every region, its distance from a region of the USA or UK where 100% of the population speaks English and belongs to the dominant ethnicity of the country. The results shown in Table 3, obtained using the London region (the bilateral distances are as described in Section 2), confirm the predominant role of insularity over remoteness, both geographical (see *Geodist to London* variable) and cultural (see *Lingdist to London* and *Ethndist to London* variables), the significance of which disappears when the island dummies are inserted.

Second, we refer to a "current" development frontier. This is based on the idea that, in the post-industrial revolution, economic development at a country level may have resulted in wealth concentration in certain core regions to the detriment of the periphery, where the GDP *per capita* reduces as the distance from the core increases. Accordingly, for every region of a given country we measure the remoteness in terms of distance from the region with the highest GDP *per capita*. The analysis is summarized in Table 4, where the distance variables are indicated with the extension "to max GDP". The results of Table 2 are fully confirmed for both the effect of being an island and for remoteness.

Finally, it should be noted that the regression calculations contained in columns (3) to (6) of Tables 2, 3 and 4, may suffer from problems of endogeneity, if one accepts the idea that, in the long run, geography itself, including being an island, may have played a role in determining the degree of cultural distance between regions. To investigate this aspect, Table 5 shows the results of the estimates obtained using the two measures of cultural distance (*Lingdist* and *Ethndist*) as dependent variables and the geographical distance, together with the

[13] The number of observations in Table 2 drops from 468 to 446 because one region for each country (i.e. the frontier region) is lost under this specification.

same controls for insularity used above, as explanatory variables. Columns (1) and (2) follow the benchmark specification, columns (3) and (4) are based on the specification used in Table 3 (distance from London), while columns (5) and (6) use the frontier specification of Table 4, (distance from the region with the highest GDP). While the geographical distance is significant, entailing that including geographical and cultural distances in the same regression would be problematic, being an island does not seem to significantly impact the degree of cultural remoteness of the regions.

4. Conclusions

If being an island constitutes a limit to the development *per se*, or whether instead it should be related to penalizing factors typical of areas, insular or not, characterized by low degrees of accessibility, is an increasingly important question in the subject of regional policies of countries. However, literature on the economic effects of insularity is relatively sparse and provides mixed results. This paper aims to contribute to the debate by addressing the issue in light of recent literature on the so-called "deep determinants" of economic development (Diamond, 1997; Easterly and Levine, 2003; Acemoglu *et al.*, 2001, 2002; Spolaore and Wacziarg, 2013a). This body of literature states that there are cultural traits strongly related to economic development that persist over time. In addition, innovation flows from the technological frontier to the rest of the world and new technologies are first adopted by culturally similar populations to the ones present at the frontier. This fact results in a negative correlation between the development and the distance from the frontier, as areas culturally close to the border are capable of implementing novel technologies more quickly. While extant literature focuses cross-country differences in economic development, posted within our regional framework, this view entails a second (within-country) level of analysis, in which one or more local frontiers guide the development process, prompting a negative relationship, even within countries, between distance from the frontier and GDP *per capita*.

The empirical analysis shows that being an island is associated with a lag in terms of GDP, even when the effects of remoteness, both in geographical and cultural (linguistic and ethnic) terms, are controlled for. Indeed, the significance of either geographical or cultural distances disappears when introducing the condition of island regions into the regression and, even more, of overseas island regions. Furthermore, it is interesting to note that being a relatively smaller or more remote (both geographically and in cultural terms) overseas island further delays economic development.

By documenting the existence of additional "economic costs", in relation to "geographic remoteness", that can be attributed to the status of insularity, these results corroborate the idea that islands are worthy of particular attention while defining regional policies. However, the analysis was not able to identify the "nature" of such costs, if not as extra costs with respect to those associated with greater cultural distance from the technological frontier(s) driving the process of economic development.

Several hypotheses can be generated to explain these extra costs. Some authors, for example, emphasize that characteristics associated with insularity can have an effect on the "vulnerability" of islands themselves, by increasing their exposure to the adverse effects of exogenous shocks (Briguglio, 1995; Adrianto and Matsuda, 2004). Exposure to natural disasters and the relative fragility of the ecosystems of islands could cause their development to follow irregular trajectories. Territorial discontinuity could have a negative impact on the economies of density and decrease technological spillovers and/or demand. Although beyond the scope of this work, these issues could constitute research ideas that should be pursued in order to give a clearer framework for the development of regional economic policies.

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A. Appendix: Construction of the database of bilateral linguistic distance.

The construction of the database of linguistic distance posed some critical issues. As explained in Section 2, we initially crossed the database provided by Alesina and Zhuravskaya (2011), from where we derived the regional distribution of languages, with the phylogenetic linguistic tree taken from "Ethnologue: Languages of the World". However, the definition of linguistic groups by Alesina and Zhuravskaya (2011) is very precise and detailed for some countries, but not as precise or detailed for others. The level of precision mainly depends on the sources used for individual countries, the coverage of which is frequently inhomogeneous between regions of the same country. Furthermore, the number of island regions in this resource (Alesina and Zhuravskaya, 2011) is fairly small, with only 11 countries possessing at least one island region (22 regions in total).

In order to solve these critical issues, two strategies were adopted.

First, we used the database published by Alesina and Zhuravskaya (2011) only for those countries where the national language distribution obtained by aggregating regional data coincided with the national distribution reported in Ethnologue. For the regions of other countries we referred to "Ethnologue: Languages of the World" (hereafter referred to as Ethnologue). Since, the number of speakers of a given language in Ethnologue is provided at the national level, the regional distribution was rebuilt using secondary sources listed in Appendix B. Whenever this was not possible, we estimated the distribution using all geographical information present in Ethnologue. Indeed, this resource indicates the geographic zone of diffusion (that normally does not coincide with specific administrative units) for the majority of languages. The geographic zones are typically listed in order of importance. In order to translate them into administrative units used in the analysis, a given region was associated with every relevant geographic zone. Successively, the number of speakers for every geographic zone was estimated. More precisely, whenever it was not possible to identify a hierarchy of areas stated in Ethnologue, we assumed that the speakers among regions were distributed proportionally to the regional population. In contrast, when it was possible to identify a hierarchy, the number of speakers for each region was calculated assuming that the number of speakers in the regions listed constitute an arithmetic progression in which the first element (the number of speakers in the first region) is equal to a fixed figure of the average number of speakers in the region. The parameter that represents the fixed figure was given a value of 0.25. Tests were also performed with other values (such as 0.014 that corresponds to the median value within our sample), but did not result in notable effects in the final results.

Second, to increase the number of islands, we included all the island regions for which the linguistic composition was deducible from Ethnologue and that were not present in the database from Alesina and Zhuravskaya (2011). Among these regions, besides for example the islands of Japan, the so-called "overseas territories" (i.e. "Overseas" Islands) were included. These are regions that, although belonging to the countries included in the analysis, constitute special administrative entities.

The definition of an overseas island is consistent with the classification generally used in official EU documents, in which the islands are usually divided into three categories (see Moncada *et al.*, 2010): overseas countries and territories, most remote regions, and

continental EU islands. Overseas island regions defined in this work belong to the first two categories.
Finally, it is noteworthy that for each country Ethnologue registers both traditional languages and those of recent immigration. The latter, however, were excluded from the analysis in order to limit potential problems of endogeneity with respect to regional income.
The final index, calculated on the basis of 220 languages distributed across 474 regions and 22 countries, is available, together with the other measures of distance, on the first author's website. From the website is also possible to download a replication package with all the data and the STATA codes used to compute the index.

B. Appendix: the list of sources used.

Australia

Speakers	Ethnologue
Ethnic groups	Australian Bureau of Statistics (http://www.abs.gov.au)
Population	Census 2011

Canada

Speakers	Statistics Canada (www.statcan.gc.ca) English and French Speakers
Ethnic groups	Statistics Canada (www.statcan.gc.ca)
Population	Census 2011

China

Speakers	Alesina and Zhuravskaya 2011 Wikipedia (Hainan island)
Ethnic groups	Alesina and Zhuravskaya 2011 Wikipedia (Hainan island)
Population	Census 2010

Denmark

Speakers	Ethnologue
Ethnic groups	Main Land: Ethnologue Faroe Islands: Statistics Faroe Islands (http://www.hagstova.fo) Greenland: Greenland in Figures 2012, Statistics Greenland.
Population	Census 2006 Faroe Islands: Statistics Faroe Islands (http://www.hagstova.fo) Greenland: Greenland in Figures 2012, Statistics Greenland.

Ecuador

Speakers	Ethnologue
Ethnic groups	Ethnologue
Population	Census 2011

Estonia

Speakers	Ethnologue
Ethnic groups	Statistics Estonia (http://pub.stat.ee)
Population	Census 2010

Finland

Speakers	Ethnologue Åland in Brief. CGiForm– MariehamnsTryckeri 8- 2008
Ethnic groups	Ethnologue
Population	Census 2003

France

Speakers	Ethnologue Distribuzione Italiani e Portoghesi: CBorrel, B Lhommeau - Insee première, 2010
Ethnic groups	Ethnologue Distribuzione Italiani e Portoghesi: CBorrel, B Lhommeau - Insee première, 2010
Population	Census 2008

Greece

Speakers	Ethnologue
Ethnic groups	Ethnologue
Population	Census 2005

Honduras

Speakers	Ethnologue
Ethnic groups	Ethnologue
Population	Census 2001

India

Speakers	Alesina e Zhuravskaya (2011)
Ethnic groups	Alesina e Zhuravskaya (2011)
Population	Census 2001

Indonesia

Speakers	Alesina e Zhuravskaya (2011)
Ethnic groups	Alesina e Zhuravskaya (2011)
Population	Census 2010

Italy

Speakers	Ethnologue Census 2001. Alto Adige

	Manlio Brigaglia, Salvatore Tola, Dizionario storico-geografico dei Comuni della Sardegna, Sassari, Carlo Delfino editore, 2006
Ethnic groups	Ethnologue Census 2001. Alto Adige Manlio Brigaglia, Salvatore Tola, Dizionario storico-geografico dei Comuni della Sardegna, Sassari, Carlo Delfino editore, 2006
Population	Census 2011

Japan

Speakers	Ethnologue
Ethnic groups	Ethnologue
Population	Census 2011

Netherlands

Speakers	Ethnologue
Ethnic groups	Ethnologue
Population	Census 2006/2011

Philippines

Speakers	Alesina e Zhuravskaya (2011)
Ethnic groups	Alesina e Zhuravskaya (2011)
Population	Census 2000

Portugal

Speakers	Ethnologue
Ethnic groups	Ethnologue
Population	Census 2011

Spain

Speakers	Alesina e Zhuravskaya (2011)
Ethnic groups	Alesina e Zhuravskaya (2011)
Population	Census 2011

Sweden

Speakers	Ethnologue
Ethnic groups	Ethnologue
Population	Census 2006

Tanzania

Speakers	Alesina e Zhuravskaya (2011)
Ethnic groups	Alesina e Zhuravskaya (2011)
Population	Census 2002

GBR

Speakers	Ethnologue
Ethnic groups	Ethnologue
Population	Census 2004 and 2011

USA

Speakers	Ethnologue Spanish Speakers (anno 2000) : US Census Bureau: "Redistricting Data, First Look at Local 2010 Census Results" US Census Bureau: "Population by Race and Hispanic or Latino Origin, for the United States, Regions, Divisions, and States, and for Puerto Rico: 2000"
Ethnic groups	US Census Bureau, Ancestry 2000 (http://www.census.gov)
Population	Census 2000

TABLES AND FIGURES

Table 1. Descriptive statistics

COUNTRY	CODE		# REGIONS	GDP per capita			geodist			langdist			ethndist		
				mean	min	max	mean	min	max	mean	min	max	mean	min	max
Australia	AUS	Non-Islands	6	34596	28569	41267	0.0698	0.0225	0.1229	0.0017	0.0010	0.0054	0.3171	0.2818	0.4236
		Islands	1	26017	26017	26017	0.0300	0.0300	0.0300	0.0010	0.0010	0.0010	0.2664	0.2664	0.2664
Canada	CAN	Non-Islands	11	25971	2270	55040	0.1028	0.0379	0.1860	0.3564	0.3234	0.4239	0.6929	0.6337	0.7606
		Islands	1	24918	24918	24918	0.0496	0.0496	0.0496	0.3378	0.3378	0.3378	0.6522	0.6522	0.6522
China	CHN	Non-Islands	28	4112	1447	13521	0.0616	0.0037	0.1359	0.1099	0.0148	0.7085	0.1099	0.0148	0.7085
		Islands	1	2962	2962	2962	0.1210	0.1210	0.1210	0.1724	0.1724	0.1724	0.1724	0.1724	0.1724
Denmark	DNK	Non-Islands	12	29287	23769	33956	0.0076	0.0014	0.0121	0.0058	0.0010	0.0591	0.0058	0.0010	0.0591
		Islands	3	26674	24011	30551	0.0766	0.0086	0.1553	0.3291	0.2113	0.5000	0.3291	0.2113	0.5000
Ecuador	ECU	Non-Islands	20	5597	3312	8721	0.0113	0.0039	0.0224	0.1225	0.0084	0.6857	0.1253	0.0118	0.6858
		Islands	1	24545	24545	24545	0.0678	0.0678	0.0678	0.0084	0.0084	0.0084	0.0118	0.0118	0.0118
Estonia	EST	Non-Islands	12	10050	7296	14889	0.0061	0.0023	0.0105	0.0010	0.0010	0.0010	0.4365	0.4062	0.6120
		Islands	2	11104	10935	11274	0.0078	0.0070	0.0086	0.0010	0.0010	0.0010	0.3962	0.3960	0.3963
Finland	FIN	Non-Islands	3	25451	22753	27164	0.0201	0.0120	0.0351	0.0813	0.0552	0.1244	0.1086	0.0831	0.1488
		Islands	1	37193	37193	37193	0.0168	0.0168	0.0168	0.5130	0.5130	0.5130	0.5217	0.5217	0.5217
France	FRA	Non-Islands	20	26583	23999	30593	0.0163	0.0053	0.0299	0.1010	0.0231	0.4655	0.1010	0.0231	0.4655
		Islands	11	18148	4066	34352	0.4454	0.0448	0.8337	0.6104	0.0174	0.9965	0.6232	0.0174	0.9965
Greece	GRC	Non-Islands	9	21228	15356	34067	0.0125	0.0067	0.0189	0.0824	0.0395	0.3405	0.2038	0.1465	0.4029
		Islands	3	21018	17192	24536	0.0252	0.0172	0.0317	0.1641	0.0397	0.2270	0.2576	0.1489	0.3149
Honduras	HND	Non-Islands	16	2327	1242	4683	0.0074	0.0031	0.0161	0.0297	0.0008	0.3797	0.0785	0.0010	0.7433
		Islands	1	4439	4439	4439	0.0122	0.0122	0.0122	0.2755	0.2755	0.2755	0.2755	0.2755	0.2755
India	IND	Non-Islands	29	2986	740	8157	0.0572	0.0166	0.1061	0.6781	0.3721	1.0000	0.6781	0.3721	1.0000
		Islands	1	3397	3397	3397	0.1019	0.1019	0.1019	0.6766	0.6766	0.6766	0.6766	0.6766	0.6766
Indonesia	IDN	Non-Islands	21	3313	1478	16211	0.0534	0.0058	0.1472	0.4082	0.0829	0.5999	0.4082	0.0829	0.5999
		Islands	5	1624	905	2648	0.0856	0.0475	0.1276	0.3230	0.0508	0.5253	0.3230	0.0508	0.5253
Italy	ITA	Non-Islands	17	27636	17945	36620	0.0235	0.0043	0.0483	0.2587	0.2028	0.3807	0.2631	0.2028	0.3808
		Islands	2	19798	18088	21508	0.0386	0.0281	0.0491	0.3305	0.3229	0.3381	0.3307	0.3233	0.3381
Japan	JPN	Non-Islands	33	27794	19905	37045	0.0169	0.0022	0.0371	0.0099	0.0099	0.0099	0.0099	0.0099	0.0099
		Islands	13	24365	19874	27745	0.0415	0.0254	0.0737	0.0342	0.0099	0.3254	0.0385	0.0099	0.3793
Netherlands	NHD	Non-Islands	11	32566	25554	43507	0.0052	0.0021	0.0086	0.0632	0.0010	0.2319	0.0632	0.0010	0.2319
		Islands	3	18882	13231	25718	0.3795	0.3487	0.3959	0.8679	0.8371	0.8920	0.8679	0.8371	0.8920
Philippines	PHL	Non-Islands	11	2681	2118	3471	0.0255	0.0053	0.0492	0.3964	0.0143	0.5320	0.3964	0.0143	0.5320
		Islands	4	2309	1616	2785	0.0294	0.0211	0.0430	0.4319	0.4211	0.4608	0.4319	0.4211	0.4608
Portugal	PRT	Non-Islands	4	18700	16382	21789	0.0099	0.0037	0.0174	0.0019	0.0005	0.0049	0.0019	0.0005	0.0049
		Islands	2	22123	18260	25986	0.0649	0.0489	0.0809	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Spain	ESP	Non-Islands	15	26272	18530	34792	0.0157	0.0059	0.0266	0.1364	0.0010	0.2970	0.1364	0.0010	0.2970
		Islands	2	27580	24911	30248	0.0580	0.0288	0.0871	0.0976	0.0010	0.1943	0.0976	0.0010	0.1943
Sweden	SWE	Non-Islands	19	28887	27675	31150	0.0167	0.0034	0.0420	0.0550	0.0420	0.2714	0.0567	0.0420	0.2787
		Islands	1	29866	29866	29866	0.0111	0.0111	0.0111	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420
Tanzania	TZA	Non-Islands	19	1045	605	2036	0.0210	0.0080	0.0331	0.2882	0.2333	0.8532	0.2882	0.2333	0.8532
		Islands	1	910	910	910	0.0195	0.0195	0.0195	0.2388	0.2388	0.2388	0.2388	0.2388	0.2388
United Kingdom	GBR	Non-Islands	11	28878	24887	35109	0.0146	0.0019	0.0326	0.0135	0.0010	0.1100	0.0192	0.0010	0.1100
		Islands	10	28199	4064	76056	0.3500	0.0214	0.8042	0.6022	0.0010	1.0000	0.6022	0.0010	1.0000
USA	USA	Non-Islands	49	42598	27682	143483	0.0826	0.0137	0.2603	0.1440	0.1098	0.2850	0.6706	0.5973	0.7874
		Islands	7	16548	3189	43027	0.5079	0.1484	0.6284	0.6555	0.4171	0.9695	0.8804	0.7873	0.9889

Table 2. Benchmark regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Area	0.00279	-0.0693**	0.0126	-0.0717**	0.0170	-0.0743**
	(0.0247)	(0.0239)	(0.0268)	(0.0234)	(0.0277)	(0.0232)
Island (dummy)		-0.170**		-0.180***		-0.183***
		(0.0591)		(0.0514)		(0.0511)
Overseas Island (dummy)		-1.861***		-1.903***		-1.901***
		(0.440)		(0.356)		(0.347)
Overseas Island x Area (interacted)		0.0988		0.147***		0.147***
		(0.0551)		(0.0418)		(0.0406)
Geodist	-0.150***	0.00360				
	(0.0259)	(0.0277)				
Overseas Island x Geodist (interacted)		-0.504***				
		(0.150)				
Lingdist			-0.0699***	0.0219		
			(0.0167)	(0.0149)		
Overseas Island x Lingdist (interacted)				-0.263***		
				(0.0481)		
Ethndist					-0.0569***	0.0280
					(0.0157)	(0.0158)
Overseas Island x Ethndist (interacted)						-0.271***
						(0.0476)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	9.249***	10.48***	9.315***	10.64***	9.369***	10.70***
	(0.243)	(0.256)	(0.237)	(0.228)	(0.231)	(0.229)
N	446	446	446	446	446	446
adj. R^2	0.887	0.899	0.880	0.905	0.877	0.906

Variables expressed in logarithms. Robust standard errors in parentheses.
OLS estimates. Dependent variable: regional GDP *per capita*.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3. Robustness: London region as a frontier

	(1)	(2)	(3)	(4)	(5)	(6)
Area	-0.0149	-0.0947***	-0.00740	-0.0747**	0.00897	-0.0842***
	(0.0278)	(0.0233)	(0.0244)	(0.0236)	(0.0278)	(0.0232)
Island (dummy)		-0.250***		-0.201***		-0.213***
		(0.0569)		(0.0546)		(0.0538)
Overseas Island (dummy)		-2.674***		-1.597***		-2.085***
		(0.505)		(0.368)		(0.399)
Overseas Island x Area (interacted)		0.137**		0.145**		0.186***
		(0.0494)		(0.0442)		(0.0463)
Geodist to London	-0.227***	0.199*				
	(0.0490)	(0.0852)				
Overseas Island x Geodist to London (interacted)		-0.686***				
		(0.161)				
Lingdist to London			-0.206***	-0.0685		
			(0.0426)	(0.0461)		
Overseas Island x Lingdist to London (interacted)				-0.183***		
				(0.0486)		
Ethndist to London					-0.152***	0.0559
					(0.0427)	(0.0474)
Overseas Island x Ethndist to London (interacted)						-0.268***
						(0.0513)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	9.904***	11.73***	10.35***	11.06***	9.825***	11.19***
	(0.272)	(0.347)	(0.252)	(0.248)	(0.229)	(0.340)
N	467	467	467	467	467	467
adj. R^2	0.876	0.898	0.884	0.898	0.872	0.897

Variables expressed in logarithms. Robust standard errors in parentheses.
OLS estimates. Dependent variable: regional GDP *per capita*.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4. Robustness: the region with the highest GDP within the country as a frontier

	(1)	(2)	(3)	(4)	(5)	(6)
Area	0.0284	-0.0727**	0.0327	-0.0591*	0.0385	-0.0642**
	(0.0248)	(0.0252)	(0.0263)	(0.0247)	(0.0274)	(0.0247)
Island (dummy)		-0.172**		-0.151**		-0.163**
		(0.0607)		(0.0548)		(0.0543)
Overseas Island (dummy)		-2.439***		-1.801***		-1.833***
		(0.418)		(0.347)		(0.341)
Overseas Island x Area (interacted)		0.184***		0.153***		0.152***
		(0.0485)		(0.0424)		(0.0413)
Geodist to max GDP	-0.114***	0.00474				
	(0.0229)	(0.0251)				
Overseas Island x Geodist to max GDP (interacted)		-0.456**				
		(0.158)				
Lingdist to max GDP			-0.0650***	-0.00560		
			(0.0145)	(0.0126)		
Overseas Island x Lingdist to max GDP (interacted)				-0.201***		
				(0.0418)		
Ethndist to max GDP					-0.0458***	0.00917
					(0.0129)	(0.0127)
Overseas Island x Ethndist to max GDP (interacted)						-0.222***
						(0.0416)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	9.202***	10.51***	9.194***	10.35***	9.280***	10.49***
	(0.253)	(0.273)	(0.238)	(0.224)	(0.235)	(0.229)
N	446	446	446	446	446	446
adj. R^2	0.893	0.911	0.892	0.912	0.889	0.913

Variables expressed in logarithms. Robust standard errors in parentheses.
OLS estimates. Dependent variable: regional GDP *per capita*.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5. Robustness: Geography and Cultural distance

	(1) Lingdist	(2) Ethndist	(3) Lingdist	(4) Ethndist	(5) Lingdist	(6) Ethndist
Area	0.0300	0.0330	0.0499*	0.0327	0.0481	0.0538
	(0.0483)	(0.0494)	(0.0230)	(0.0209)	(0.0618)	(0.0637)
Island (dummy)	0.159	0.0820	0.0706	-0.0649	0.291	0.202
	(0.235)	(0.228)	(0.0594)	(0.0331)	(0.276)	(0.274)
Overseas Island (dummy)	1.846	1.379	3.077***	0.540	0.538	-0.180
	(1.227)	(1.303)	(0.838)	(0.674)	(1.230)	(1.326)
Overseas Island x Area (interacted)	0.118	0.119	-0.116	-0.0630	-0.000869	0.00419
	(0.160)	(0.171)	(0.125)	(0.113)	(0.122)	(0.131)
Geodist	0.293***	0.301***	0.181	0.622***	0.267**	0.276**
	(0.0850)	(0.0890)	(0.198)	(0.163)	(0.0989)	(0.101)
Overseas Island x Geodist (interacted)	0.450	0.333	0.999***	0.373	-1.373**	-1.586**
	(0.577)	(0.636)	(0.292)	(0.309)	(0.513)	(0.555)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-5.833***	-5.798***	-0.134	1.088**	-6.125***	-6.099***
	(0.704)	(0.714)	(0.485)	(0.383)	(0.819)	(0.839)
N	452	452	473	473	452	452
adj. R^2	0.704	0.674	0.822	0.697	0.663	0.651

Variables expressed in logarithms. Robust standard errors in parentheses.
OLS estimates. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figure 1. The distribution of GDP *per capita* in the island regions included in the database

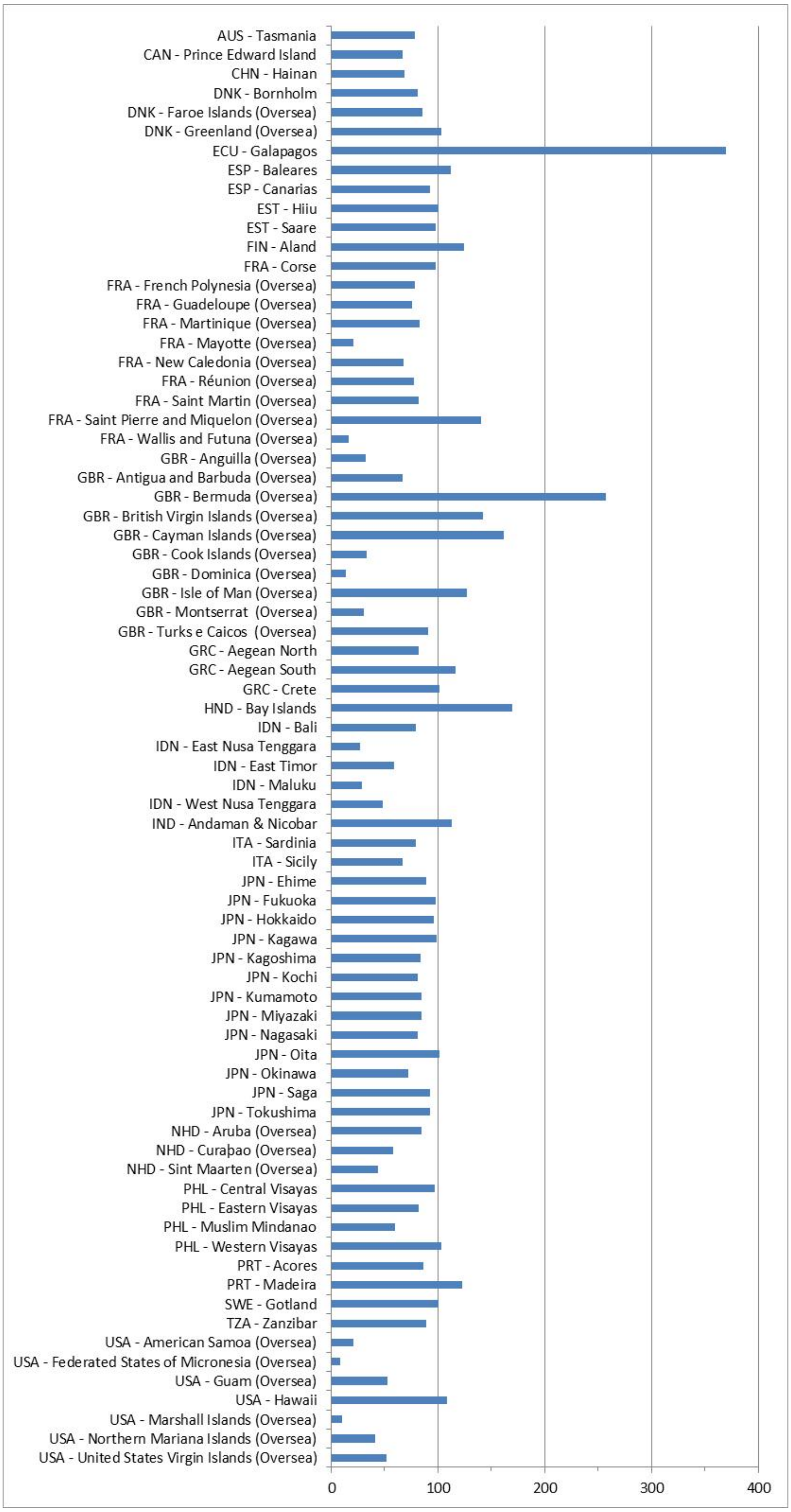
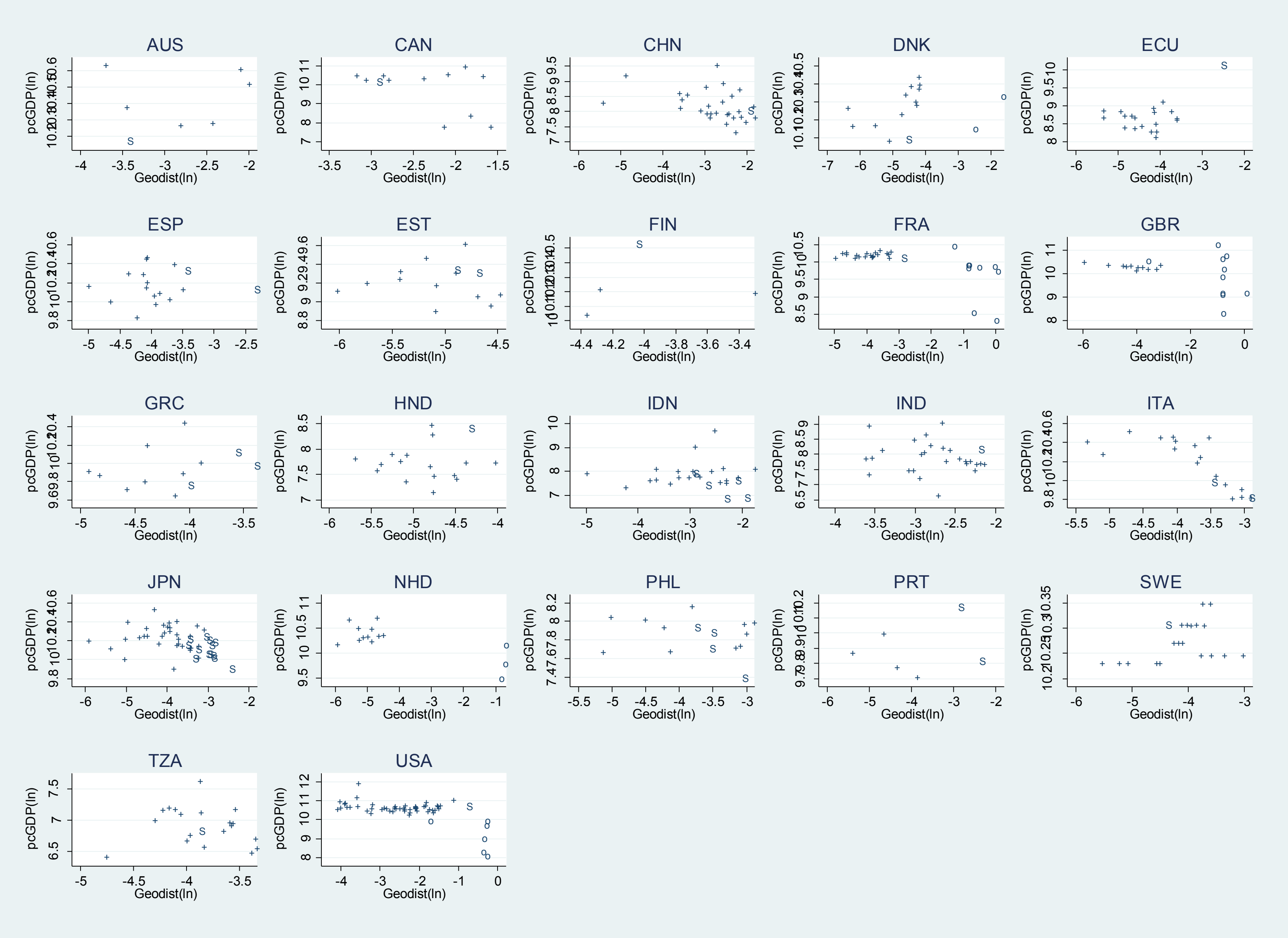


Figure 2. GDP *per capita* and the geographical distance from the local frontier (by country)



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