THE ESTIMATION OF THE COSTS OF INSULARITY THROUGH A REGRESSIVE ECONOMETRIC MODEL APPLIED TO SICILY[1]

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1. Premise

The geographic insular nature, which characterizes some territories and their communities determines a peculiar condition of periphery and specific accessibility problems, sometimes associated with the presence of structural delays in development processes. The wide multidisciplinary literature of reference traces the specific disadvantage of island territories compared to continental ones to many factors: the limited territorial dimension of the markets and the variety of products, the logistical dependence on air and sea transport, the amplified impact of climate change, the difficulty of actions aimed at resilience, the reduced socio-demographic dynamism (Armstrong and Read, 2004). The result is a peculiar framework of constraints on the sustainability of development processes and a specific inelasticity to economic dynamics. These factors translate into an objective condition of economic and competitive disadvantage compared to continental territories.

Due to its orographic nature, in the European Union, the insular-continental dualism is a dimension that is structurally intertwined with the debate on development and territorial cohesion, even in the presence of limited attention to the insular dimension of policies aimed at supporting precisely the processes development and cohesion in the Union. In the EU-28 it is estimated there are 2400 inhabited islands, belonging to 13 Member States. Over 20.5 million inhabitants, 4.6% of the EU population, live (data as of 2020) in NUTS 3 island regions. It is certainly true that Articles 174 and 349 of the TFEU (Treaty on the Functioning of the European Union) that islands are territories with certain geographical specificities, although the economic policies of the Union do not present specific lines for island territories.

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Only, this year, on 21 April 2022, the Regional Development Committee of the European Parliament adopted the resolution "Islands and cohesion policy: current situation and future challenges", which will be voted on by Parliament in plenary session next June. It is the first official document of the Union which calls for the definition of a specific policy area for island territories. From a Euro-Mediterranean perspective, the insularity and sustainability of development and cohesion processes becomes central.

The cost of being an island is intertwined in the Mediterranean with the impact of the sequence of structural shocks that have hit the globalized economic system in sequence in the last three years (contractions in demand, production capacity, availability of raw materials and primary products, energy supply) by changing the real nature of economic fluctuations and medium-long term cycles. The Mediterranean, primary corridor of globalization, is deeply affected by the effects of the current crisis which could have a more drastic and profound impact on the resilience of island economic systems, characterized by factors of dependence and inelasticity that are more pervasive than continental systems (Deidda, 2015).

However, despite the strong emphasis on the economic dimension of the island question and the related debate on targeted development and cohesion policies, the number of contributions and the variety of arguments among economists are still significantly limited. Yet, the data on the gaps due to insularity, as the case of Sicily clearly shows, returns an alarming picture that highlights employment imbalances, high poverty, high costs for transport, widespread margins, reduced internationalization and a decisive infrastructural inequality.

Recently, some examples of evaluation exercises have been published aimed at estimating the socio-economic impact deriving from the condition of insularity on a given territory and it is understood that there is no univocal shared method, also due to the lack of unambiguous methodological orientation and/or political-strategic in defining insularity.

In this paper we have tried to offer a contribution to the economic debate on insularity, starting from the theme of measuring the disadvantage deriving from the state of insularity in economic terms. The relevance of the estimate of the costs of insularity for Sicily leads us to reflect on the need to extend the application of the study to other territorial contexts of the EU. This would allow, on the one hand, the definition and proposition of specific public intervention assets on a European scale, complementary or modular to those to be defined at Member State level, and, on the other hand, to base the sizing on verifiable quantitative parameters. financing of a specific investment policy aimed at cohesive action for European island territories based on trajectories of inclusive and sustainable development.

2.   Reference regulatory context

A study on insularity cost in the largest European and Mediterranean island may seem an ambitious work, considering the wide dimension of regional population, wealth, goods, transport and economic target, as well as present serious economic crisis due to COVID-19 pandemic and most urgent emergency measures which are now the highest priority. The condition of insularity, pursuant to article 174 and foll. TFEU and art. 119 (revised) of the Italian Constitution, must be addressed by implementing specific rebalancing measures (territorial continuity, tax benefits, economic development measures, infrastructural improvement, aid schemes, etc.) (Fois, 1999; Frosini, 2007; Meloni *et al.,* 2015). Their goal is not only to fulfil the known principles of European and national law, but above all to implement concrete legislative measures to balance an economic gap and related "insularity cost", ensuring to Sicilian citizens equal treatment and social rights[2].

Article 174 TFEU is the main pillar of European social, economic and territorial policy of cohesion. As generally known, the first and second paragraphs state that the EU aims at reducing the economic development gap among regions by strengthening cohesion policies, while the third paragraph states that a particular attention must be paid to those regions suffering from serious and permanent geographical disadvantages, including islands (Armao *et al.,* 2016).

Unfortunately, despite several specific statements on this subject by the European Parliament (the latest was "Special situation of islands", European Parliament resolution, 4 February 2016), the European Committee of Regions ("Entrepreneurship on Islands: contributing towards territorial cohesion", Opinion of the European Committee of Regions 2017 / C 306/10, May 2017) and other less important bodies, the "condition of insularity" is still considered as a marginal aspect within cohesion policies and ESI funds' implementation[3].

In the European Document on 2021-2027 Planning, approved by the Conference of Italian Regions on 21 February 2020, it was highlighted, among other things, that post-2020 cohesion policy should consider carefully islands' situation, recognize their strategic role and create the conditions for their equal and coherent development compared to other European areas. More specifically, the

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[2] It should be remembered that Italy, after Brexit, has become the European country with the largest island population, over 6.6 million inhabitants (12% of them live in Sardinia and Sicily and the latter is now the largest European island) out of the total 17 million European islanders, consequently it has to focus on the condition of insularity as of its main public policy priorities.

[3] A total of 17.7 million people live in 362 islands with over 50 inhabitants in 15 European countries (3.7 million in outermost regions and over 6.6 million in Sicily and Sardinia); in these regions GDP per capita is under 80% of EU average and a significant part of them still belong to under-developed region category.

European Institutions were formally requested to adopt regulations and planning schemes to balance territorial discontinuity, defining a specific "insularity index" depending on territorial extension, population, geographical and travel distance from the continent and most developed national areas. The final goal is to promote a islands' social, economic and environmental development in urban areas as well as inland isolated areas, with fewer population and services, according to the provisions of TFEU art.174.

With reference to national law and insularity status, despite the previous fund cancellation provided for by Article 119, third paragraph of the Constitution, later eliminated in 2001 reform text, public law recognises this disadvantage and by Law no. 42 of 2009, Article 27, guarantees the adoption of rebalancing measures like tax benefits, infrastructure enhancement and implementation of equal conditions. According to this provision, "following the failure to redefine financial relations between the State and the Autonomous Region of Sardinia in accordance with Article 27 of Law no. 42 of 2009, it should be noted that, almost ten years after the enactment of this law, the insularity issue and its disadvantages has never been taken into consideration in the definition of revenue and expenditure budgets for autonomous regions".

Therefore, this rule carries out, for the first time, a more careful interpretation of Article 27 of Law no. 42–2009, which becomes relevant for its constitutional recognition of insularity status, even without a specific quotation within the text of the Constitution itself. It will have crucial effects on financial relations between the State and islands' authorities, as it clearly recognizes "insularity cost" as a key factor to arrange these relations in a complete and appropriate manner[4].


3. Insularity as a condition of disadvantage

Insular regions, either nearest or furthest from the continent, have some basic features that make them different from continental regions. This derives from the incontrovertible fact that insularity, considered as territorial discontinuity, causes several economic, environmental, social, demographic and transport disadvantages to islands compared to continental areas. Insularity has become an important issue within the political, economic and social debate also in the European Union, which includes a great number of small and large islands.

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[4] In line with the above-mentioned concepts, but not included in this research, it is useful to observe that the condition of insularity may be considered as a necessary and sufficient prerequisite to adopt development tax measures consistent with EU Treaties, but not considered as a State aid pursuant to art. 107 and 108 of the TFEU and of Regulation no. 2015/1589 of the EU Council of 13 July 2015.

Sicily has approximately 5 million residents (28 percent of overall island population) and is one of the largest and economically most relevant islands in Europe, with a peculiar geographical insular area including also a smaller island close district. Average GDP per capita of this population is quite modest, that is 79.2% of EU GDP average, so that a significant part of these islands is included among the least developed European regions[5]. In such context, there is a strong wealth and GDP difference among European islands. In Sicily, most of the social and economic indicators, adopted by the European Commission for spatial comparisons between the Nuts2 regions, are below the Italian and European average.

The competitiveness framework is summarized using a complex indicator called the Regional Competitiveness Index (RCI). In this context, Sicily shows negative values in some relevant sectors such as: infrastructures, human resources, innovation and institutional and administrative efficiency (figure 1).

Figure 1 – *Competitiveness Index in 2019, comparison between UE28, Italy and Sicily.*
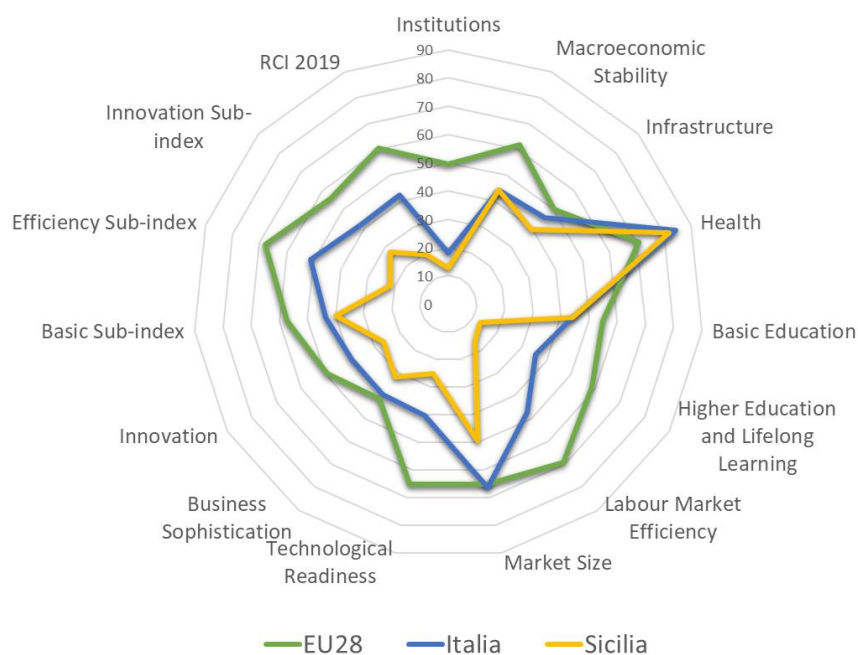
Source: European Commission.

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[5] Corsica Regional Councillor. Entrepreneurship in the islands: a contribution to territorial cohesion (2017/C306/10).

Moreover, even in a national context, Sicily has historically been characterized by a significant gap with respect to other Italian regions, as shown by the main socio-economic indicators. The main macroeconomic data show these differences: in 2018, Sicily GDP per capita was 17,721 Euro, at the penultimate position among Italian regions (followed by Calabria), with a gap of 1.266 Euro compared to the average in Southern Italian regions (figure 3). In the same year, the unemployment rate in Sicily for over 15 population was 21.5%, about 3% below Southern Italy average rate (18.4%) and twice national average rate (10.6%). With regard to gross fixed investments the values in Sicily are nearly always lower than in all Italy and Southern Italy, and tend to decrease more markedly because of its low attitude to investment, especially during 2008 financial crisis, showing its tangible effects until 2015 especially in particularly fragile economic systems, like Sicily.

3.1 *Estimations of insularity cost.*

To start an analytical evaluation procedure, whose results may support policy decisions, the first objective was to carry out a macroeconomic estimation of insularity effects/costs in Sicily, and subsequently to create a more complex model and give a value to any "cost item". It was necessary to carry out a preliminary evaluation of insularity economic impact, which may be a reference to the institutional activity; consequently, after considering the existing studies on the subject. In this study we intend to measure, on the basis of an econometric model referring to a series of explanatory variables, the impact on GDP per capita of appropriate indicators linked to territorial wealth resources. What is obtained is an overall macroeconomic assessment, which, however, may not define the cost of any single component affected by insularity, and is also influenced by the model chosen. The approach, based on the research work carried out in 2020 by IBL Institute (Amenta *et al.,* 2020) follows quite the same econometric model, referred to economic development existing studies, to measure the average annual impact of insularity on GDP per capita and overall GDP; as noticed above, however, it may not give a value to any cost item due to insularity. This model firstly defines an island features from the economic point of view, by pointing out three factors, that must occur jointly: i) small size tendency; ii) remoteness; iii) vulnerability. Specifically, a tendency to create small size entities may cause in turn a tendency to establish a self-referent economy, a less efficient use of productive factors and a condition of structural delay; a remote distance causes a general increase in transport costs, a non-integration in neighbouring markets and related specializing opportunities, an increase in the unitary cost of locally produced and imported goods; finally, vulnerability increases the risk of suffering from the negative

consequences of exogenous economic or environmental shocks. These three factors are strictly linked, so that "the limitations of small-size islands become more serious if they are vulnerable and far from the markets, the limitations of remoteness are wider for vulnerable and small islands and vulnerability has worst effects in small and remote islands. If any of these factors tends to decrease, most of the disadvantages linked to insularity are reduced" (Amenta C., Stagnaro C. and Vitale L., 2020).

3.1. Econometric estimation based on per capita GDP

The application of the econometric model is based on an econometric model used by Bruno Leoni Institute through a panel data dataset reconstructed at regional level and in historical series (2000-2018) on which one was built fixed effects regressive procedure[6] (Bontempi and Golinelli, 2006). Use of panel data, which concern observation more statistical units for two or more periods, allows you to operate using a more powerful information set than data simple as they capture greater variability on subjects and over time periods including that determined by the presence of omitted variables, reducing the risk of collinearity between the variables. The regressive model, with the goal to control the structural factors of the variables, uses the lagged term of the variable dependent within the set of variables explanatory as it assumes that the level current of the dependent variable is strongly determined by its past level. Likewise, all economic variables of the model were deflated by avoid possible distortions in the resulting estimates from different pricing structures in the time and between regions. Finally, the standards errors of the estimated coefficients were corrected for the fact that the comments do not they are independent and identically distributed since the regions appear in the sample repeatedly, an even number of times to the years observed.

The model is as follows[7]:

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[6] For econometric model analysis, GRETL software (Gnu Regression, Econometrics and Time-series Library) was used, a multi-platform package for statistical and econometric analysis written in C programming language, open source and free. A panel is a sample that contains observations on N items for T years, ie. the observations on each element are repeated over a period of time (time series data on each element). In the present case Italian regions are the elements. The fixed effects' model measures the specific effect in a deterministic way, that is, the set of specific characteristics of each element, which however remain unchanged over time.

[7] In details, we have: GDPpc is the annual gross domestic product per capita in Sicily, according to Istat regional data; Distance_continent: a variable that measures the distance from the continent. Obviously, this variable assumes a positive value only for Sicily and Sardinia – ontinent_averagereggio measures the average distance between the routes Cagliari-Rome and Sassari-Rome to Sardinia (495 km) and Palermo-Reggio Calabria and Catania-Reggio Calabria to Sicily

$$GDP_{pcit} = \beta_0 + \beta_1 \ Distance\_continent + \beta_2 \ Interest\_active\_rate_{it} + \beta_3 \ Savings\_GDP_{it} + \beta_4 \ Highway\_sup_{it} + \beta_5 \ Railways\_sup_{it} + \beta_6 \ Publicspending\_GDP_{it} + \beta_7 \ Illiterate_{it} + \beta_8 \ Airports_{it} + \beta_9 \ Interchange\_comm_{it} + \beta_{10} \ Surface_{it} + \beta_{11} \ Ports_{it} + \beta_{12} \ Tertiary \ education \ rate + \varepsilon_{it}.$$

The coefficient of interest in the model is obviously Distance_continent. This coefficient represents a kind of economic penalty on per capita income in function of the unitary increase in distance from the continent and therefore from the state of insularity, which can also be defined as one implicit tax for island residents. This penalty, multiplied by the distance from the mainland, provides a measure approximate loss of GDP per capita regional which, multiplied by the basin of reference of the regions (e.g., population resident), offers a first estimate in terms of total GDP of the cost of insularity.

The choice of model to measure the distances in kilometers is linked to a choice logistics for the movement of goods and goods people. As for the distance from Sicily, the choice focused on nearest province in terms of distance physics (Reggio Calabria), Obviously this choice, on which I am in further study course, represents a first, reasonable and prudential proxy of the concept of distance, in a broad sense, come on reference economic markets, identifying the continental point geographically closer.

The results of the application are reported in table 2. Specifically, we can observe how the distance coefficient from the peninsula both negative and strongly significant.

The model achieves a loss of GDP per capita equal to 1,246 euros, (calculated on basis of the estimate of the cost in terms of GDP per capita for every kilometer of distance, or 6.81 multiplied by the average of distances of Palermo-Reggio

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(183); Interest_active_rate is the average active interest rate of regional banks, data source is the Bank of Italy; Savings_GDP is a proxy of regional savings' amount, based on the ratio between the amount of bank deposits and regional GDP, according to Bank of Italy data; Highway_sup measures the ratio between highway network kilometres and regional extent. Data source is Istat; Railways_sup measures the ratio between railway network kilometres and regional extent. Data source is Eurostat; Publicspending_GDP is the amount of regional public expenditure. Data source is Istat; Illiterates means the illitterate population rate in different regions; in particular, this variable is calculated as a ratio between the number of illiterates and the resident population according to 2011 census. This variable represents a human capital proxy. Data source is Istat; Airports means the number of airports recognized by Enac (military or inactive airports are excluded). Data source is ENAC; Interchange_comm is the variable that represents the ratio between Import and Export total amount and Gross Domestic Product in different regions. Data source is Istat; Surface means regional territorial extent; In the Variant model we have the following integrations in regressor composition: Ports means the number of ports in a region. Data source is Istat; Tertiary education rate indicates the ratio between 30-34 aged population with a 5/6 education level (Isced7) and the total amount of same aged population. Data source is Istat.

Calabria and Catania- Reggio Calabria equal to 183 kilometers). Taking into account the confidence interval 95 percent of the cost of insularity for Sicily it is in the gap between 500-2000 euros per capita. In terms of GDP overall it is possible to estimate the cost annual insularity for Sicily in about 6.2 billion euros equal to 7 percent of GDP (table 3 and 4).

Table 1 - *Regression estimates.*

Variables	GDP_pc	
β_1*Continent_averagereggio*	**-6,81**	***
β_2*Interest_active_rate$_{it}$*	-2,85	***
β_3*Savings_GDP$_{it}$*	2,99	***
β_4*Highway_sup$_{it}$*	5,09	***
β_5*Ferrovie_sup$_{it}$*	-9,07	***
β_6*Publicspending_GDP$_{it}$*	-4,76	***
β_7*Illiterate$_{it}$*	-9,10	***
β_8*Airports$_{it}$*	4,52	***
β_9*Interchange_comm$_{it}$*	-7,31	***
β_{10}*Surface$_{it}$*	-1,09	
β_{11}Ports$_{it}$	-9,89	***
β_{12}Tertiary education rate	-4,37	***
Costant	16,71	***
Observations	*380*	
R-squared LSDV	*0,8209*	
R-squared	*0,8202*	

Source: NVVIP elaborations on IBL model
and Istat/Eurostat data
*** *significance level at 99%*

Table 2 - *Insularity cost estimates and referring parameters.*

GDP current prices	88.843 millions of euro
GDP per capita	17.721
Resident population (2018)	4.999.981
Insularity cost (absolute value)	6.231 millions of euro
Insularity cost/GDP	7,0%
GDP lost per capita	1.246 euro

5. Some concluding remarks

The condition of a territory penalized by limiting geographical specificities such as periphery, insularity or poor accessibility, is common to many EU regions and requires the adoption of contrasting political choices which, however, must be commensurate with the extent of the disadvantages that must be mitigated or removed, but also the possible benefits that could derive from it. In particular, insularity, understood as territorial discontinuity, determines further criticalities of an economic, transport, environmental, social and demographic nature that determine an objective disadvantage compared to continental territories as noted in the extensive reference literature. In the face of growing attention on this issue both at national and at European level, there are few works of an economic nature that give results suitable for guiding policy actions.

In this work we have tried to provide an estimate of the possible costs linked to

the island condition of Sicily, using an approach based on the analysis of the main elements that determine the development of an island territory identified in the factors "size", "distance" and "vulnerability". These factors were measured through some proxy variables placed in historical series and referred to the last twenty years for all Italian regions and following the application of a regressive model, an econometric estimate was obtained that quantifies the cost of insularity for Sicily. approximately 6.23 billion euros per year, equal to 7.0 per cent of regional GDP.

We need more refined estimation models, more adherent to regional specificities or based on different approaches including those based on ecosystem "pillars" or on specific compound indices which, beyond the gross domestic product, take into consideration all the dimensions of well-being. can (and must) be developed, in order to prepare further evaluation exercises. In addition to further approaches, other costs could also be investigated to complete the big picture. These include i) the costs to be incurred for an infrastructural equalization work, or for the realization of investments in public works in the logic of territorial continuity, ii) the costs to be borne centrally to create a tax advantage aimed to attract companies that have relocated abroad to the disadvantaged area by giving an incentive to back-shoring, a phenomenon particularly useful for supporting the strategies to reduce global value chains stimulated by the shock of the pandemic that is still underway, iii) costs related to impoverishment of the environment and ecosystems due to oil extraction and the product that is refined for over 40% in Sicily, certainly not compensated by royalties and finally iv) the costs related to the performance of the educational system that we can consider as a proxy of human capital since, as CRENoS has highlighted, being geographically isolated from the rest of the ter national territory constitutes a significant disadvantage in attracting students and teachers from outside[8].

To conclude, the reflections that emerged within this work lead in the direction of imagining that the convergence of island areas must be pursued following a short and long-term strategy and through targeted policies that certainly look at the more strictly growth profiles (therefore, quantitative) and development (ie also qualitative) with consequent choices that must be oriented towards respect for the territories and suited to inclusive and sustainable development. This, from a political point of view, should lead not to a simple economic claim, but rather (alongside it) to the definition of a specific finalization of the resources claimed by priority of intervention", in order to guarantee their destination to the removal of the causes of disadvantage linked to insularity, while offering greater solidity to the request for specific interventions aimed at compensating the costs of insularity because it would define a formal commitment aimed at real structural overcoming

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[8] Rapporto Crenos 2020, Cuec, pp. 168-172.

of the reasons for disadvantage from insularity.

Acknowledgements

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SUMMARY

The geographic nature of the islands determines a peculiar condition of peripherality and specific accessibility problems often associated with the presence of structural delays in development processes. Data on the gaps due to insularity, as the case of Sicily clearly shows, returns an alarming picture that highlights employment imbalances, high poverty, high costs for transport, widespread margins, reduced internationalization and a decisive infrastructural inequality.

In this work we have tried to offer a contribution to the meager debate on insularity, starting from the measurement of the disadvantage of insularity in economic terms. For Sicily, an estimate of the costs related to the insularity was drawn up using a regressive econometric approach based on the analysis of some factors that determine the development of an island territory, namely "size", "distance" and "vulnerability". The study produced an estimate that quantifies the cost of insularity for Sicily at approximately 6.23 billion euros per year, equal to 7.0 percent of regional GDP.

The relevance of the issue requires that it also be referred to other territorial contexts and to more defined methods, with the main aim of defining and proposing specific public intervention assets and basing on verifiable quantitative parameters, the financial dimensioning of a specific investment policy aimed at a cohesive action for island territories based on inclusive and sustainable development trajectories.

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