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Regional drivers of land take: A comparative analysis in two Italian regions

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1. Introduction

Notwithstanding the growing interest in measuring its magnitude, and assessing its unwanted consequences, a rigorous and unambiguous definition of land take has not been provided yet. In itself, "land take" is a Euro-English expression which is usually and variously associated to urban and other artificial land developments and to the loss of agriculture, forest and other natural or semi-natural land. Among the various extant definitions, and following Zoppi and Lai (2014, 2015) we choose the operational definition provided by the European Environment Agency (EEA) (2013), which defines land take as the "Change of the amount of agriculture, forest and other semi-natural and natural land taken by urban and other artificial land development. It includes areas sealed by construction and urban infrastructure as well as urban green areas and sport and leisure facilities".

The reason for this choice is that the selected definition allows for a quantitative assessment of the phenomenon over the years, provided that consistently produced measurements of artificial land are available within the chosen time frame.

The very lack of such consistently produced, hence comparable, measurements is the main reason that explains the conflicting assessments of worldwide magnitude of land take. Assessments of artificial land range from 0.18% of the world land area in the '90s (Hansen et al., 2000:1350) to 0.20% in 2000 (European Commission, Joint Research Centre, 2003), to 0.88% in 2010 (Chen et al., 2014), and it is indisputable that in such years a significant land take occurred globally. However, to compare such data in order to derive a quantitative assessment of land take would be wrong because of the irreconcilable differences in data production.

At the National (Italian) level, a recent report produced by the National Research Institute for the Protection of the Environment (ISPRA, 2015, pp. 10–11) shows that land take has increased steadily – albeit with a slight decrease in pace in the latest years – from 8,100 km^2 (equaling 2.7% of the national land mass) in the '50s to approximately 17,000 km^2 (5.7%) in the '90s, to 21,000 km^2 (7.0%) in 2014.

Within this context, we analyze and compare land-taking processes in two Italian NUTS2 regions, Liguria and Sardinia, by building upon two previous studies by Zoppi and Lai (2014, 2015) that estimate the magnitude of land take in Sardinia over two different timeframes (2003–2008 and 1960–2008 respectively), analyze Sardinian drivers of land take, and assess their quantitative impacts.

The aim of this paper is therefore to understand whether land take processes in Liguria and in Sardinia over two similar time periods were influenced by the same drivers or whether regional peculiarities must be taken into account to explain differences. The results of this comparison are of particular relevance in terms of policy making and evaluation, since this paper highlights that the main differences between the two case studies are related to different regional policies and planning measures in force in the two selected studies, while the significance and the impact of other drivers is quite similar in the two regions.

This paper is organized as follows. The second section provides the reader with a definition of land take, followed by a presentation of the case studies and by a preliminary identification of potential drivers of land take. In the third section, data on the magnitude and the trend of land take in the two regional selected case studies and chosen timeframes are presented; next, we provide the results of the econometric model correlating land take and its drivers, as well as regional inferences drawn upon the results. Finally, in the

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fourth and concluding section, we discuss relevant similarities and differences that should be taken into account to define customized regional planning policies that help limit land take.

2. Land take and its drivers

2.1. Defining land take

To identify an agreed-upon measure of land take is difficult for a number of reasons, among which the most important is the definition of land take itself. Among the various available definitions, we choose to follow the one provided by the European Environment Agency (2013), according to which land take is the "Change of the amount of agriculture, forest and other semi-natural and natural land taken by urban and other artificial land development. It includes areas sealed by construction and urban infrastructure as well as urban green areas and sport and leisure facilities".

If we agree on the above definition, then land take occurs when a piece of land, classed as agricultural or forestry or natural land in a given year, in a subsequent year is "taken" by artificial land development. Artificial areas, in the definition of land take provided by the EEA, include, but are not limited to, sealed surfaces and urban areas. Small green areas surrounded by built-up areas, for instance, are included within artificial areas, as well as natural or seminatural areas in low-density outskirts (Comber, 2008; Serra et al., 2008; Ferreira et al., 2010; Sharma et al., 2012; Başnou et al., 2013).

From this standpoint, the Corine Land Cover (CLC) classification is quite handy to assess quantitatively land take for two reasons. First, it groups land cover types into five main classes at Level 1: (1) artificial areas, (2) agricultural areas, (3) forests and seminatural areas, (4) wetlands, and (5) waterbodies; hence, land take as defined by the EEA can be measured as the size of areas that were classed as non-artificial classes (that is, belonging to classes 2, 3, 4, or 5 as above listed) in a given year and that are classed as artificial (that is, belonging to class 1) in a subsequent year. Second, available and comparable datasets based on this classification exist, which in principle makes it possible to obtain consistent measures across Europe and in different timeframes.

2.2. The two regional case studies

Two Italian coastal regions, Sardinia and Liguria (Fig. 1), in which the relation inland-coastal area dramatically changed in the XX century, are here chosen as case studies because of two main reasons: first, the population shift from rural to the main (and coastal) urban areas; second, the significance of tourism-related land development. The two above factors jointly contribute to exacerbate the differences between inland and coastal areas in terms of population and income. A second common aspect is the fairly large number of municipalities in the two regions (377 in Sardinia, which spans over approximately 24,000 km^2 and has a population of about 1.64 million people in 2011, and 235 in Liguria, which has an area of around 5400 km^2 and a population of about 1.57 million people in 2011), which in Italy are responsible for granting planning permits and for building and maintaining local infrastructure. Moreover, in both regions, strong planning rules have been recently implemented in order to control development and transformation of land in areas deemed as worth preserving for their landscape characteristics or natural assets.

2.3. Potential drivers of land take in the context of the two case studies

After Zoppi and Lai (2014, 2015) and in accordance with Lambin et al. (2001) and Veldkamp and Lambin (2001), we hypothesize that land take is affected by physical aspects, by spatial planning-related factors, and by social determinants.

Among physical factors we include the average size of a municipality's non-artificial-land areas at the beginning of each time period that became "artificialized" (meaning that they can be classed as "artificial" in the CLC) by the end of that period, as well as their slope and their distance from the nearest town[1]; we also include accessibility (in terms of: endowment of roads[2], proximity to the regional administrative capital center, proximity to the closest province administrative center); finally, we also consider the distance from the shoreline.

Among factors related to spatial planning we consider the presence and endowment of nature conservation areas (such as national parks, regional parks, nature reserves, Sites of Community Importance Special Protection Zones, Special Conservation Areas, Ramsar sites: see Pileri and Maggi (2010) for a comparative analysis in the Italian territory), and of natural and seminatural areas as defined in the planning instruments in force in the two regions (the Sardinian RLP in Sardinia and the Landscape Plan in Liguria, next LP). Next, because the regional planning tools in force in the two regions differ in defining areas that should be either more suitable for, or less prone to, urbanization, for each time period here considered for Sardinia we include the amount of area that was included in the so-called "coastal strip" as defined in the same RLP, or in which land transformation was not allowed under the previous landscape plans in force until 2006. For the Liguria region, strict building restrictions are in force in a 300-m buffer zone along the shoreline, and "softer" restrictions in a 1,000-m buffer zone along the shoreline, hence we consider these two variables. Moreover, we also include for each time period the amount of area that was artificialized and that was classed either as "conservation" or as "maintenance" areas in the Liguria LP in force since 1991. "Conservation" areas are defined in the LP as areas in which new development and infrastructure are forbidden so as to preserve current features and built volume, and to prevent the sealing of previously non-sealed surfaces, whereas in the so-called "maintenance" areas increase in built volume is allowed, provided that such increase does not entail transformation of rural settlements into urban ones. However, the implementation of the plan provisions was not straightforward, especially in the western part of the region, where new development entailed the rise of new "hybrid" (rural-urban) settlements.

Among social determinants we here consider residential density, which accounts for spatial polarization of urban settlements.

Finally, a series of Moran tests was performed in order to derive an autocorrelation-related spatially-lagged dependent variable (Anselin, 1988, 2003), under the assumption that proximity to areas that have been artificialized also plays a role in affecting land take.

The full list of potential drivers is provided in Table 3, together with their definitions and motivation for their selection on the basis of the literature.

[1] The centroid of a town's built-up area was used to calculate the distance.

[2] We only included those roads that the Italian Code concerning Road Regulation (Italian law enacted by Decree n. 1992/285) classifies as "Highways", "Main extra-urban roads" and "Secondary extra-urban roads"; this means that basically only roads connecting towns and city centers were included in our analysis, leaving aside minor tracks and dirt roads. In the Sardinian case, the layout of such roads is provided within the so-called "Regional Multiprecision Spatial Dataset" (available from http://www.sardegnageoportale.it/index.php?xsl=1598& s=291551&v=2&c=8831&t=1); for the Liguria region within the so-called "Topographic Database" (available from http://www.cartografia.regione.liguria.it/apriFoglia.asp?itemID=30102&fogliaID=1237&label=Carta%20Tecnica%20Regionale%201:5000%20dal%202007%20-%20II%20Edizione%203D%20/%20DB%20Topografico).