An analysis of regional drivers of land take over a 50-year time span: The case of Sardinia, Italy

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Abstract

Land take is a significant issue in the European Union (EU), where, according to the Communication of the European Commission no. 571 of 2011, no net land take should be achieved by 2050 and impacts on land take should be taken under strict control. It is therefore vital not only to understand what the main drivers of land takes are, but also whether they act similarly over time. To this end we analyze land-taking processes over two time periods, 1960-1990 and 1990-2008,and take the region of Sardinia as a case study so as to investigate if the main drivers of land take identified in previous studies bring about similar, or different, effects in the two periods.

Keywords

Land take, Spatial planning, Regression models

Introduction

A comprehensive and agreed-upon definition of land take has yet to be provided, as contrasting definitions and hence measurements coexist. Among others, the operational

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definition 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", was here chosen. Consistently with a previous paper of ours (Zoppi and Lai, 2014), we do not propose normative judgements on land take; rather, we aim at understanding what factors can explain it and whether drivers of land take act similarly across time by looking at the island of Sardinia (Italy) in two time periods, 1960-1990 and 1990-2008.

We consider land take as related to physical and planning code determinants, and to social variables, by using the same covariates as Zoppi and Lai (2014). Because of constraints on data availability, in order to estimate land take we integrated various spatial data sources, among which the Regional Landscape Plan of Sardinia (RLP) to map artificial land as of 1960, the Urban Morphologic Zones (UMZ) identified by the EEA to map artificial land as of 1990, and finally the regional Corine Land Cover Map to identify artificial land as of 2008. As far as explanatory variables are concerned, among physical potential drivers we include the average size (PSIZ), slope (SLOP) and distance from the closest urban center (PRS) of areas that were "taken" in a given time period; accessibility, in terms of endowment of roads (ACCESS), proximity to the regional capital center (DISTCAPC), proximity to the nearest province administrative center (DISTNEAC); distance from the coast (DISC). Planning-code-related drivers include areas where various kinds of building restrictions are or were in force, such as nature conservation areas (CONSAREA); areas classed as natural and semi natural areas (NAT) or as agricultural and forestry areas(AGFO) by the RLP; areas located in the so-called "coastal strip" (COASTRIP) as identified by the RLP; areas with severe building restrictions under the former landscape plans (in force from 1993 to 2006) (OLPL). Socio-economic drivers include population density (DENS), as several studies highlight its positive agglomeration effect on land take (among many, Sklenicka, 2013; Guiling et al., 2009). Finally, a spatially-lagged dependent variable was also included to avoid biases in the model's estimates. Our spatial units coincide with the 377 municipalities of Sardinia, and the values that each variable takes in each municipality in a given time period were calculated by means of GIS.

Results

An ordinary-least-squares (OLS) model was used and two preliminary OLS regressions (one with the actual values of the explanatory variables and one with their logarithms) were used for each period; since the linear models' fitness (80%) is greater than that of the log-linear one (73%), we chose the former.

The estimates related to the 1960-1990 time period unveil significant correlations for: the average size of areas classed as non-artificial in 1960 and artificial in 1990 (PSIZ); the size of areas (both natural and agriculture/forestry) included within the landscape components having environmental value that become artificial (NAT and AGFO); the percentage of a municipality's area included in the coastal strip (COASTRIP); the municipality's area classed in the planning code in force before 2006 as areas where strict building restrictions applied that became artificial between 1960 and 1990 (OLPL); the residential density (DENS); and the spatially-lagged dependent variable (AUTC). With the exception of the weighted average slope (SLOP), which does not appear to influence land take in the 1960-1990 period, all the remaining variables show somewhat significant correlations. The estimates related to the 1990-2008 period are consistent with the 1960-1990 estimates for most of the variables. Both estimates are summarized in Table 1.

Table 1 – OLS results, dependent variables PLT6090 (1960-1990 period) and PLT9008 (1990-2008 period).

	1960-1990 period			1990-2008 period		
Variable	**Coefficient$_i$**	**t-statistic**	**Hyp. test: coeff.=0**	**Coefficient$_i$**	**t-statistic**	**Hyp. test: coeff.=0**
Constant	-0.9315	-3.413	0.0007	-1.7298	-3.514	0.0005
PSIZ	0.1122	10.627	0.0000	0.8553	12.588	0.0000
SLOP	0.0018	0.174	0.8621	-0.0150	-1.073	0.2839
PRS	-0.0740	-1.494	0.1361	-0.0232	-0.336	0.7372
ACCESS	0.2315	1.618	0.1065	0.7924	4.239	0.0000
DISTCAPC	-0.0018	-1.944	0.0527	0.0011	0.890	0.3741
DISTNEAC	0.0073	1.867	0.0627	0.0050	0.917	0.3596
DISC	0.0066	1.299	0.1947	-0.0023	-0.302	0.7626
CONSAREA	-4.1E-05	-1.624	0.1053	-7.0E-05	-2.189	0.0293
NAT	0.0337	5.359	0.0000	-0.0024	-0.450	0.6532
AGFO	-0.0290	-3.517	0.0005	0.0018	0.841	0.4011
COASTRIP	0.1483	4.499	0.0000	0.1201	2.712	0.0070
OLPL	0.0037	4.397	0.0000	0.0006	0.447	0.6553
DENS	0.0075	17.616	0.0000	0.0026	6.261	0.0000
AUTC	0.4777	8.727	0.0000	0.4222	4.489	0.0000
	(Adjusted R-squared = 0.8024)			(Adjusted R-squared = 0.6289)		

Conclusions

A double agglomeration effect is put in evidence in both time periods, since land-taking processes are positively and significantly related to high population density and high concentration of land that changes its status from non-artificial to artificial. Hence, low-density settlements and extensive and light land-taking processes could help saving non-artificial land, since the concentration of land take in a limited number of municipalities would imply a larger extent of land which becomes artificial. Secondly, the higher the accessibility, the more a municipality is suitable to land take, thus strategic regional policies aimed at balancing accessibility would limit the concentration of land take and the associated agglomeration effect. Moreover, the lower a municipality's proximity to the nearest province administrative center, the less the municipality is suitable to land take, which supports balancing accessibility as well. Thirdly, the presence and size of protected areas is negatively and significantly connected to land take, as expected. Hence, conservation of natural resources and habitats could hinder land-taking processes and influence their spatial layout. This is also confirmed by the estimates of both regressions related to the covariates accounting for former landscape plans, which are positively correlated to artificialization of land, meaning that the more conservative planning rules are weakened, the more land-taking processes occur. A similar phenomenon is put in evidence by the covariates accounting for areas defined as landscape components with an environmental value in the landscape plan. The fact that protection of nature, environment and natural resources matters is also put in evidence by the absence of correlation between land-taking processes and the distance from the coast, in the 1990-2008 time period, and the evidence of an impact of this variable on land take in the 1960-1990 time period. Since in the previous years (1960's-1980's) urbanization in Sardinia was prominent in coastal municipalities, the non-coastal characterization of land take in the 1990-2008 period could only be related to the conservative planning rules implemented by the regional landscape plans in force from the 1990's onwards.

In this paper, we tentatively consider a set of variables which includes location-related and physical determinants, and planning code-related factors. Our analysis does not assume value judgments on land take. Nevertheless, the findings imply a set of policy statements which can be taken into account in order to influence land-taking processes, which are consistent with statements proposed in a previous study (Zoppi and Lai, 2014).

To conclude, agglomeration effect increases the intensity of land take. As a consequence, extensive urbanization processes and planning codes that prevent the artificialization of vast contiguous areas should be effective in saving-up non-artificial land. A balanced accessibility of regional cities and towns and a comprehensive regional policy concerning protection of nature, natural resources, environment and endangered species and habitats should be important as well. Moreover, supporting restrictive planning rules concerning new development in the coastal strip helps to counter and limit land take.

References

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