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## Tertiarization and land use change: The case of Italy

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## ABSTRACT

In this paper we investigate the effect of the tertiarization process on urbanization-driven land consumption and the extent to which it can explain the complex relationship between growth and environment. We disentangle the role of economic growth from that of changes in the economic structure by augmenting an EKC relation and take into account heterogeneous responses between metropolitan and non-metropolitan areas. To this purpose, we use a panel approach on a dataset of Italian provinces (NUTS-3) sampled every ten years between 1960 and 2010. We find that tertiarization has contained the land consumption process explaining approximately one third of its total slowdown. We also find that a U-shaped EKC relation between land consumption and economic development exists but it is mostly driven by metropolitan areas. In other provinces the relation is L-shaped. From the policy point of view, we show that economic growth *per se* seems unable to contain land consumption. Fostering the tertiarization process can sustain more compact and concentrated urbanization models.

## 1. Introduction

In wealthier countries, built-up areas expanding at higher rates than population growth is a typical process of late urbanization phases, mainly suburbanization, resulting in land consumption, fragmentation of rural space, human health problems, and increasing demand for transportation (Burchell et al., 2005). Urbanization leading to discontinuous, low-density settlements generate negative environmental, social and economic impacts for metropolitan regions. A permanent monitoring of urbanization-driven land consumption based on a thorough understanding of the socioeconomic determinants of suburbanization became increasingly urgent when formulating more efficient policies of urban containment (Bruegmann, 2005).

With the final aim to understanding latent trade-offs between growth and sustainability, the recent literature on the Environmental Kuznets Curve has investigated the impact of economic development on multiple ecological and territorial dimensions, focusing on a vast range of environmental degradation processes (see Stern, 2004 for a review). Since economic growth was associated with contrasting effects on environmental sustainability (e.g. Panayotou, 1995), the resulting evidence of earlier studies is puzzling due to spatial variability at both regional and country scale, data heterogeneity and sensitivity of the empirical results

to the socio-environmental indexes used. To investigate such complex relationship, the literature has shifted to the analysis of structural and socioeconomic variables, other than income, that might have important environmental impacts (see Bimonte, 2002; De Bruyn and Opschoor, 1997; Esposito et al., 2016; Grossman and Krueger, 1995; Han and Chatterjee, 1997; Magnani, 2000; Vona and Patriarca, 2011). In this direction, a recent study (Bimonte and Stabile, 2017) has investigated non-linear relationships between the short-term performances of socioeconomic systems and land consumption. A similar study by Esposito et al. (2016) considered the effect of economic growth on land quality. We contribute to this literature by analyzing the role of the structural aspect of growth, i.e. the changing sectorial composition of the economy. In other words, we investigate the effect of the tertiarization paradigm on urbanization-driven land consumption and the extent to which it can explain the complex relationship between growth and environment. Unlike in the sprawl literature, which mainly focuses on metropolitan areas, we consider all geographic areas although we control for the specific effect on urban areas.

In the case of carbon emissions, De Bruyn and Opschoor (1997) and Han and Chatterjee (1997) have outlined the positive role of structural change in regional economies in reducing the environmental footprint. We differentiate from these studies by focusing on the land-use

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dimension of the environmental impact. We build on [Bimonte and Stabile \(2017\)](#) that have verified the existence of an EKC curve of land consumption at regional scale in Italy. Using province-level diachronic data on urbanized land in Italy, we aim to assess the impact of the shift from an industry-based to a service-based economy on land consumption and the extent to which this specific paradigm of growth contributes to explain the contrasting forces underlying the non-linear effect of overall economic growth.

The environmental impact of different economic structures can be analyzed in different ways. The main approaches are based on the notions of 'natural capital' ([Hawken et al., 1999](#)) and 'carrying capacity' ([Wackernagel and Rees, 1996](#)). The first concept refers to the world's stock of natural resources, which includes geology, soils, air, water and all living organisms, providing free goods and services that support life. Carrying capacity is grounded on the definition of the maximum potential capacity of a system to support key functions, being the basis to quantify the 'environmental footprint', i.e. the per-capita measure of the environmental impact of overall human activity. In this study, we focused on the latter concept when evaluating the relationship between land consumption and tertiarization (see [York et al., 2004](#)), while considering both per-capita and overall land change to urban use when performing robustness checks.

Differently from [Bimonte and Stabile \(2017\)](#), which measure land consumption considering the official statistics of new building permits released at the regional scale, we use geo-spatial data on urbanized land at a spatially-disaggregated, provincial level. We computed an urban footprint indicator (UFI) based on the amount of per capita built-up land. The term "urban" used in this study is not specifically related to the notion of cities. In our case, urban land identifies all built-up areas (with productive, residential and service use) and the open spaces functionally related to them (parking areas, railways and road networks, construction sites, etc.), thus including the whole of sealed soils in a given area. The evident relation between land cover and loss of ecosystem services led the European Commission to develop a strategy for soil protection ([European Commission, 2006](#)) and, more recently, to fix the objective of 'no net land take' to be reached by 2050, which states that land consumption should not exceed a per-capita annual rate of 1.6 m<sup>2</sup> ([European Commission, 2016](#)). Based on these premises, the UFI was considered a suitable proxy when assessing land consumption dynamics at the regional scale; a progressive increase in the UFI outlines a transition toward a more dispersed settlement model ([Zitti et al., 2015](#)).

We investigate the effect of tertiarization on the UFI by running an econometric analysis on a panel of Italian provinces sampled every 10 years from 1960 to 2010. The Italian case is representative of a more general socioeconomic context associated with traditional compact settlements and semi-dense urban forms, both in the Mediterranean basin and in the other regions of the world ([Cuadrado-Ciuraneta et al., 2017](#); [Pili et al., 2017](#)). A study of the Italian Institute for Environmental Protection and Research (ISPRA, 2016) estimated that land consumption in Italy causes every year a cost of 800mn€ in terms of ecosystem services loss.

During the time span under consideration, per-capita urban land in Italy increased hand in hand with economic growth ([Salvati and Gargiulo-Morelli, 2014](#)), in line with patterns observed in most European countries ([Bonaverio et al., 1999](#)). At same time, Italy has exploited the tertiarization paradigm that characterized development economies since the 1970s. Thus, analyzing this case may provide helpful suggestions for policy-making in Europe and other similar geographic contexts.

To disentangle the role of economic growth from the effect of changing economic structures, we explicitly consider per-capita value added dynamics. Consistently with the EKC literature, we have considered a quadratic formulation for this variable. We add province and time-specific effects to quantify the impact of the territorial structure typical of each Italian province and the legal constraints to land conversion to urban use - both at national and local level. In addition, we have taken into account spatial dependence arising from cross province spillovers in

the land consumption process by using a Spatial Autocorrelation model (SAC) with fixed effects ([Lee and Yu, 2010](#)) estimated through Maximum Likelihood ([Belotti et al., 2017](#)). The latter introduces spatial dependence both in UFI growth and in the error term and allows to estimate indirect impacts from neighbouring provinces which are not captured by standard panel techniques.

The structure of this paper is as follows: Section 2 identifies the factors affecting land-use change dynamics in affluent countries, with special focus on Europe and Italy. Section 3 explains the dataset and provides descriptive evidence on the evolution of the urban footprint and its relation with the identified factors over the past 50 years; Section 4 explains the econometric procedure and discusses the empirical results, providing some robustness checks; in Section 5 we draw the conclusions.

## 2. Tertiarization and land consumption

Tertiarization processes have been explored from various perspectives ([Ellger and Scheiner, 1997](#); [Goebel and Gornig, 2016](#); [Harrington et al., 1997](#)), focusing especially on the intimate impact of tertiarization on metropolitan regions and urban systems as a whole. In this direction, structural change can alter both the 'vocation' and internal structure of urban areas, involving a process of metropolitan reconfiguration and land-use change (see, among others, [Lin, 2004](#); [Illeris, 2005](#)). Accordingly, the impact of a changing economic structure in terms of urban expansion is not limited to land devoted to productive settlements. This process triggers land transformation to residential, infrastructural, and other non-productive uses, which have a much larger impact on the overall land consumption. Indeed, according to [Brueckner \(2011\)](#), urban sprawl has three main determinants: households income and population growth, and the decline in commuting costs; the tertiarization process, by affecting economic performance, internal migration flows and commuting needs, impact on all these components.

The earliest literature on the impact of the service sector on urbanization predicted a net concentration effect in line with [Christaller's \(1933\)](#) central place theory, implying tertiarization to reduce land consumption. However, this conclusion was based on service activities being limited to local markets at the beginning of the 20th century ([Sombart, 1907](#)). Subsequently, when most widespread services have lost their local aspect shifting from non-basic to basic activities, several factors have been identified to act in the opposite direction by supporting suburbanization and other forms of more extensive land consumption ([Illeris, 2005](#)). Among these factors, [Krikelas \(1992\)](#) and [Cuadrado-Roura et al. \(2002\)](#) have found that development in transport and communication technologies has increased tradability, removing the constraint of physical proximity to the market and the need for face-to-face relationships. [Illeris \(2005\)](#) and [Harrington et al. \(1997\)](#) have examined a variety of functions that are located outside big cities: software production, translation, routine back-office, military installations, universities, specialized hospitals, transport terminals, border trade offices, and public administration.

In United States metropolitan areas, business and professional services displayed faster growth in suburban rather than city centre jurisdictions ([O'Huallachain and Reid, 1991](#)) as a result of the suburbanization of the relevant markets. Limiting the analysis to producer services, [Coffey and Polèse \(1989\)](#) have shown that the development of ICT had contrasting effects on service employment suburbanization. On the one hand, they consider the potential to economic activities free from location constraints, allowing firms in peripheral regions to manage multi-site organizations without locating any of their activities in a metropolitan area. On the other hand, the same evolution enables head offices and service firms in large urban regions to centralize their high-level management, as well as scientific and technical functions.

Finally, it is worth mentioning that, along with the overall process of tertiarization of a country's economy, a consistent process of deindustrialization may occur ([Goebel and Gornig, 2016](#)), which would involve

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