



EKC and the income elasticity hypothesis Land for housing or land for future?

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**EKC AND THE INCOME ELASTICITY HYPOTHESIS
LAND FOR HOUSING OR LAND FOR FUTURE?**

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Abstract

This paper investigates the relationships between land consumption and per capita gross domestic product (GDP) for a panel of 20 Italian regions over the period 1980-2010. It tests for the existence of an EKC. As proxy of land consumption, it uses the supply of new housing, being residential construction the main cause of soil sealing and urban sprawl. To test this hypothesis it runs a panel data regression model. In the considered period, results show the existence of an inverted EKC whereas, on a longer period, a N-shaped curve may be inferred. Contrary to the EKC hypothesis, both fixed effect and random effect model estimates show that higher income does not induce greater environmental awareness or, in different words, that the income elasticity hypothesis holds for housing demand rather than for environment. The paper offers a tentative explanation of this phenomenon. Considering results and the specificity of the resource under consideration, the paper claims for a shift from market to public policy, from private to pro-social preferences, and for independent institutions and exogenous norms.

Keywords: Environmental Kuznets Curve; economic growth, land; soil sealing; housing.

1. Introduction

Land is one of most important natural assets. It represents the material base of any human and economic activity. It embraces ecological (soil) and social (landscape) functions. Land use strongly influences soil erosion and soil functions such as carbon storage (EEA and JCR, 2010a)¹. Urbanization is one of the major cause of land use change. Land take for urban development and infrastructure results in soil sealing, the most alarming cause of soil degradation. It represents the loss of soil resources due to the covering of land for housing and infrastructures. It is generally irreversible (EEA and JCR, 2006).

Historically, urbanization and housing consumption patterns have been the main driver of land conversion. Recently, changes in social and consumer preferences modified housing choices, mainly in terms of average per capita living space and housing location (EEA and JRC, 2006; Fischer *et al.*, 2013). This has heavily affected land conversion. In particular, the phenomenon of *urban sprawl*, that is the physical pattern of low-density expansion over large urban areas, mainly into the surrounding

¹ Soil is defined as the top layer of the earth's crust. It is composed of mineral particles, organic matter, water, air and living organisms — a non-renewable resource which performs many vital functions (EEA and JCR, 2010b).

agricultural areas, under market conditions (EEA and JCR, 2006) is one of the principal factors impacting on soil's main functions.

Urbanization and housing choices have been normally highly correlated with income level (Jedwaba and Vollrathb, 2015). Considering the abovementioned environmental impacts of urbanization (mainly via land consumption), we believe that it would be worth exploring the relationship between economic growth and land consumption further.

Soil sealing in suburban areas has been normally estimated by using cartographical and statistical data (Munafò *et al.*, 2010), and urban expansion and farmland abandonment have been identified as the main cause of land degradation processes (Smiraglia *et al.*, 2016). Understanding the dynamics of urban expansion and its link with the economic growth could be of interest to develop appropriate land management policies.

One of the main stylized fact about processes of economic growth and environmental dynamic is the Environmental Kuznets Curve. It postulates an inverted U-shaped relationship between per capita income and environmental quality as expressed by various impact indexes (Grossman and Krueger, 1995; Torras and Boyce, 1998). In the last decades, many studies have investigated this relationship looking for certain regularity. Although with mixed results, many have focused on carbon dioxide (CO₂) emissions (Aldy, 2006, 2007; Balaguer and Cantavella, 2016; Jebli, 2016; Brock and Taylor, 2004; Ezcurra, 2007; Nguyen Van, 2005; Romero-Ávila, 2008; Westerlund and Basherwe, 2008), per capita SO₂ and NO_x emissions (Cole *et al.* 1997; de Bruyn *et al.*, 1998; Kaufmann *et al.*, 1998; List, 1999; Panayotou, 1995). Others, together with the previous, tested for additional selected environmental indicators. For example: Thomson (2014) tests the existence of an EKC for river pollution, Antle and Heidebrink (1995), Panayotou (1995) and Shafik and Bandyopadhyay (1992) do the same using the rate of deforestation; Bimonte (2002, 2009) use the percentage of protected area, Magnani (2000) and Komen *et al.* (1997) the public R&D expenditure for environmental protection, while Caviglia-Harris *et al.* (2009), Wackernagel *et al.* (1997) and Rothman and Herbert (1996) the ecological footprint. Recently, attention has been devoted to the relationship between income and urban development (Bimonte and Stabile, 2017). To the author's knowledge, research on this field is very scanty while deserving attention².

Building on the research of Bimonte and Stabile (2017), this paper deepens the analysis of the relationship between per capita income and land consumption, as proxied by residential housing. As stated, urbanization has been and still is the main cause of land consumption. Housing, especially residential, represents the majority of all construction. A good proxy of new housing supply is the

² On this issue see the Africa Consensus Statement to Rio+20 (UNCCD, 2012).

number of building permits (BP) issued by local authorities. It has been demonstrated that a strong relationship exists between BP and new housing supply (Rena, 2011; Somerville, 2001).

The choice of this variable is also consistent with the paper's aim, because it accounts for public environmental concern and policy, since BP are under the public control. The paper tests whether the Income Elasticity Hypothesis (IEH) holds in the case of land consumption induced by residential housing. The EKC, in fact, rests on the assumption that environment is income elastic: once the income reaches a threshold level, the demand for environmental quality starts to grow with income. In some case, it grows more than proportionally with respect to income, i.e. the income elasticity becomes greater than one and, therefore, environment converts into a luxury good (Dinda, 2004; Roca, 2003; McConnel, 1997).

The idea that lies behind the IEH is that when a country gets a sufficiently high standard of living, people appraise more the environment with respect to other goods and, consequently, they demand for better environmental conditions (Pezzey, 1989; Selden and Song, 1994). This turns into higher defensive expenditures and donations, but also in demand for less damaging products/activities and public policies that tend to reduce environmental degradation (Dinda,2004).

In order to test for the IEH, we run a panel regression model. The data is from the 20 Italian regions, and cover the 1980 to 2010. The main reason for this choice is that it is very difficult to get continuous, reliable and comparable data for a longer period. Moreover, in 1980, the Italian National Institute of Statistics (ISTAT) modified the data collection system. However, it complies with our goal. The postwar reconstruction phase and the following economic boom period (the *Italian miracle*) were very special periods, characterized by population growth, massive interregional migration, especially from south to north and from rural to urban areas, and social policy reforms. This led to an explosion of urban areas and infrastructural investment. The data set stops at 2010 to exclude the effects ensuing two important events: the economic crisis and the abrogation of the ICI (the Italian property tax) on family homes.

2. Land consumption and the EKC: an essential literature review

The EKC hypothesis postulates that the environmental impacts of economic activities will increase in the first stage of economic development and then decrease once per capita income passes certain threshold (Grossman and Krueger, 1995; Torras and Boyce, 1998). A sizeable literature now exist on EKC, of theoretical and empirical nature³. Evidence of the existence of variables, other than income level, that may influence the relationship have been tested (for example Balaguer and Canavella, 2016; Bimonte, 2002; Grossman, 1995; Grossman and Krueger, 1996; Magnani, 2000; Selden and

³ For a critical survey, see Carson (2010) and Dinda (2004).

Song, 1994; Suri and Chapman, 1998; Unruh and Moomaw, 1998). However, while some studies support and are consistent with the existence of an EKC others question it from different point of view (Aşici and Acar, 2016; Bagliani, *et al.*, 2008; Caviglia-Harris *et al.*, 2009; Harbaugh *et al.*, 2002; Stern and Common, 2001; Stern, *et al.*, 1996; York *et al.*, 2004).

Though with heterogeneous results, the majority of the studies test countries' efficiency rather than the EKC. In fact, environmental impact is expressed in intensity of use terms, i.e. per capita or per dollar emissions. This is unfortunate, because even if the per capita or per unit environmental impacts converge to a tiny level, different from zero, in the long run the total impact could increase because of population or income growth (Common, 1995). Moreover, they do not always account for the environmental performance or the overall environmental status of a country (Bimonte, 2012; Rothman and de Bruyn, 1998; Stern, *et al.*, 1996). The overall environmental quality or state depends on concentrations and stocks rather than on emissions and flows, although these measures are related. The distinction is particularly relevant when the impact has a stock-effect, as it is in the case of land. On the base of previous considerations, in this paper we test the relationship between per capita income and land consumption, as proxied by BP. Although narrow and partial, the latter index fits with the paper aim. In fact, together being locally determined, it is a stock-sensitive variable, subject to saturation effect. In order to test for IEH, this is a very useful feature. IEH rests on the assumption that marginal appraisal of goods vary with income. However, in line with economic theory, the relative importance of goods (their marginal rate of substitution) varies also with the available quantity of a good: the less (more) remains of a good, in relative terms, the higher (lower) the assigned value (decreasing marginal utility). Moreover, unlike other indicators, such as pollutants, it is only marginally (or indirectly) affected by atmospheric conditions, international trade and displacement effect (Bimonte, 2002). Finally, it may be considered as a direct measure of public environmental concern and policy. Indeed, urban planning is a prerogative of the public sector. Land use change and any construction activity needs local authority permission. A sufficiently permissive urban planning policy is a necessary condition for residential development to take place. Among the various determinant of housing development, like interest rate (McQuinn and O'Really, 2008; Di Pasquale and Wheaton, 1994), expectation on future price increase (O'Sullivan and Gibb, 2012) and others, building codes and zoning laws seems the more effective (Caldera and Johannson, 2013; Green *et al.*, 2005; Hilber and Vermeulen, 2012).

Although BP does not discriminate between single and multi-storey buildings, it may be considered a good proxy of land consumption. In fact, combined with the reasons mentioned above, the evolution of housing consumption patterns has led to a preference for single storey buildings and dispersed settlement. According to the 15th Italian census, 51.8% and 23% of residential buildings were

composed of one and two flats, respectively (ISTAT, 2014). In 2001, the 14th census recorded that 22.6% consisted of one floor and 52.9% of two (ISTAT, 2004).

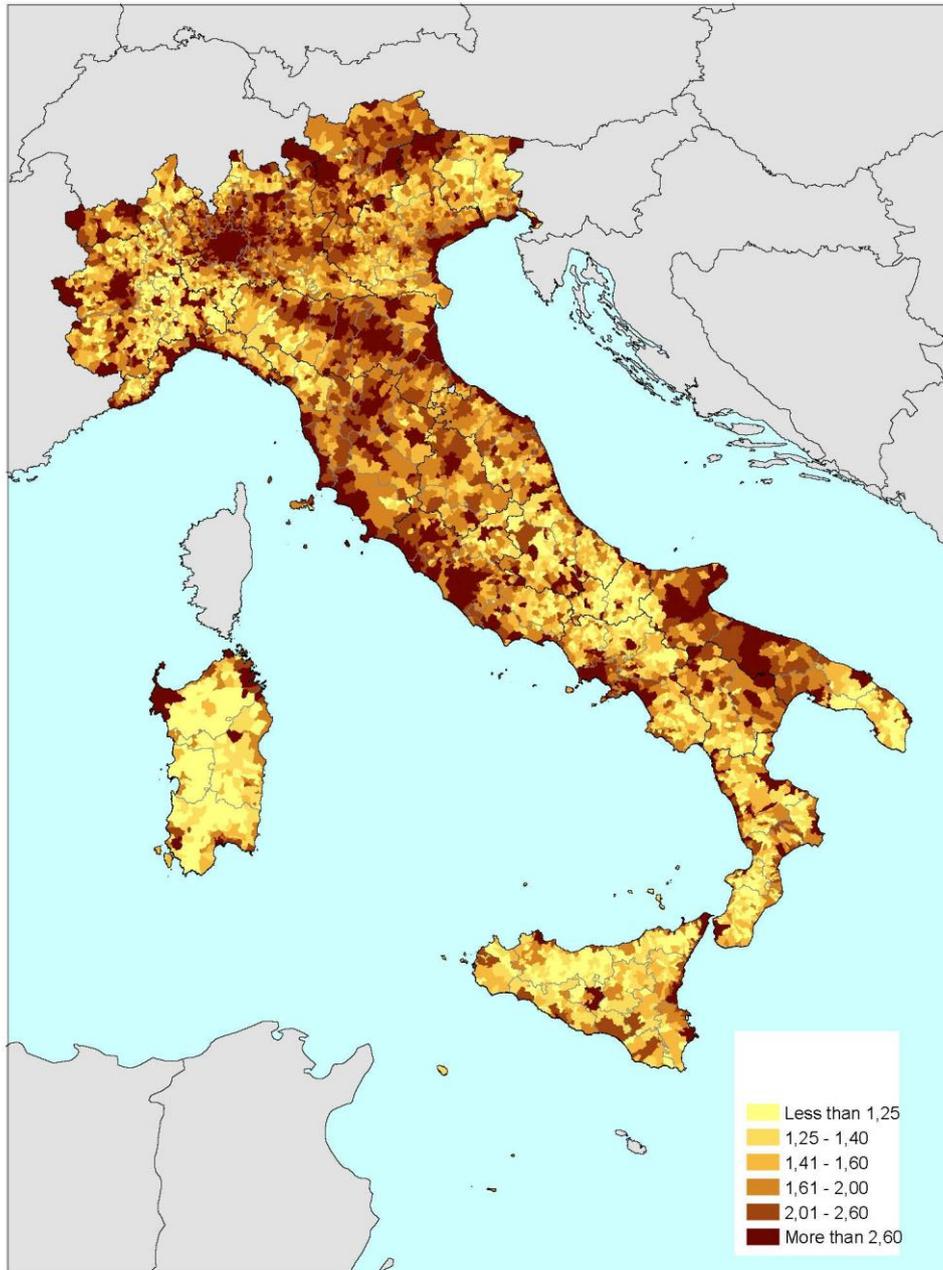


Figure 1: Average number of residential dwelling per building. Source: *ISTAT website*

Due to the urbanization process, in the period 1990-2006 Italy lost 135.534 ha (Prokop *et al.*, 2011) mainly due to residential (over 60%) and productive-commercial construction (about 30%). According to the Italian Institute for Environmental Protection and Research (ISPRA, 2014), about 7% of Italy's total land area is now sealed. This figure has doubled in the last 60 years⁴. So did the

⁴ One has to consider that about 35% of Italy's total surface area is occupied by mountains. The majority of land transformation caused by physical constructions affects flat areas.

number of houses⁵. Figure 2 shows the area of sealed soil as a percentage of total area in 1956 and 2012.

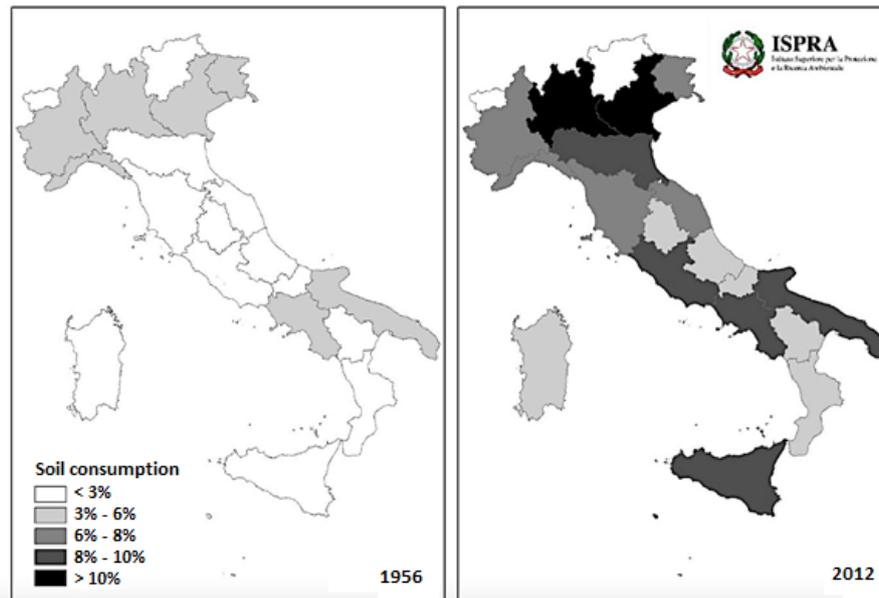


Figure 2: Soil consumption at regional level, 1956-2012

Source: ISPRA (2014)

The growth of population and, more recently, households are normally considered the main determinant of urbanization (cities and other human settlements). This link seems missing in the recent phenomenon of urban development (Bimonte and Stabile, 2015; Fischer *et al.*, 2013). Evolution in lifestyle and consumers' preference affect location choice and average per capita living space, i.e. housing consumption patterns (Keilman, 2003). Housing increasingly satisfies relative, rather than absolute, needs (positional good) inducing a "keeping up with the Joneses" behavior. Social, cultural and economic circumstances can profoundly affect the development of urban areas and, as consequence, its natural and social environment. In particular, patchy and scattered development, with a tendency for discontinuity, has many adverse effects on life quality and land consumption. The phenomenon of urban sprawl, with single as opposed to multi-storey buildings, and dispersed as opposed to compact settlement patterns, recently spread over many European cities, especially in coastal and lowland areas (Munafò *et al.*, 2010). Consequently, the amount of soil sealed per person has doubled over a 50 year period (EU, 2012). As evidenced in the last World Bank conference on land and poverty (March 2016), this is now a common feature of many cities all around the world.

⁵ The number of houses exceeds 29 million. Many are empty (about 1/5) or second homes.

Together with the previous, nowadays, constructions are also governed by additional determinants. It is an investment, both a safe haven asset during economic crises and a speculative or portfolio management investment in periods of economic growth. Investors can speculate on price increases (O'Sullivan and Gibb, 2012; Sivitanidou and Sivitanides, 1999) and public sector on developable land. At least in Italy, in many cases land has become a monofunctional resource to be (over)used in order to extract either a private rent, revenues for the public sector or political benefits for local administrators.

If houses were “merely” a place to live (as they have long been), we would expect that after a period of expansion a declining phase follows, because of the saturation effect (that implies lower additional consumption). In fact, being a stock-sensitive variable, together with the fulfilment of housing needs, the supply of new housing would cause the shrinking of developable land and the surge in environmental opportunity cost. This would cause a reduction in the BP emission and, consequently, housing supply. An EKC would emerge. In the long run a steady state would result (constant stock) with an investment equal to δ , i.e. the depreciation rate. This would also be justified by a decrease in the population growth rate.

In fact, among others, the EKC rests on the assumption that the environment is an income-elastic commodity. Environmental quality and protection is expected to improve with income, because individuals become more environmentally conscious and can afford to exert political pressure for the enforcement of environmental regulations (Panayotou, 1995; Grossman and Krueger, 1995). In our case, this means that because of a higher perceived environmental cost (the marginal social cost caused by additional sealed land is increasing), social pressure leads to stricter urban planning.

However, as stated, despite the higher environmental opportunity cost, developable land accrues private rent and public revenues, and income growth induces higher housing demand. Would the strength of socio-cultural evolution, economic and speculative drivers overwhelm environmental awareness and concerns, we may observe an inverted EKC. This means that in the later stage of development imitation and speculative effect dominates the saturation effect. It also implies that the IEH holds for private assets rather than for the environment.

To test which of the two relationships prevails in the case of land management, we run a panel data regression model over per capita income and per capita supply of new BP from all the Italian regions. This permits to take into consideration a heterogeneous set, from an economic, cultural and a morphological-natural point of view, and test for fixed effects. In fact, in such analysis a key factor is regional heterogeneity. As for population, regional migration while accelerating population decline in some regions will contribute to a further population increase in more economically developed regions. This should affect urbanization development.

3. The model

Although some theoretical based studied exists in the literature, the EKC is proposed as a stylized fact concerning the relationship between pollution and economic growth. The usual polynomial used to test the EKC is a second-order function. Accordingly, to test our hypothesis we run the following standard reduced functional form:

$$BPpc_{i,t} = \alpha_i + \beta_1 Y_{i,t} + \beta_2 Y_{i,t}^2 + \varepsilon_{i,t}$$

where:

$BPpc_{i,t}$ is the per capita building permits issued⁶;

$Y_{i,t}$ is per capita GDP.

The sample is comprised of regions with different geographical and environmental constraints, and at different stage of development. As stated, the data refer to per capita BP and income for the period 1980-2010. We test both the fixed effects (FE) model and the random effects (RE) model. We run the regressions with STATA. Main results are presented in the appendix (table 1 and 2). Estimates with RE_GLS turned out to be nearly the same as those produced by FE_LSDV (Theta=0.85357),⁷ however RE estimates proved more satisfactory and efficient, as confirmed by the Hausman test (table 3 in the appendix). Finally, we used the Pooled-OLS estimation method, which assumes homogeneous behavior of different regions for slope and intercept. The Breush and Pagan test (Lagrange multiplier) rejected the null hypothesis (table 4 in appendix). This means that individual effects are important and RE estimates must be used instead of POLS.

The results are very sound, as shown by all the diagnostic tests. The coefficients are highly significant. It is worth noting that it may appear that GDP per capita is a relatively weak predictor variable. This is due to the selected environmental indicator. BPpc is a very tiny number (see table 5 in the appendix). Therefore, coefficients need to be interpreted accordingly.

As it can be seen, if we agree with the working hypothesis put forward in this paper, i.e. that BP are a good proxy for land consumption, the EKC is rejected. In fact, the panel data regression highlighted that the relationship between per capita income and the selected environmental indicator (i.e. BP) follows a U-shaped path. This inverted EKC is presented in figure 3. As expected, in the first part the

⁶ BP represents the number of annual building permits per 100,000 persons issued by local governments. This is so because BP is tiny compared to population: while the mean value of the national population is about 57 million, that of BP is less than 230,000.

⁷ When Theta is close to 1 the RE and FE estimates tend to coincide. This happens when σ_{μ}^2 is greater than σ_{ε}^2 , i.e. when there is heterogeneity (see table 2 in the appendix).

relationship is negative. In fact, after the reconstruction period, the economic boom and the concomitant urbanization boost, land consumption (housing development) dampened, converging to a lower per capita level. In this period, the saturation effect dominates other effects.

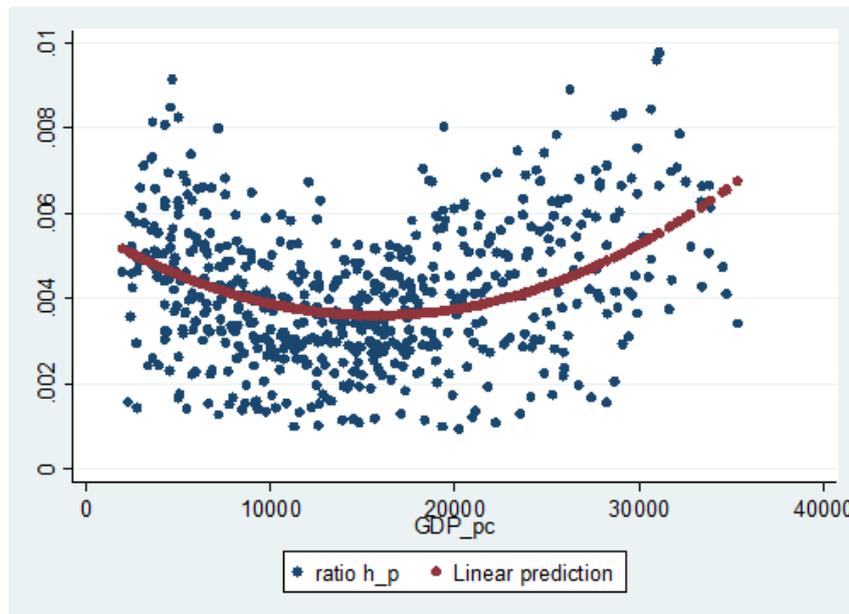


Figure 3: Relationship between housing supply and income (per capita data).

Then, in the first half of the 1990s the relationship inverts, becoming positive. This happens when income is about 16,000 Euro (threshold level). It is worth noting that, because of differences in economic conditions and development stage, regions passed the threshold level at different point in time. This can be seen in figure 4. It presents the relationship between per capita income and per capita BP for each region. In this second phase, the imitation and speculative effect dominates the saturation effect, and land consumption increases with income. This means that in the later stage of development, private assessment of resources prevailed over social assessment. The expected change in the marginal rate of substitution did not happen.

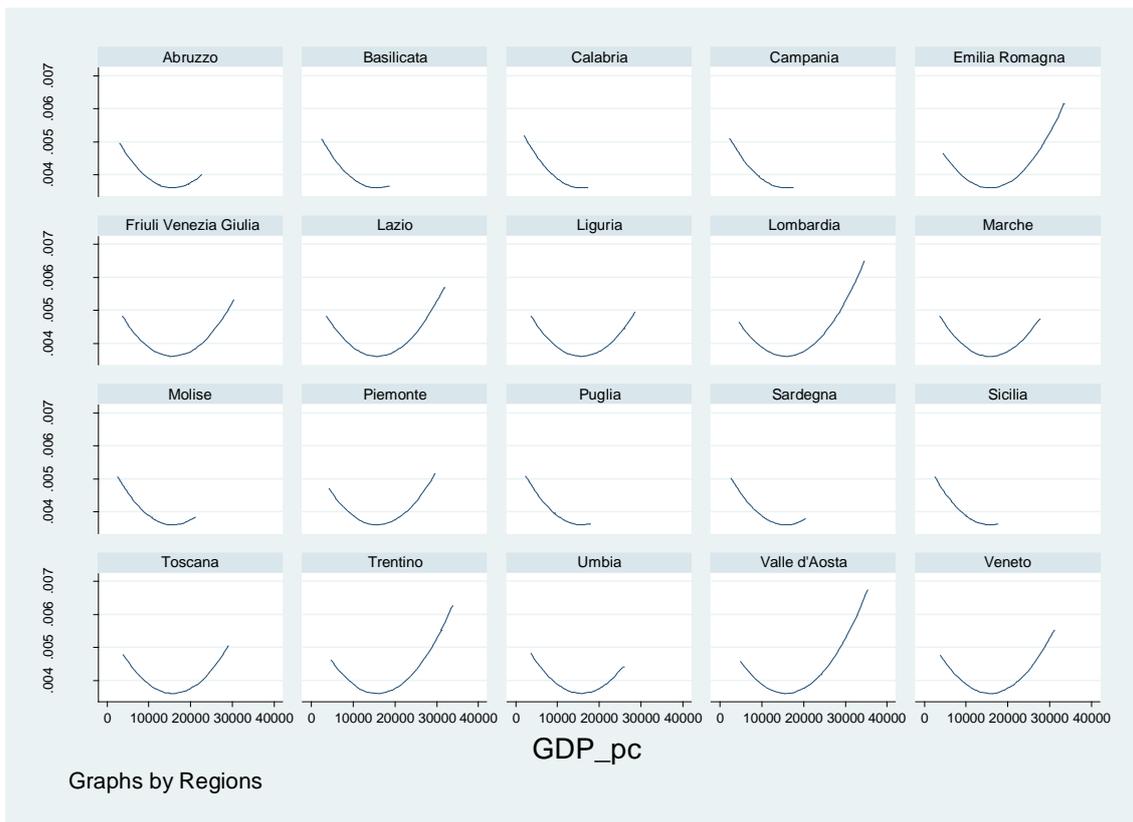


Figure 4: Relationship between housing supply and income (per capita data).

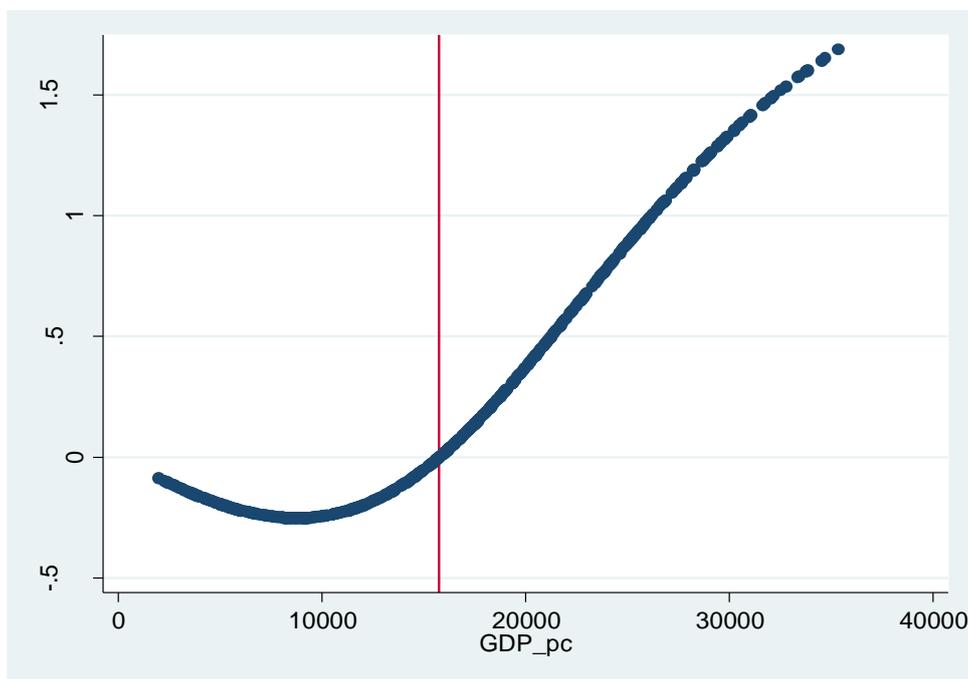


Figure 5: Income elasticity of building permits.

According to our results, the supposed/expected IEH put forward in the EKC hypothesis does not hold. Rather, and somewhat surprisingly, in the second stage of development the change in lifestyle and preferences' structure are so intense that the IEH holds for housing. This means that the social

appraisal of land decreases. Once the per capita income is about 26,000 euros the income elasticity becomes greater than 1 (figure 5). This means that housing (and land for housing) behaves like a luxury good. The shifting of preferences from public to private goods makes environment (i.e. land conservation) similar to an inferior good. After a certain threshold level, “demand” for conservation decreases with income growth.

4. Discussion

After the economic and infrastructural boom of the 1970s, the demographic increase and the wave of internal migration, land consumption, as proxied by the number of building permits issued by public authorities, lessens. This depends mainly on the combined effect of the slowdown in the growth rate of the Italian population, which remained more or less stable, the higher social marginal costs of land consumption and the saturation effect⁸. It is expected that all these aspects determine stricter urban planning. The latter should aim at meeting dwelling needs at the lowest social (environmental) cost. Unfortunately, according to our results, this pro social/environmental policy was short-lasting. Once the per capita GDP passes the threshold level, estimated at about 16,000 euro, the relationship between per capita income and land consumption becomes positive. The turning point occurs around the first half of the 1990s, although with differences between regions. Beyond this threshold, further economic growth widens the gap between private and social appraisal of environmental resources.

Together with other socio-cultural phenomena, this stylized fact was fostered by market and political variables. As for the former, in the second half of 1990s, the combined effect of income growth and low interest rates produced greater availability of funds that sustained real estate market. However, as stated before, a sufficiently permissive urban planning policy is a prerequisite for land development to take place. This also implies that local government preferences shifted from social to private goods and from long- to short-run objectives, with detrimental overall effects on welfare.

According to our results, the expected modification in the marginal rate of substitution did not occur and, unexpectedly, environment turned in an inferior good. This may be the result of an apparent “win-win” game where public and private interests, together with institutional and political elements, interact. In fact, many environmental goods, like land, have the characteristics of commons or public goods. This stimulates free riding or opportunistic behaviors. Public control is, therefore, required. However, since housing affects widespread interests, public sector may connive. This is more plausible the greater the number of beneficiaries. When a multitude is involved, accommodating behavior is fruitful from a political/electoral point of view. On the other side, no reaction takes place because a big enough minority benefits from it. This suggests why individuals (society) on one side and public

⁸ The share of home-ownership reached about 69% by 1998. It was 76,6% in 2012.

authorities on the other favor private over social goals and overrate present benefit to detriment of future social costs.

As stated by Bimonte and Stabile (2017), the accommodating behavior of the public sector could have been also the consequence of the liberalization and decentralization process that started in the 1990s. The reform consisted in a reduction of central government transfers to local authorities offset by expanded fiscal autonomy. Since then, the Italian property tax (ICI) has been the main source of revenue for local government. Therefore, the latter may have used their taxing power to finance their current expenditure and budgetary needs. In order to expand their tax base, and increase revenues through the ICI and an *una tantum* impact fee on new or proposed development projects, municipalities presumably adopted more accommodating urban planning policies.

Multiple and diffused interests may have caused an (alarming) adverse alliance between the watchers (controllers) and the watched (those controlled) that resulted in an acceleration in the process of changing land use and soil sealing. Instead of maximizing intertemporal social welfare, citizens and their representatives maximized their short-term interests.

5. Conclusions

Many authors have cautioned against the simplistic conclusion one might infer from the empirical status of the EKC hypothesis, i.e. that once an economy gets a sufficiently high standard of living, people appraise more the environment and, consequently, demand for better environmental conditions and environmental policies. Therefore, the “ultimate” environmental policy would be economic growth (Beckerman, 1992).

In fact, there is no automatic process governing the relationship between income and environment, even when an EKC seems to exist (Grossman and Krueger, 1995). Economic growth is not a panacea for environmental quality, and policies that promote economic growth are not substitutes for environmental policy (Arrow *et al.*, 1995). In this field, effective work needs a shift from market economics to political and social economics.

Our results provide additional support for these claims. But, somehow, they also caution against them. Both economic factors and public policy may contribute to enhance environmental quality, but this is not necessarily true. What is needed is a shift from private to pro-social preferences, independent institutions and exogenous norms. Public sector may fail, because its actions may depend on how costs and benefits are distributed between players and lobbies (Thompson, 2014). The more private benefits are widespread and social costs dispersed, the more likely is the failure of public sector and the connivance of society. This is particularly true the more (intra and intertemporal) external effects and common and public goods are involved.

This is exactly what our results seem to suggest. In the case of housing (and land) private and short term interests prevailed. Rather than causing higher environmental resource appraisal, income growth modified housing consumption patterns and preferences. This had detrimental effects on the environment. The supposed IEH did not take place and the environment evolved into an inferior good instead. Against a surge of construction activities, the public sector (municipalities) adopted an accommodating urban policy. It is widely admitted that stringent rules are the most effective way to dampen the impact of demand shocks on urban growth and the economic and environmental consequences of expansion cycles. In the absence of social reaction (the expected political pressure), in many cases environmental protection was sacrificed at the altar of short run political/electoral goals.

To conclude, whether our results and interpretation may be agreed upon, it is a matter of fact that land consumption is strongly related to economic growth. Given the widespread interests involved, we think that in the case of depletable resources (like land) the only sustainable option is committing local authority to compelling exogenous norms. Urban policy should comply with natural law: like the earth ecosystem, human settlements should develop (evolve) without growing. Local authorities would only be required to decide how to "evolve". Any other solution produces (cumulative) soil consumption. Converging to zero net land degradation is at the core of the United Nations' proposal (UNCCD, 2012).

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Table 1: Fixed-effects (within) regression

Group variable: regions		Number of obs = 580 Number of groups = 20 Obs per group: min = 29		
R-sq: within = 0.2523 between = 0.1040 overall = 0.1517		corr(u_i, Xb) = 0.0537* F(2,19) = 25.16 Prob > F = 0.0000		
<i>H</i>	Coef.	Robust Std. Err.	t	P>t
<i>Y</i>	-.0259921	.0037043	-7.02	0.000
<i>Y</i> ²	8.22e-07	1.31e-07	6.29	0.000
<i>α</i>	566.162	23.20651	24.40	0.000
<i>sigma_u</i> <i>sigma_e</i>	119.48819 96.992812	Rho (fraction of variance due to u_i) = .60280377		
F test that all u_i=0		F(19, 558) = 43.50	Prob > F = 0.0000	

* Correlation differences across units with regressors

Table 2: Random-effects GLS regression

Group variable: regions		Number of obs = 580 Number of groups = 20 Obs per group: min = 29		
R-sq: within = 0.2523 between = 0.1043 overall = 0.1520		corr(u_i, X) = 0 (assumed) theta = .8535759 Wald chi2(2) = 50.06 Prob > chi2 = 0.0000		
<i>H</i>	Coef.	Robust Std. Err.	z	P>z
<i>Y</i>	-.0260026	.0037087	-7.01	0.000
<i>Y</i> ²	8.24e-07	1.31e-07	6.31	0.000
<i>α</i>	565.8766	36.09202	15.68	0.000
<i>sigma_u</i> <i>sigma_e</i>	121.68075 96.992812	Rho (fraction of variance due to u_i)** = .6114777		

** 61% of the variance is due to differences across panels

Table 3: Correlated Random Effects - Hausman Test

Test cross-section random effects				
	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.	
Cross-section random	0.922898	2	0.6304	
Cross-section random effects test comparisons:				
Variable	Fixed	Random	Var(Diff.)	Prob.
GDPPC	-0.000000	-0.000000	0.000000	0.8245
GDPPC2	0.000000	0.000000	0.000000	0.4401

Table 4: Breusch and Pagan Lagrangian multiplier test for random effects

Var(u)	0
chibar2(01)	2702.82
Prob > chibar2 =	0.0000

Table 5: Descriptive statistics – Building permits per 100,000 persons

<i>Regions</i>	<i>mean</i>	<i>sd</i>	<i>variance</i>	<i>min</i>	<i>max</i>
Abruzzo	497.1736	151.331	22901.06	300.8525	825.9578
Basilicata	355.1704	114.8806	13197.54	162.7611	712.6518
Calabria	391.0806	66.32163	4398.559	246.6452	491.7671
Campania	178.2486	38.52062	1483.838	127.0911	244.0662
Emilia Romagna	526.8271	162.6478	26454.3	270.7796	849.1268
Friuli Venezia G.	468.5546	136.2089	18552.88	261.0501	815.1432
Lazio	322.3561	95.78676	9175.104	136.6894	492.3659
Liguria	160.9152	57.03328	3252.795	94.3259	323.6488
Lombardia	473.9269	106.9672	11441.98	302.3857	699.1016
Marche	456.0793	115.704	13387.42	291.0872	733.798
Molise	440.9488	120.8068	14594.29	221.215	649.2484
Piemonte	303.5551	61.63479	3798.848	197.7971	417.6646
Puglia	398.9537	92.1726	8495.789	245.3224	594.4381
Sardegna	597.4562	92.55748	8566.888	454.5227	804.4547
Sicilia	331.3104	95.83546	9184.436	175.6389	523.6061
Toscana	330.5323	78.41155	6148.371	223.8268	508.9766
Trentino	626.4181	152.6401	23298.99	386.2347	978.9618
Umbria	418.2738	115.7176	13390.56	228.7062	676.6996
Valle d'Aosta	466.5015	139.2911	19402	168.521	800.2849
Veneto	561.2289	140.0348	19609.73	344.6734	891.9218
Total	415.2756	163.273	26658.06	94.3259	978.9618