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RUBRICHE

Per capita income and inequality: evidence from Italian tax data

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Abstract

The vast empirical literature on the Kuznets curve has produced very contradictory results during the years, and its exact shape is controversial. In the present paper we aim to verify empirically the relationship between growth and inequality using Italian municipal data, following a spatial analytical approach that can provide hidden insights useful for policy-maker in defining local growth actions. We perform the analysis at different level of spatial aggregation (municipality, province, and region), dealing also with the Modifiable Areal Unit Problem. Our empirical results support the presence of a positive U-shape curve,

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suggesting the presence of a third phase of the Kuznets curve, where the service-knowledge transition impacts income inequality trends in a way similar to the agricultural-industrial transition of the past.

Sintesi - Reddito pro capite e disuguaglianza: evidenze dai dati fiscali italiani

La vasta letteratura empirica sulla curva di Kuznets ha prodotto risultati molto contradditori nel corso degli anni e la sua forma esatta risulta ancora controversa. Nel presente lavoro ci proponiamo di verificare empiricamente la relazione tra crescita e disuguaglianza utilizzando dati comunali italiani, seguendo un approccio analitico spaziale che può fornire intuizioni nascoste utili ai policy-maker nella definizione di azioni di crescita locale. Eseguiamo l'analisi a diversi livelli di aggregazione spaziale (Comune, Provincia e Regione), affrontando anche il Modifiable Areal Unit Problem. I nostri risultati empirici supportano la presenza di una curva a U positiva, suggerendo la presenza di una terza fase della curva di Kuznets, dove la transizione servizi-conoscenza impatta sull'andamento della disuguaglianza di reddito in modo simile alla transizione agricolo-industriale del passato.

JEL Classification: R11; R12; D31; D63; O47.

Parole chiave: *Coefficiente di Gini; Curva di Kuznets, MAUP; Dipendenza Spaziale.*

Keywords: Gini coefficient; Kuznets Curve; MAUP; Spatial Dependence.

1. Introduction

Inequality is a central concern of development researchers and considerable debate has surrounded inequality within a country, in terms of its impact on growth, and what policies can best be deployed to reduce it or to manage its consequences for growth and development. The seminal study conducted by Kuznets in 1955 is a reference point for most of the researchers evaluating the possible relationship between economic growth and inequality. Kuznets (1955) conjectured the inequality of income distribution to increase in the early phase of development and later to decrease again, using time series data in the United States, United Kingdom and Germany. This inverted U-shaped curve has since then been called the Kuznets curve. Empirical findings were based on the hypothesis that the shift of labor from the agricultural sector, characterized by both low per-capita income and within-sector inequality, toward the industrial/urban sector, with higher per-capita income and a relatively higher degree of within-sector inequality, results in an inverted U-shaped curve for the economic growth.

In the half century since Kuznets' writing on the subject, much empirical evidence has been gathered to shed light on his hypothesis, but support for it is far from clear-cut, partially hampered by an initial lack of reliable data.

Hirschman and Rothshield (1973), in the development policy debate of the 1950s and 1960s, attempted to explain how social tolerance for inequality depends on the characteristics of the growth process and how an unequal distribution of the fruits of economic growth does not necessarily generate political instability and social tensions. This interpretation of cross-country differences in the relationship between income distribution and economic growth as a function of social tolerance for inequality is called the "tunnel effect." In the early stages of rapid economic development, when inequalities in income distribution across social classes may be very large, it may be that society's tolerance for such inequalities may vary significantly. How tolerant we are depends on the circumstances. After stagnation we tend to be more tolerant than during development. If the degree of inequality in income distribution increases in the early stage of development, then the response to that increase will depend on the degree of tolerance in the country concerned, which tolerance varies from country to country: in general, more heterogeneous societies tend to be less tolerant. The level of tolerance then varies with the development process. The socio-political context is also important. If, given a certain social structure the tunnel effect is weak (tolerance for inequality is low), a "grow first, distribute later" strategy will not be successful.

Most of the empirical work on the Kuznets hypothesis has tested the existence of the Kuznets Curve using various methodologies, where empirical difference in existing datasets, estimation techniques and/or model specifications have been proposed as possible reasons for the differing results from previous studies. Most of the papers have used a parametric model in their analysis, which has resulted in different varying conclusions depending on the specific functional form being used in the application. This by no means a rejection of the existence of the inverted U-shape relationship.

According to Moran (2005), the history of the U-curve hypothesis can be partitioned into three different periods. The first goes from 1955 to the 1970s, when the U-curve was an undisputed fact defined as a foundation for the new growth economics. In the second period, from 1980s to the early 1990s, the hypothesis became widely challenged and contradictory findings have emerged. Finally, the third period from 1990s to today is still characterized by lots of controversies, with more and more analysis of the various versions presented over the decades (Moran, 2005; Kanbur and Venables, 2007) and experimental disproves of Kuznets' original statements (Piketty, 2005; Piketty, 2014; Baymul and Sen, 2018; Sumner, 2018; Nasr et al., 2019).

The international income distribution data necessary to evaluate Kuznets's hypothesis remained severely limited until the mid-1970s, restricting until then the analysis on some standard countries time series data. Panel datasets were used in 1998 by Deininger and Squire both to estimate regressions that control for country-specific fixed effects on the level of inequality, and even to allow for separate inequality paths across countries. Once country-specific controls were included in the model, the significance of the Kuznets curve vanishes. The authors concluded that more countries have inequality paths inconsistent with the Kuznets hypothesis and that most countries' inequality changes slowly over time.

The debate about the question whether cross sectional or time series data are better suited to test the connection between growth and inequality continues to be a central issue in the empirical analysis (see, e.g., Ram, 1991, Deininger and Squire, 1998, Barro, 2000, Banerjee and Duflo, 2003 and Sukiassyan, 2007).

Recent models that feature a Kuznets curve generalize beyond the shift of persons and resources from agriculture to industry and argued that a similar type of non-linear dynamics should also occur because of skill-biased technological change (Galor and Tsiddon 1997; Aghion et al., 1999; Galor and Moav, 2000), especially for developed countries. The counterpart of the movement from rural agriculture to urban industry may also be a shift from a financially unsophisticated position to one that involves inclusion with the modern financial system (see Greenwood and Jovanovic 1990).

Income inequality in OECD countries is at its highest level for the past half century and the average income on the richest 10% of the population is about nine times that of the poorest 10% (OECD, 2016). Inequality in Italy has increased in recent years, after a period of stabilization, commonly to other main European countries (Istat, 2019). However, Italy's disparities are characterized by different regional behavior, with a particular feature not shared by other European countries like France, Germany, and United Kingdom, as being inversely related to the level of wealth pro capita.

Zuznets' original hypothesis implies that in order to analyze the relationship between economic growth and inequality, empirical tests are conducted with time series or panel data. However, the analysis can be done using cross sectional data for individual countries at the spatial level. In this case, while not observing the relationship between economic growth and inequality at the time level, it is possible to investigate, at a given instant in time, for which levels of per capita income inequalities in the distribution of income are most amplified.

In the present paper, we suggest performing the analysis following a spatial approach, by considering Italian data on income per capita and inequality in 2015, using municipal data provided by the Italian Ministry of Economic and Finance (Department of Finance), to estimate the relationship between growth and inequality. Our dataset includes 8.000 municipalities spread across the 110 Italian provinces, grouped in 20 regions, and give the opportunity to pursue the analysis at different spatial disaggregated levels. Data of the Department of Finance are based on detailed information of the individual taxpayers (grouped into income classes) and allow calculating inequality indices considering the entire distribution of income, in each single municipality. This richness of data is an important point of our analysis, since in territorial analysis, inequality is often measured using aggregate data (in terms of sum or average).

In literature, we can find different papers focused on the relationship between Italian inequality and growth, based mainly on data observed in time series (Fiorio, 2011) and/or over (macro)regions (Mussida and Parisi, 2016, Cerqueti and Ausloos, 2015), but none follows a spatial approach and analyses the Kuznets curve on the fine municipality spatial unit. Although Italy is characterized by the well-known North-South divide, structural differences in infrastructure, quality of life, employment opportunity, and technology and finance markets can be found mainly at a finer spatial level, where rural-internal areas, industrial districts, and metropolitan city, for example, show different growth paths. To this end, following a spatial approach in the investigation of the Kuznets curve, may highlight dynamics otherwise hidden, providing insights useful for policymaker in defining local growth actions.

Since Openshaw and Taylor (1979) formalized the so called *Modifiable Areal Unit Problem (MAUP)*, this has been an important area of research within geographer and spatial researcher (Fotheringham and Wong, 1991; Miller, 1999). Openshaw and Taylor (1979) showed that correlation between variables may vary for different boundaries systems used in empirical analysis and evinced empirically that changes in scale or unit definition may alter findings in quantitative measures and statistical tests. In our spatial analysis, we try to shed some lights on the Kuznets curve also by facing the issue of MAUP, tacking on the analysis distinctly on regional, provincial, and municipal data.

Furthermore, income inequality is generally analyzed by using analytical methods and models that neglect the impact of location. Instead, the estimation of spatial models proposed in the present paper, allows investigating the presence of spatial effects and spillovers in the relationship between average per capita income and inequality that may play a key role in setting strategic policies.

The layout of the paper is as follows. Section 2 gives a brief review of the Kuznets curve and its different versions proposed in literature. In Section 3 we describe the indices and data used in the empirical analysis, proposing some spatial descriptive statistics and maps at different spatial scales. Section 4 concerns the presentation of our empirical study of the inverted U-curve and the spatial estimated models. In the last Section of the paper, we draw some concluding remarks and summarize the main results.

2. The Kuznets curve and its critics

In his seminal work in 1955, Kuznets argued that the relationship between the level of per capita income and inequality in the distribution of income may take the form of an inverted U. The Kuznets hypothesis suggests that as economic development occurs, income inequality first increases and, after some "turning point", starts declining.

The basic of the Kuznets's hypothesis consists in representing income or economic growth on the horizontal x-axis and economic inequality on the vertical y-axis and its specification may be defined through the following model (Robinson, 1976):

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 X_i^2 + u_i$$

where inequality Y_i may be measured through an index, like Gini, Theil, or Atkinson (Cowel, 2000) and X_i is the GDP or income per capita (in level or logarithm), and i is the observed unit. The inverted Kuznets hypothesis implies $\beta_1 > 0$, $\beta_2 < 0$ with $|\beta_1| > |\beta_2|$. If the inverted U-curve is asymmetric, with an elongated right tail (Galbraith and Kum, 2002), then $\beta_1 < 0$.

Empirical studies on Kuznets hypothesis gave controversial results during the last decades and there is still discrepancy of recognition of the relationship between these two variables. Paukert (1973) confirmed the inverted U-shaped relationship between income inequality and economic development by using 56 countries and results confirm the Kuznets hypothesis. Instead, Fields and Jackubson (1994), and Aghion and Howitt (1998), found evidence of an anti-Kuznets curve, where the relationship is defined by a positive U-shape curve. This third possibility of the shape of the relationship implies the following values for the parameters:

$$\beta_1 < 0, \qquad \beta_2 > 0 \qquad (|\beta_1| > |\beta_2|)$$

Over the years, many extensions and modifications of the original model proposed by Kuznets have been suggested in literature. More recent tests have been based on large datasets, see, for example, Deininger and Squire's (1996) inequality database in which there are numerous high-quality observations (Gini indices and quintiles) for 108 countries. Using this database Deininger and Squire (1998) conclude that the data give little support to the inverted U hypothesis at least in country-by-country tests in 90 percent of the cases.

Jha (1996) introduced in the model also the education level (primary and secondary schooling attainment in the population) and the five-year growth rate of income, whereas Kim et al. (2011) included the age structure of population, the degree of trade openness, and the proxies for the labor market including the unemployment rate and the share of self-employment.

List and Gallet (1999) used an unbalanced panel of 71 which includes a mix of lower-developed and higher-developed countries over the period 1961-1992 and proposed the following model:

$$Y_{it} = \beta_{0i} + \beta_1 X_{it} + \beta_2 X_{it}^2 + \beta_3 X_{it}^3 + \Phi T + \sum_{i=1}^{13} C_i D_i + \varepsilon_{it}$$

where β_{0i} are the fixed or random effects, ΦT is the time trend, and D_i are corrective dummies for the differences in definitions of the Gini index used as dependent variable in the analyzed countries. In their application, the authors show that after the end of the Kuznets curve, starting from the 1980s, the beginning of a new Kuznets curve can be observed, which contradicts Kuznets' theory of no income inequality in the advanced stages of growth.

Galbraith and Conceicão (2001) found recent findings of rising inequality in several developed countries described by a U-shaped relationship between income inequality and GDP per capita, which also contradicts the original Kuznets hypothesis.

The latest empirical evidence on the subject has been mixed. Barro (2000) presents the results of panel data analysis of 100 countries and concludes that Kuznets curve holds as a "clear empirical regularity". The author also finds that primary and secondary schooling attainment is negatively related to inequality, while higher education attainment is positively related. On the other hand, Gallup (2012) using panel data of 87 countries did not confirm Kuznets hypothesis and found the existence of anti-Kuznets curve. Evidence of a U-shaped relationship (anti-Kuznets curve) can be found in different recent papers (Kiatrungwilaikun and Suriya, 2015; Castells-Quintana et al. 2015), that point out how latest trends show inequality tends to decline in low-income countries and increase in developed economies.

More recent works (e.g., Rodrik, 2007) argue that economic growth alone may be insufficient to solve the problem of reducing inequality and poverty, and possible factors that may cause increase in inequality and growth are the expansion of the financial sector, the technological progress, the globalization, and the increase of service sector employments (OECD, 2011). Raitano (2016) suggests that the relationship between income dispersion and economic growth is changed during the last decade, after the outbreak of the global financial crisis in 2008. Lakner and Milanovic (2015) claim that the Kuznets curve is going through a third phase after the inverted U-curve, characterized by a new increase in growth and inequality, what has been seen since the 1980s in developed countries. This S-shape curve, also known as the Elephant curve (Alvaredo et al., 2018; Chancel and Gethin, 2017) was previously suggested by List and Gallet (1999) and can be explained by the rise of the knowledge economy (Known 2016), where the service-knowledge transition impacts income inequality trends in a way like the agricultural-industrial transition of the past. Similar conclusions were drawn by Roine and Waldenström (2015), who proposed a new Kuznets curve based on technological developments starting not from a sectoral shift from agriculture to industry but from traditional to technologically intensive industry. Factors affecting the skill-composition in the demand of labor force in the technology era will tend to affect the distribution of income, as for example the increasing integration with the world economy (i.e., globalization). Data of the 27 OECD countries for the period 1980-2000 show that the financial sector has grown on average by 201%, international trade by 58.54%, employment in services by 34.68%, technology (measured as productivity) by 56.5%, and economic globalization by 37.6%. These data support the hypothesis that from the 1980s a new technological era is started in the developed countries.

Finally, critics on empirical analysis of the Kuznets curve concerns data comparability in income distribution data, in terms of choice of the recipient unit, income concept, geographical coverage and of divergent household survey design (Jha, 1996). Moreover, the switch from cross-sectional to time series or panel data, may significantly impact the analysis, making not always comparable results obtained from within and between countries studies (List and Gallet, 1999).

3. Data and variables

Data used in the paper were released by the Italian Ministry of Economy and Finance (Finance Department) and consider the different income of all taxpayers (employee, retired, self-employed, companies, etc.) in year 2015. Income data are summarized in class-distribution for each single municipality, providing high detailed information on the income distribution. However, the use of such data implies two important drawbacks, one substantial and the other methodological, given by the existence of tax evasion and by the presence of negative income in the lower class of the income distribution, respectively. While the first issue is not considered in our analysis, the second question may be solved through appropriate methodological adjustments, in the computation of the inequality index.

To perform our analysis on the Kuznets curve, we employed the Gini index as a measure of income inequality, the most popular index used in literature, whose value ranges from 0 to 1, with the higher the value the larger inequality. However, Gini index can be calculated only for positive income values, otherwise it is not necessarily bounded in the interval [0,1]. It could take values greater than one and, more important, it may overestimate the inequality of the income distribution. Omission of the negative values represents the usual solution, thus altering empirical results. To solve the problem, two methods have been proposed in literature. Chen et al. (1982) propose the following normalized formula of Gini, obtained by resorting the absolute mean difference-based expression:

$$G_{CTR} = \frac{1 + \frac{2}{n}\sum_{1}^{n} j y_j - \frac{1}{n}\sum_{k+1}^{n} y_i \left(1 + 2\left(n + j\right)\right)}{1 + \frac{2}{n}\sum_{1}^{k} j y_j}$$

where $y_i = \frac{Y_j}{n\mu_Y}$ and k is defined as $\sum_{1}^{k} y_j < 0$ and $\sum_{k+1}^{n} y_j > 0$. In case of nonnegative income $k = 0$. The normalization of the index was later adjusted by Berebbi and Silver (1985). However, Raffinetti et al. (2015) show that the Gini normalization proposed by Berrebi and Silber (1985) had an abnormal behavior in detecting the existing inequality between income distributions. Therefore, the authors propose a different normalization when income involve also negative values and apply the following maximum value at the denominator of the formula of G_{CTR}:

$$\Delta_{\max} = 2\frac{(n-1)(T^{-}+T^{+})}{n^{2}}$$

where T^{-} and T^{+} are the total negative and positive incomes, respectively. The new index is named G_{RSV}. The correlation coefficient between the two indexes on our dataset is 0.9984, therefore their use is almost equivalent. Because of the reliability and robustness of in case of polarized distributions, we prefer to use this as measure of inequality in our spatial analysis. Hereafter, we use as Gini index, the G_{RSV}.

Table 1 below presents some basic statistics for the main variables that we will use in our empirical analysis on the Kuznets curve – income per capita and Gini index – distinctly at each spatial aggregation level (municipality, province, and region). We also include the Moran's statistic to verify the presence of spatial autocorrelation.

Table 1 **Summary statistics of Income per capita and Gini Index**

		Summary statistics							
Variable	**Level**	**Min**	**1st Qu**	**Median**	**Mean**	**3rd Qu**	**Max**	**St Dev**	**Moran's**
Income Per Capita	Municipality	3.390	14.664	17.597	17.452	19.944	46.095	3.673	0.783***
Income Per Capita	Province	13.537	16.357	19.109	18.735	20.741	27.166	2.836	0.298**
Income Per Capita	Region	14.611	16.453	19.597	18.988	21.029	23.632	2.690	0.732*
G Index	Municipality	0.220	0.356	0.380	0.383	0.409	0.676	0.041	0.480***
G Index	Province	0.366	0.396	0.407	0.414	0.433	0.476	0.024	0.083**
G Index	Region	0.389	0.402	0.421	0.421	0.436	0.469	0.022	0.232*

Note: *p<0.1; **p<0.05; ***p<0.01

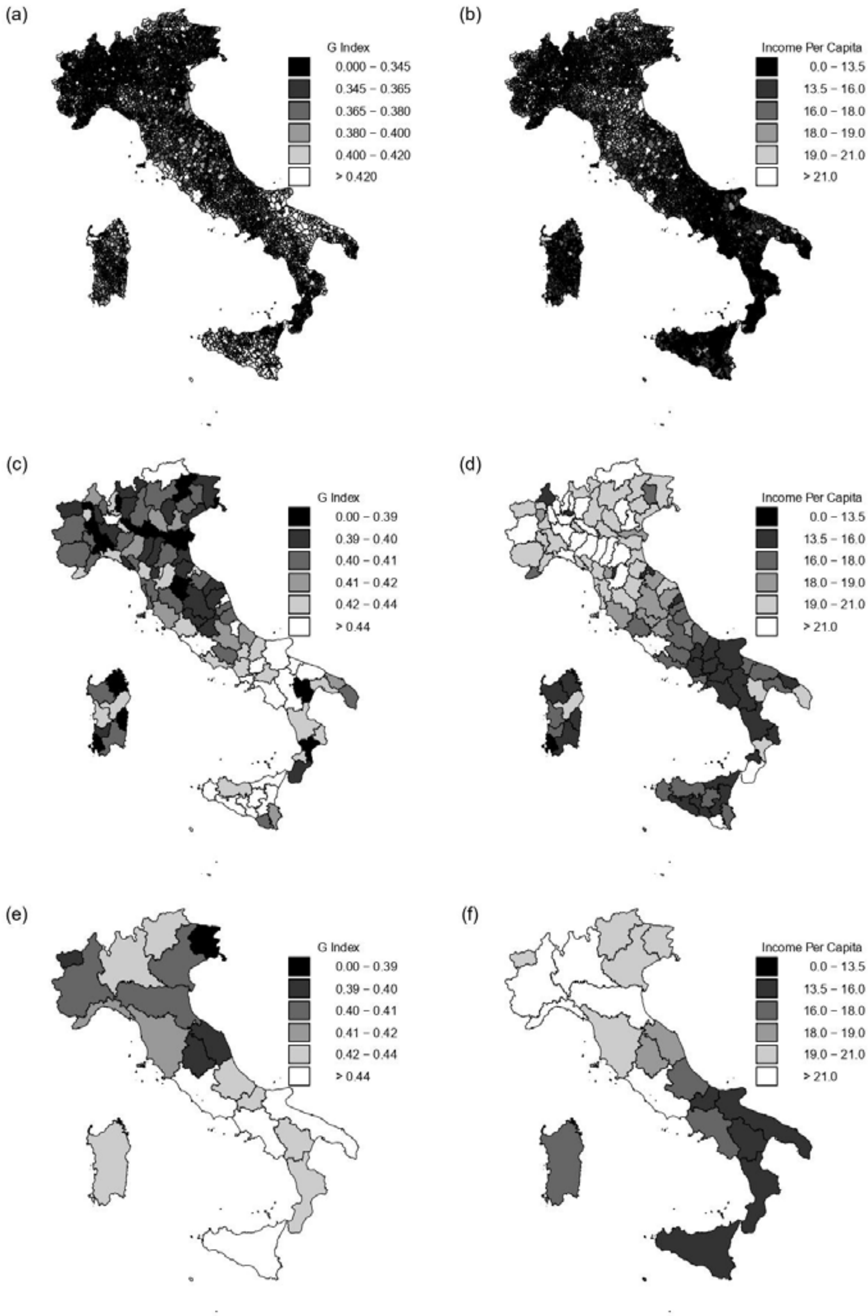
The statistics is always significant, highlighting the presence of spatial dependence in both variables. Moreover, we note that the significance is higher at finer spatial resolution: municipality data present higher dependence than regional ones.

The Gini inequality index and the income per capita are shown in the maps in Figure 1, at the different spatial resolutions.

The behavior of the Gini index is accordant in all the three spatial aggregations, with lower degrees of inequality in Northern and Central Italy, while Southern east and Islanders have higher values, although municipality data in general present higher heterogeneity, confirmed by the value of standard deviation reported in Table 1.

Looking at the income per capita variable, its spatial distribution change with respect to the aggregation level. At municipality level, higher values of income are in Northern and Central Italy; however, we can also find many municipalities with low income per capita in these areas. When we look at the maps at province and regional level, instead, the classical development pattern in terms of North-South divide can be recognized. Differences found in the spatial distribution of the variables, with respect to the spatial resolution used in the map, support the possible MAUP effects in the analysis.

Figure 1 **Spatial distribution of Gini index and income per capita at different spatial levels**



4 Empirical results

The aim of the paper is to verify empirically the relationship between inequality and per capita income for our cross-sectional Italian data in year 2015, and if this follows the U-inverted shape, as suggested by Kuznets. The analysis is made at the three different spatial resolutions: municipality, province, and region. First, we estimate on our data a linear (OLS Poly 1) and quadratic (OLS Poly 2) polynomial regression at the different spatial scales. The AIC statistics of these regressions are reported in Table 2. The two polynomial regressions are compared, in terms of AIC statistics, also with respect to the non-parametric Cubic spline interpolation. This smooth fitting method is a piecewise third order polynomials regression, which pass through a set of control points.

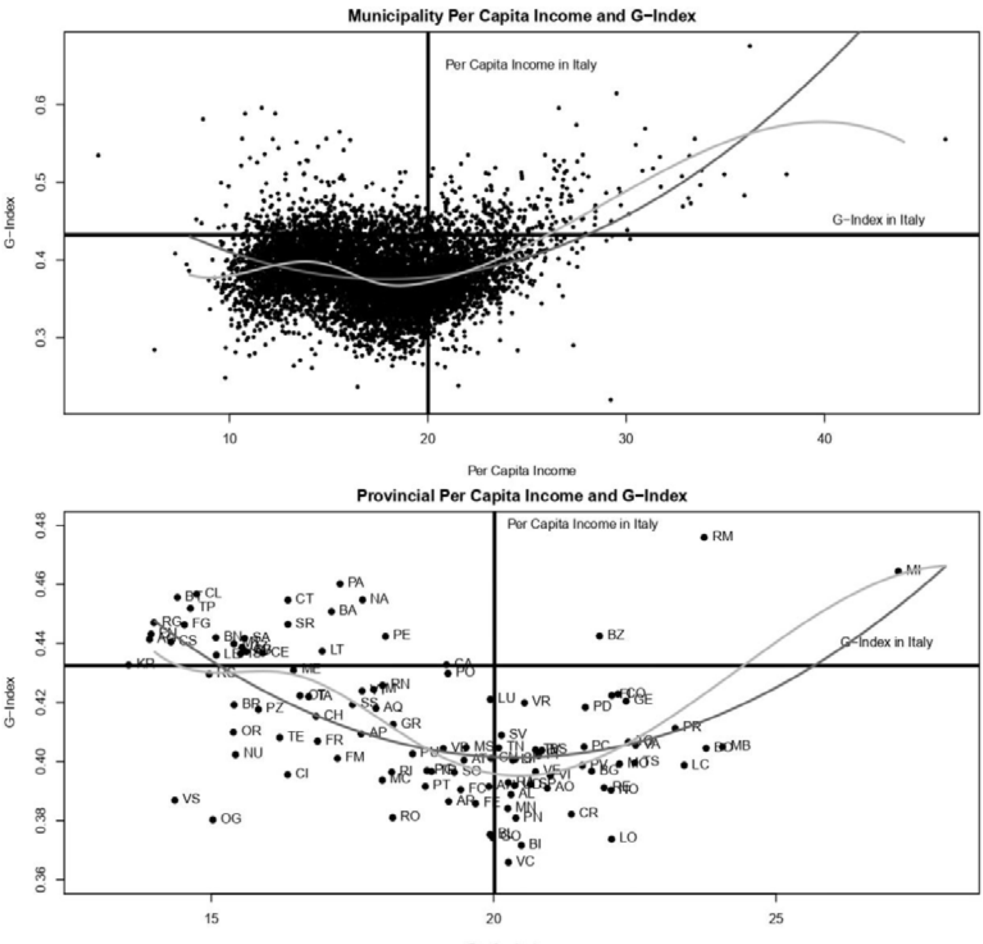
Table 2 **AIC statistics for some models at different spatial resolution**

	Municipality	Province	Region
OLS Poly 1	-28309.907	-519.594	-94.365
OLS Poly 2	-29043.703	-546.685	-98.157
Cubic Spline	-29576.829	-552.261	-100.843
LAD Poly 1	-28047.808	-524.019	-98.620
LAD Poly 2	-28701.093	-554.015	-102.326

Although AIC statistics are optimal in all three spatial resolutions for Cubic Spline estimations, when an F-test is applied to compare the goodness of fit of quadratic and cubic spline regressions, only in the municipality case the cubic spline outperforms significantly[1].

Figure 2 shows per capita Income – Gini index relationships at the three different spatial aggregation levels. In all graphs, we reported also the estimated quadratic polynomial regression (black line) and the cubic spline (grey line).

Figure 2 **Inequality – per capita Income relationships at different spatial aggregation levels (black line is the OLS Poly 2 regression and the grey line the cubic spline)**



1 The p-values at province and regional level are 0.101 and 0.115 respectively.

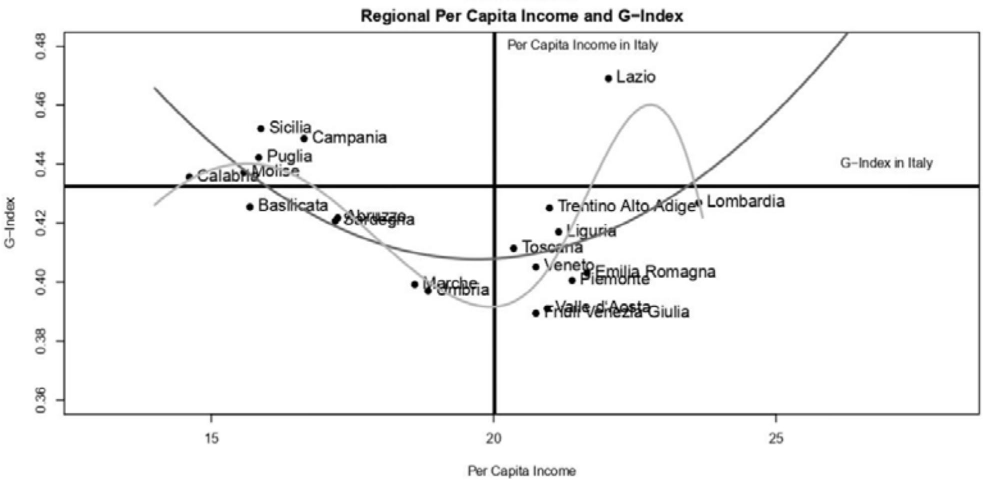


Figure 2 suggests the presence of a positive U-shape curve, with a decreasing relationship for lower per capita incomes and increasing inequality for higher per capita incomes. The cubic interpolation seems supported by the presence of few outlier points that could reduce the adaptation of quadratic polynomial regressions. To this end, we estimated the polynomial regressions also with the Least Absolute Deviations (LAD) method. LAD is a robust estimation technique; in that it is robust to outliers in the data. It gives equal emphasis to all observations, in contrast to ordinary least squares which, by squaring the residuals, give more weight to large residuals. If we compare the AICs of LAD regressions (also reported in Table 2), these are optimal in case of provincial and regional data, supporting the quadratic polynomial regression. In case of municipality, the cubic spline remains the best choice.

We proceed with the estimation of the quadratic polynomial regression on our data, for all three spatial aggregations (also for municipalities, to have model homogeneity) and results of the estimation with both OLS and LAD methods are reported in Table 3. From the estimation output we can draw different conclusions. First, in all cases ; therefore, our application supports the presence of a U-shape curve that contradicts initial Kuznets' theory of no income inequality in the advanced stages of growth. Our data are characterized by a new increase in growth and inequality, what has been seen since the 1980s in many developed countries (Chancel and Gethin, 2017) and can be explained by the rise of the knowledge economy (Known 2016).

Second, the estimated coefficient is similar in municipal and province models (OLS and LAD), while it changes in regional data estimation. This result points out the presence of the MAUP effect (Openshaw and Taylor, 1979), as previously highlighted in the introduction section, showing that correlation between variables may vary for different boundaries systems used in empirical analysis.

Finally, we note that the municipality regression has a low , confirming that the quadratic polynomial regression does not adapt well on our data.

Table 3 **Estimation of Quadratic polynomial models with OLS and LAD methods**

	OLS Polynomial Regression Results			**LAD Polynomial Regression Results**		
	Dependent variable: G-Index			Dependent variable: G-Index		
	Municipality	Province	Region	Municipality	Province	Region
Per Capita Income	-0.020***	-0.046***	-0.070**	-0.024***	-0.047***	0.068
	(0.001)	(0.007)	(0.028)	(0.001)	(0.007)	(0.049)
(Per Capita Income)^2	0.001***	0.001***	0.002**	0.001***	0.001***	0.002*
	(0.00002)	(0.0002)	(0.001)	(0.00003)	(0.0002)	(0.001)
Constant	0.555***	0.869***	1.100***	0.591***	0.888***	1.086**
	(0.007)	(0.070)	(0.261)	(0.010)	(0.064)	(0.455)
n	8000	110	20	8000	110	20
R^2	0.088	0.359	0.362	0.044	0.285	0.299
Adjusted R^2	0.088	0.347	0.287			

Note: $^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Looking at Figure 2, provinces in the right upper quadrants, characterized by high inequality and high per capita income, are Milan, Rome and Bozen: the most developed Italian cities, with high service sector employers. Moreover, Milan is the financial market of Italy. Just behind these cities, we can find some important municipalities of the North-East, like Bologna, Padova and Piacenza, that have recorded, in recent decades, a significant expansion of the international trade. Instead, in the upper left quadrant we can find geographical zone with low income and high inequality, that are at most located in Southern Italy, as for example the Sicilian municipalities, Foggia, Cosenza, and Benevento. In the bottom, we can find other Southern cities (Potenza, Aquila, Chieti) and some in the Center (Macerata and Grosseto), that seem to follow the down-phase of the standard Kuznets curve, with decreasing inequality, along their growth paths. The shape of curve is in line with the well-known North-South divide, however some exception can be found, for single specific realities that outperform from their local behavior. When we consider regional data, the territorial behavior is more homogeneous, with evidence of North and North-east regions in the new knowledge and service era, characterized by increasing growth and inequality, and the Southern in the decreasing second phase of the standard Kuznets curve.

Basic statistics previously reported in Table 1, have shown the presence of spatial correlation in both analyzed variables. This result suggests introducing a spatial augmented Kuznets curve in our analysis. Many examples of spatial models can be found in literature to study inequality and economic growth (Dall'Erba et al., 2008, Ertur et al., 2006). Moreover, recently, the Environmental Kuznets Curve (EKC) was applied successfully to explain the relationship between economic growth and environmental quality (Stern, 2004) and many authors consider the spatial interdependence in the EKC for Europe, by estimating spatial econometrics models. According to these considerations, standard Kuznets curve can be re-formulated following the Spatial Durbin Model (SDM) approach:

$$Y_i = \beta_0 + \rho WY_i + \beta_1 X_i + \beta_2 X_i^2 + \gamma_1 WX_i + \gamma_2 WX_i^2 + u_i$$

where ρ is the scalar spatial autoregressive coefficient, W is the non-stochastic spatial weight matrix that specifies the spatial dependence structure among the observations and WX_i and WX_i^2 are the linear combinations of the spatially lagged explanatories. The use of SDM has been recommended and supported in spatial analysis by LeSage and Pace (2009) and Elhorst (2010). This model has as special cases the Spatial Lag Model (SLM), when $\gamma_1 = 0 = \gamma_2$. Another widely used model in empirical studies on economic growth is the Spatial Error Model (SEM), which incorporates spatial autocorrelation in the disturbance term. Finally, the Spatial Autoregressive Model with Autoregressive disturbance of order (1,1) (SARAR) is considered, as widely used when the Spatial Durbin and the Spatial Error models do not remove sufficiently the residuals spatial autocorrelation.

For the estimation of these spatial models, it is necessary to define an appropriate contiguity matrix W. Empirical studies dealing with spatial units often use geographical-based distances. In this paper, the spatial contiguity matrix W is defined in terms of a row-standardized binary matrix, based on distances from the k nearest neighbor observations, where k changes depending on the spatial aggregation level[2].

The model is chosen looking at the AIC (Table 4) and the LR ratio test (Table 5). The best value of AIC (i.e., the minimum value) is always obtained for the SDM.

2 k = 8, 5 and 4 respectively for municipalities, provinces and regions.

Table 4 **AIC for different spatial models, at different spatial resolution**

	Municipality	Province	Region
Spatial Lag	-33039.596	-464.304	-96.211
Spatial Durbin	-34291.036	-465.847	-109.100
SARAR	-34134.702	-462.486	-98.570
Spatial Error	-33986.085	-464.327	-100.465

Furthermore, we also apply a Likelihood ratio test (LR), where the SDM is compared with the other spatial models. Also in this case, data support the choice of the SDM, although in case of province spatial aggregation, the p-value is at its limit of significance.

Table 5 **LR test of SDM with respect to the other spatial models**

	SARAR		Spatial Error		Spatial Lag	
	Test	p-value	Test	p-value	Test	p-value
Municipality	158.334	0.0000	308.952	0.0000	1255.441	0.0000
Provincial	5.361	0.0216	5.519	0.0633	5.544	0.0636
Regional	12.529	0.0004	12.635	0.0018	16.888	0.0002

Following all these tests and empirics, we decide to use the SDM specification as the proper spatial model specification of the Kuznets curve, at all spatial levels. The output of the estimates is reported in Table 6.

Table 6 **Estimation of the SDM for municipality, province and region, Italy 2015**

	Dependent variable: Gini-Index		
	Municipality	Province	Region
Per Capita Income	-0.002*** (0.001)	-0.040*** (0.003)	-0.036* (0.020)
(Per Capita Income)^2	0.0002*** (0.00002)	0.001*** (0.0001)	0.001* (0.0005)
W(Per Capita Income)	-0.005*** (0.001)	0.005 (0.011)	0.022 (0.034)
W(Per Capita Income)^2	-0.0001*** (0.00003)	0.0001 (0.0003)	0.001 (0.001)
ρ	0.7798*** (0.0091464)	0.29811** (0.12932)	-1.0017* (0.46544)
Constant	0.145*** (0.009)	0.005 (0.088)	1.074*** (0.388)
Observations	8000	110	20
Wald Test	7,268.801***	5.314**	4.632**
LR Test	4,327.420***	5.315**	3.646*

Note: *p<0.1; **p<0.05; ***p<0.01

The SDM confirms the presence of a U-shape curve, with . The spatial lagged variables are all significant only for the model estimated on municipality data, where the autocorrelation coefficient ρ is high and positive. Inequality in a municipality is highly dependent on the inequality in neighbor municipalities. Moving on to the province model, the spatial lagged variables are no more significant, and the spatial dependence is caught only by the autocorrelation. ρ reduces in value and significance. Finally, when we look at the model estimated at regional level, not surprising, the spatial effects are no more present (the ρ is at the limit of the significance) and the model reduces to the non-spatial one.

The spatial models cannot be directly compared in terms of MAUP, because of the different contiguity matrixes W introduced at the various spatial resolutions. However, we note that in the estimated SDMs, regional and provincial models have the same β_2. Our empirical analysis highly confirms that the relationship between the variables changes when moving from high spatial resolution data to lower ones. Moreover, when dealing with observations at municipality level, the use of spatial models is highly recommended.

5. Conclusions

In this paper we used a spatial approach to study the validity of the inequality and development relationship of the Kuznets curve. Empirical analysis is based on data from the Finance Department database of the Italian Economic Ministry on income distributions of taxpayers at municipality level, for year 2015. Analysis is performed at different spatial aggregation levels and with both standard and spatial models. To overcome problems of negative incomes, a recently new Gini index proposed in literature is applied in the analysis. Our results show that we are in presence of a positive U-shape Kuzntes curve, in line with recent studies that support the existence of a third phase in the growth paths for developed countries. Empirical results show that the issue of MAUP should carefully be taken into account, as different models' specification are significant in describing the relationship, depending on the spatial aggregation level used in the analysis. Moreover, our findings highlight the presence of spatial dependence, questioning the application of models that don't consider the space in their specification.

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ECONOMIA ITALIANA 2021/3

Disuguaglianze e povertà: il caso italiano

Le disuguaglianze economiche – di reddito e di ricchezza – sono più alte di quanto non fossero due o tre decenni fa per la grande maggioranza dei paesi. Anche se non altrettanto può dirsi con certezza a livello globale, per effetto soprattutto della crescita del reddito medio e della caduta della povertà in paesi come la Cina e l'India. Con riferimento all'Italia le disuguaglianze "interne" nei redditi disponibili, misurate con l'indice di Gini, sono passate (dati OCSE) dal 28% circa dell'inizio degli anni'90 al 33% degli anni più recenti. **Giuseppe De Arcangelis, Maurizio Franzini e Alessandro Pandimiglio**, editor di questo numero, sottolineano che per comprendere le cause di questo fenomeno occorre *"interrogarsi sulle caratteristiche del processo di crescita economica e il loro impatto sulle disuguaglianze. Adottando questa prospettiva non si può non fare riferimento al cambiamento tecnologico e all'affermarsi delle tecnologie digitali, da un lato, e ai processi di globalizzazione, dall'altro*".

A questi due fattori certamente si aggiungono i cambiamenti istituzionali e nelle regole del gioco che, condizionati dalla tecnologia e dalla globalizzazione, hanno notevolmente contribuito ad aggravare le disuguaglianze, indebolendo la forza contrattuale dei lavoratori e generando tolleranza rispetto all'affermarsi dei monopoli in molti mercati.

Su tutte queste tematiche molto resta da precisare e da conoscere. In questo volume di Economia Italiana vengono pubblicati lavori che possono aiutare a porsi le domande più rilevanti e che contribuiscono a migliorare la nostra capacità di rispondere ad esse. **Mussida e Sciulli** mettono in evidenza lo svantaggio delle regioni del Sud anche nella persistenza nello stato di povertà. **Curci e Savegnago** offrono una chiara esposizione delle finalità e delle problematiche derivanti dall'introduzione nel nostro paese dell'assegno unico e universale (AUU). **Aprea e Raitano** illustrano i problemi che sorgono a definire e misurare in modo univoco la povertà. **Gravina e Vallanti** affrontano l'impatto dell'automazione sull'occupazione e sulla distribuzione dei redditi. **Aliprandi, Andreano, Benedetti, Pandimiglio e Piersimoni** si occupano del rapporto tra crescita economica e disuguaglianza nei redditi. Nel suo intervento il Presidente dell'Istat, **Gian Carlo Blangiardo,** sottolinea che la disuguaglianza è un fenomeno multidimensionale e ci ricorda l'importanza dei dati sia per conoscerla nelle sue molteplici caratteristiche, sia per valutare gli effetti che hanno le politiche dirette a contrastarla.

ECONOMIA ITALIANA nasce nel 1979 per approfondire e allargare il dibattito sui nodi strutturali e i problemi dell'economia italiana, anche al fine di elaborare adeguate proposte strategiche e di *policy*. L'Editrice Minerva Bancaria è impegnata a riprendere questa sfida e a fare di Economia Italiana il più vivace e aperto strumento di dialogo e riflessione tra accademici, *policy makers* ed esponenti di rilievo dei diversi settori produttivi del Paese.

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