A New Income Indicator for the Assessment of Regional Competitiveness and Sustainability

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Abstract - **The present study evaluates the economic dynamics of more than 600 local districts for two years (2001 and 2005) in Italy with the aim to propose a new income indicator for the assessment of regional competitiveness in a traditionally divided country. The spatial distribution of district value added standardized by land surface was analyzed and compared with traditional indicators of per capita and per worker district value added. The three income indicators were then correlated to 15 variables (including share of agriculture and industry on total product, labour productivity by sector, per-capita and per-worker value added) to produce a multidimensional analysis of regional development using exploratory statistics. This approach allows evaluating the complex geography of economic development in Italy and the different relationships between the three income indicators and the selected socioeconomic variables at the district scale. Results indicate that the three income indicators show a diverging spatial distribution being correlated to different socioeconomic variables. The north-south divide and other geographical gradients traditionally observed in Italy (coastal-inland, urban-rural, among others) were identified by all income indicators. The joint use of the three income indicators reviewed in this study is considered to improve monitoring of regional competitiveness dynamics in divided countries.**

Keywords *- Economic development, Local district, Exploratory data analysis, Italy.*

1. Introduction

Formation and consolidation of value added at the local scale and of territorial disparities among regions is an important issue not only for applied economics (Barro and Sala-i-Martin, 2004), but also for other disciplines, including urban/rural sociology, geography and planning (King et al., 2001). Indicators of urban and regional competitiveness, economic sustainability and territorial cohesion are commonly used in reporting regional disparities and improvements in developmental policies (Terrasi,

1999; Arbia and Paelinck, 2003; Proietti, 2005). Local value added was sometimes seen as a proxy for more complex socioeconomic dynamics; using multivariate analysis, Salvati and Carlucci (2014) demonstrated that the district value added in Italy is strongly correlated with a number of different indicators in both economic and social research domains and can also reflect, in specific territorial conditions, the level of sustainable development. Impressive changes in the economic structure of countries and regions were also described using long-term value added time series and the analysis of territorial disparities largely benefited from indicators derived from district income or value added estimated at the municipal scale (Viesti et al., 2011).

Different (direct and indirect) indicators were proposed to assess the level of income at the local scale by computation on value added, disposable income, revenues from personal taxes and consumption levels, among other (Casadio Tarabusi and Palazzi, 2004). The majority of these indicators were derived from official statistical sources embedded in the national accounting systems (Salvati and Carlucci, 2014). Regional income is generally expressed through computation of value added at various geographical levels, from administrative regions to provinces or prefectures or other relevant spatial units. Relevance of the used spatial unit is evaluated according to the peculiarities of the administrative system enforced in each country and to the developmental policies that are targeted to improve income levels (Salvati and Zitti, 2007). Indicators at local district and municipality are being increasingly diffused according to the large availability of digital statistical data and ancillary information from other relevant sources. These indicators usually provide a more detailed picture of the geography of wealth and economic development

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of a certain region or country that more traditional regional estimates. At the same time, these indicators may be affected by important sampling errors or represent poor estimates of regional account aggregates due to the negative impact of up-scaling procedures on value added estimates' precision (Patacchini, 2008).

Another problem deals with the standardization of the aggregated value added using adequate variables. Different measures were generally computed to provide a direct value of local (district or municipal) value added: (i) per-capita value added, i.e. divided by the resident (or present) population at a certain year in the study area or (ii) per-worker value added, i.e. divided by the working population observed at a certain year in the study area. Based on the assumption that product value added is a function of capital, labour and land, emphasis was therefore attributed to the use of production factor standardization variables when developing these indicators. The present study introduces a new income indicators, based on land, the third production factor. In particular, this indicator should represent the spatial dimension of the local income aggregate, by dividing district or municipal value added by the surface area of that administrative unit. Per-area local value added could be integrated with per-worker and per-capita value added at the same spatial scale in order to provide a more comprehensive picture of territorial disparities and urban competitiveness.

This study analyzes the spatial distribution of the three income indicators illustrated above for two points in time (2001 and 2005) in more than 600 local districts, taken as homogeneous spatial unit and relevant from the economic point of view, in Italy. Correlations with ancillary indicators, made available at the same spatial scale and year, were studied in order to highlight latent patterns specifically characterizing each of the studied income indicators.

2. Methodology

2.1. The study area

The examined area covers the whole Italian territory (301,330 km^2). The Local Labor Market Area (LLMA) districts, reflecting homogeneous areas from the economic perspective at an enough detailed geographical scale, are considered as the analysis spatial unit (Giusti and Grassini, 2007). A total of 686 districts were defined by the Italian National Statistical Institute (Istat) according to data collected in 2001 National Census of Population (Istat, 2006).

2.2. Socioeconomic indicators

Three income indicators (VAOC: per-worker district income, VAPC: per capita district income and VAPS: per-area district income expressed as euros/km^2) and 15 ancillary socioeconomic indicators (see Table 1) have been made available at the district scale from official statistical data provided by Istat referring to 2001 and 2005. Both strictly economic indicators derived from regional accounts and variables describing territorial features of the local districts have been considered (Istat, 2006).

Table 1. The variables considered in this study.

Acronym	Name	Unit of measure
South	Dummy labeling southern districts	0 and 1
pAGR	Share of agriculture in district product	%
pIND	Share of industry in total product	%
pSER*	Share of services in total product	%
PR_AG	Labour productivity in agriculture	Euros
PR_IN	Labour productivity in industry	Euros
PR_SE	Labour productivity in services	Euros
Urban	Dummy labeling urban districts	0 and 1
Monta	Dummy labeling mountainous districts	0 and 1
Sup	Surface area of each district	km^2
Dens	Population density	Inhabit/km^2
CapReg	Dummy labeling regional head district	0 and 1
CapPr	Dummy variable labeling province	0 and 1
Dist_reg	Distance from the regional head town	km
Dist_pro	Distance from the province head town	km

2.3. Data analysis

Maps were provided to assess graphically the spatial distribution of the three income indicators (VAOC, VAPC, VAPS). To explore separately the pair-wise relationship between each of the three income variables and the selected ancillary indicators on a local scale, a non-parametric Spearman rank correlation analysis was carried out for both 2001 and 2005 testing for significance at $p < 0.05$ based on Bonferroni's correction for multiple comparisons. A Principal Components Analysis (PCA) was also carried out to assess the evolving regional disparities in Italy and to identify the geo-economic gradients underlying differences in the spatial distribution of the income indicators proposed in this study. The PCA was applied to a matrix (see Table 1) composed of 9 variables in both 2001 and 2005 (pAGR, pIND, PR_AGR, PR_IND, PR_SER, VAOC, VAPC, VAPS, Dens) and 8 stable variables in both years (South, Urban, Monta, Sup, CapReg, CapPr, Dist_Reg, Dist_Pro) for a total of 26 evaluated variables *plus* 1 supplementary variable (pSER in both 2001 and 2005) excluded from the PCA due to multi-collinearity with pAGR and pIND. All variables were made available on the 686 Italian districts. As the analysis was based on the correlation matrix, the number of significant components (m) was chosen by retaining those with eigenvalue > 1 (Salvati and Zitti, 2009). The Keiser-Meyer-Olkin (KMO) measure of sampling adequacy, which tests

whether the partial correlations among variables are small, and Bartlett's test of sphericity, which tests whether the correlation matrix is an identity matrix, have been used in order to assess the quality of PCA outputs. These tests indicate if the factor model is appropriate to analyze the original data. Based on the scores of the two most important components, districts were segregated into different groups based on the score plot (Salvati and Zitti, 2009).

3.   Results

The spatial distribution of the three income indicators in 2005 is shown in Figure 1. Per-worker value added in the Italian districts (a) identifies a north-south gradient with northern regions producing homogeneously above 50,000 euros per workers and southern regions being almost below this threshold. Central districts showed a more heterogeneous income distribution, alternating high and low productivity areas. Per-capita value added (b) showed a typical latitude gradient with the highest income districts concentrated in the Po plain (northern Italy) and in Rome metropolitan area (central Italy). A more patchy income distribution was observed in southern Italy according to the local socioeconomic context. Coastal areas usually diverged from inland areas as far as the income distribution is concerned.
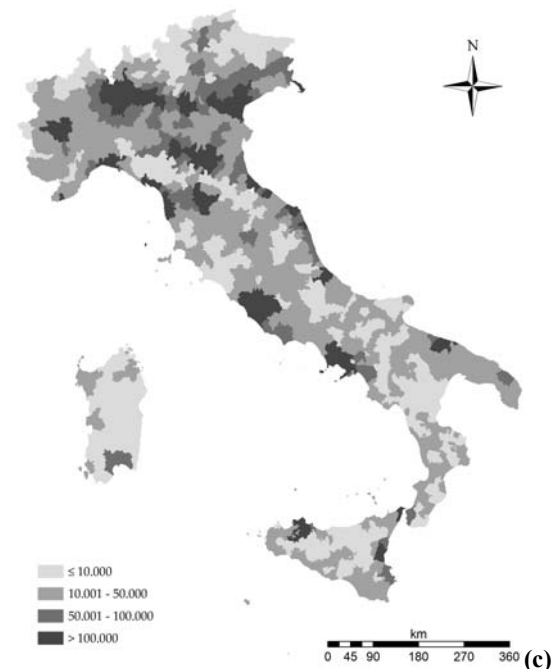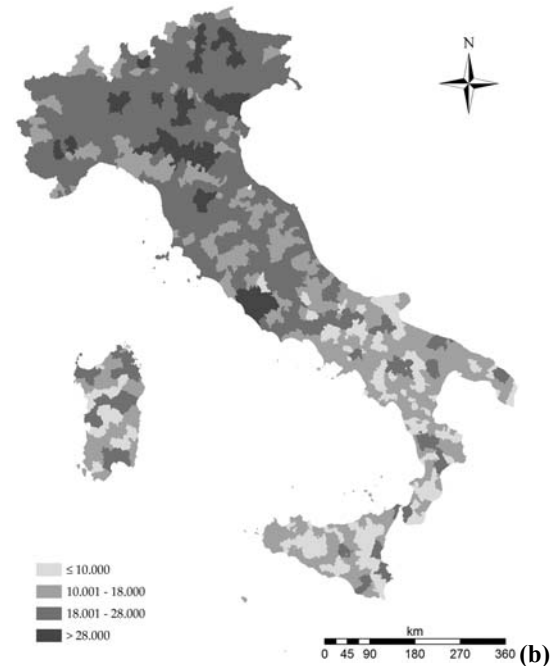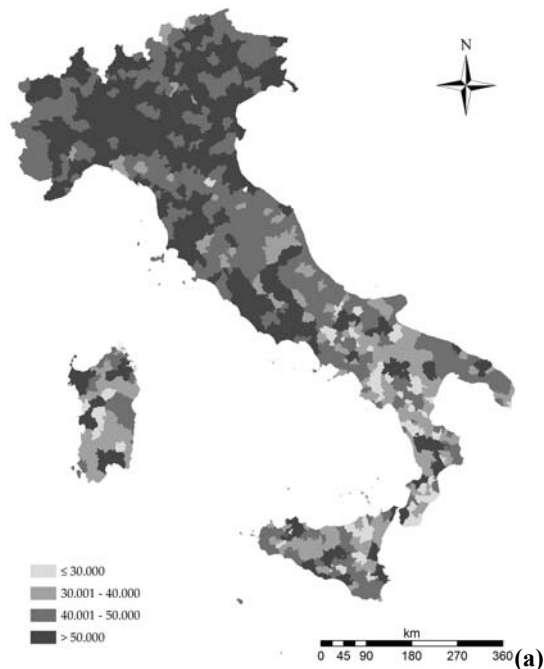

Figure 2. Maps illustrating the spatial distribution of (a) per-worker (b), per-capita and (c) per-area value added in the Italian districts (2001).

Finally, another territorial gradient emerged from the analysis of per-area value added distribution in Italy (c) evidencing the urban-rural divide based on the gap between large metropolitan systems (Rome, Milan, Turin, Naples, Genoa, Venice, Bologna, Florence, Pescara, Palermo, Cagliari, Bari and few other head towns) and less dense, internal or agricultural-devoted areas throughout the country.

Non parametric Spearman rank correlations were carried out separately between the three income indicators and the 15 selected socioeconomic variables (Table 2). A total of 10 and 9 variables respectively for 2001 and 2005 correlated significantly with all income indicators with coherent signs (South(-), pAGR(-), PR_IN(+), PR_SER(+), Urban(+), Dens(+), CapReg(+), CapPro(+), Dist_Pr(-); pIND(+) in 2001 only). As expected, this indicates a regional process of value added formation mainly based on economic agglomeration, the contribution of more productive industrial and tertiary sectors, the divided structure of urban-rural system and the consolidated gap between northern and southern districts. PR_AG and Sup were found positively associated to only per-worker and per-capita district income possibly suggesting the importance of the income standardization based on surface area and the urban-rural gradient identified by per-area income. This was confirmed by the negative correlation with Monta and DistReg found only with per-area income.

Table 2. Spearman correlations between the three income indicators and the selected socioeconomic variables (bold indicates significant coefficient at $p <$ 0.05 after Bonferroni's correction for multiple comparisons).

Variable	Income		
	Per-worker	Per-capita	Per-area
2001			
South	**-0.62**	**-0.74**	**-0.29**
pAGR	**-0.58**	**-0.62**	**-0.65**
pIND	**0.33**	**0.46**	0.20
pSER	0.01	-0.11	0.15
PR_AG	**0.46**	**0.47**	0.17
PR_IN	**0.76**	**0.71**	**0.40**
PR_SE	**0.88**	**0.75**	**0.57**
Urban	**0.30**	**0.33**	**0.29**
Monta	-0.13	-0.08	**-0.55**
Sup	**0.47**	**0.47**	0.12
Dens	**0.30**	**0.25**	**0.92**
CapReg	**0.20**	**0.21**	**0.21**
CapPr	**0.44**	**0.42**	**0.46**
Dist_reg	-0.09	-0.18	-0.23
Dist_pro	**-0.38**	**-0.33**	**-0.53**
2005			
South	**-0.60**	**-0.75**	**-0.29**
pAGR	**-0.62**	**-0.68**	**-0.64**
pIND	**0.21**	**0.37**	0.16
pSER	0.14	0.00	0.18
PR_AG	**0.38**	**0.30**	0.13
PR_IN	**0.75**	**0.74**	**0.41**
PR_SE	**0.90**	**0.76**	**0.58**
Urban	**0.33**	**0.34**	**0.29**
Monta	-0.18	-0.09	**-0.56**
Sup	**0.49**	**0.47**	0.12
Dens	**0.35**	**0.27**	**0.93**
CapReg	**0.20**	**0.20**	**0.21**
CapPr	**0.49**	**0.43**	**0.46**
Dist_reg	-0.10	-0.17	**-0.22**
Dist_pro	**-0.41**	**-0.33**	**-0.53**

Out of 26 examined variables, PCA extracted three main components explaining together 60.2% of the total variance. Loadings were reported in Table 3. Component 1 (37.2%) identifies, for both examined years, a gradient based on the opposition between per-worker and per-capita value added, in turn associated positively with labour productivity of industry and services and negatively associated with the share of agricultural product in district value added. This component clearly reflects a north-south gradient. Component 2 (15.5%) identifies a gradient primarily based on agglomeration economies with per-area value added and population density showing the highest positive loadings. This suggest that the three income indicators proposed here assess different economic dimensions and thus can be used together in a more comprehensive analysis of regional competitiveness dynamics. Finally, component 3 (7.5%) is primarily based on sector specialization in industry and services characterizing especially northern and central Italian districts. The share of industrial product on district value added is negatively correlated with the share of service product on district value added along component 3.

Table 3. PCA loadings (bold indicates significant loadings > |0.6|; * indicates supplementary variable in the analysis).

Variable	Factor 1	Factor 2	Factor 3
South	**-0.67**	0.40	0.13
pAGR01	**-0.68**	-0.05	-0.07
pIND01	0.42	-0.49	**-0.61**
pAGR05	**-0.71**	-0.01	-0.04
pIND05	0.38	-0.50	**-0.64**
PR_AG_01	0.40	-0.33	-0.31
PR_IN_01	**0.72**	-0.27	0.02
PR_SE_01	**0.77**	-0.10	0.28
PR_AG_05	0.27	-0.22	-0.22
PR_IN_05	**0.74**	-0.29	0.00
PR_SE_05	**0.81**	-0.04	0.30
VAOC01	**0.91**	-0.19	0.18
VAOC05	**0.91**	-0.12	0.22
VAPC01	**0.92**	-0.19	0.05
VAPC05	**0.90**	-0.17	0.08
VAPS01	0.57	**0.71**	-0.28
VAPS05	0.57	**0.72**	-0.28
Urban	0.40	0.19	0.32
Monta	-0.25	-0.34	0.21
Dens01	0.38	**0.81**	-0.34
Dens05	0.39	**0.81**	-0.35
Sup	0.46	-0.18	0.40
CapReg	0.31	0.42	0.18
CapPr	0.54	0.36	0.38
Dist_reg	-0.26	-0.13	0.22
Dist_pro	-0.49	-0.28	-0.02
*pSER01	-0.04	0.52	**0.65**
*pSER05	0.00	0.50	**0.66**
% variance	*37.2*	*15.5*	*7.5*

Factor score plot (Figure 2) indicates a quite homogeneous distribution of local districts along

component 1 reflecting the north-south gradient (northern and more affluent districts with positive PCA scores) and a more heterogeneous distribution along component 2. Some metropolitan areas (Milan, Naples, Rome, among others) were identified along component 2 and characterized by high per-area district value added in both 2001 and 2005. Only moderate differences between 2001 and 2005 were found in the relationship among variables as shown by PCA. This indicates that the economic structure and local performances changed only moderately in the short-term in Italy conserving the structural patterns observed among income indicators and ancillary socioeconomic variables.
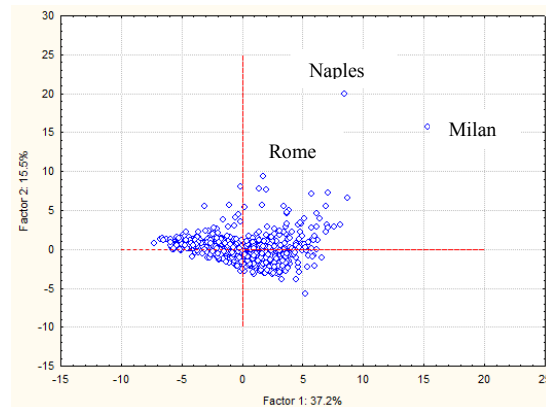

Figure 2. MFA factor score plot

4.   Discussion

The present study provides insights in the analysis of local development in a divided country exploring the spatial distribution of three income indicators and a set of socioeconomic variables made available at the district scale in Italy at two years (2001 and 2005). High-resolution spatial units and key socioeconomic indicators together with diachronic multidimensional approaches are successfully applied to the study of regional competitiveness and territorial disparities. Despite some criticisms concerning the relevance of the LLMA district as an homogeneous economic region (Giusti and Grassini, 2007), this spatial unit shows appreciable features that fill the need for data integration, reliability and relevance to regional issues (Salvati and Zitti, 2009).

Results highlight the importance of integration among different income indicators, possibly producing a more comprehensive picture on the local economic structure and performances. At the same time, results indicate an increasingly complex economic geography of Italy reflected in the multiple

relationships among income indicators and the ancillary socioeconomic variables (Dunford, 2008). Especially the north-south gap consolidated in the last year and other gradients (urban-rural, coastal-inland, among others) emerged from the analysis as particularly important to determine territorial disparities (Dunford, 2002). Geo-economic gradients involve processes, related not only to economic but also to organizational, institutional, social and cultural factors (Dunford and Greco, 2007), which develop at the regional scale and need specific monitoring based on local-scale indicators and geographic information systems as a support to decision-making and developmental policies. More comprehensive income indicators can also offer a novel contribution to the study of sustainable development of local districts (Zuindeau, 2006, 2007; Karlsson, 2007).

Permanent monitoring of socioeconomic conditions on a local scale may benefit from a holistic approach based on multi-scale quantitative models possibly coupled with qualitative approaches. Both process understanding and policy implementation depend on the mutual interactions among the drivers of economic development acting differently at the various relevant geographical scales.

Acknowledgments

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