*Title Page (WITH author details)

Socio-economical analysis of Italy: The case of habiotoponym cities

Roy Cerqueti[1,a]

[a] University of Macerata, Department of Economics and Law
Via Crescimbeni 20, I-62100, Macerata, Italy
Tel.: +39 0733 258 3246; Fax: +39 0733 258 3205
E-mail: roy.cerqueti@unimc.it

Marcel Ausloos[b,c,d]

[b] School of Management, University of Leicester
University Road, Leicester, LE1 7RH, UK
E-mail: ma683@le.ac.uk

[c] eHumanities Group[2]
Royal Netherlands Academy of Arts and Sciences
Joan Muyskenweg 25, 1096 CJ Amsterdam, The Netherlands

[d] GRAPES – Group of Researchers for Applications of Physics in Economy and Sociology
Rue de la Belle Jardiniere 483, B-4031, Angleur, Belgium
E-mail: marcel.ausloos@ulg.ac.be

[1] Corresponding author

[2] Associate researcher

Blind Manuscript (WITHOUT author details)
Click here to view linked References

Socio-economical analysis of Italy: The case of habiotoponym cities

Abstract

This paper considers joining the economical characteristics of Italian cities with a relevant sociological aspect of the Catholic saints. More than in other countries, a high percentage of Italian cities are toponyms coming from the name of specific saints (hagiotoponym). The link with Italian religious views is distinct. The statistical analysis of the economic contributions that each hagiotoponym city provides to the Italian GDP is considered. Such an analysis is also based on the comparison with Italian data and is considered with the Theil, Gini, and Herfindahl-Hirschman indices. It is obtained that hagiotoponym cities represent a proxy of the overall Italian reality of medium-sized cities in the case of outliers removal.

Keywords: GDP, Italian cities, Theil index, Gini index, Herfindahl-Hirschman index, religion.

1. Introduction

In new economic geography, this study examines the relationships between specifically defined entities and the global and local economies. The wealth flow is one item often considered, beside the various political and geographic constraints. In so doing, the problem of assessing the statistical properties of a country's geographic-economic structure has been widely debated in the last decades (Fan & Scott, 2003). However, economic indicators other than histograms and rank-size plots can be useful. The Theil, Herfindahl-Hirschman, and Gini indices as measures of various economic specificities are considered below. It is important to note that Theil and Herfindahl-Hirschman indices are particular generalized entropy measures and satisfy the same axiomatization scheme (Shorrocks 1980, 1984; Dagum 2008; Magdalou & Nock 2011). Here, their calculations are adapted to cities in a country. The concerned distribution relies on the aggregated tax income (ATI) of a city during the years 2007-2011.

Consider N cities and denote as y_i the ATI of the i-th city, for each $i=1,2,\ldots,N$, so that the ratio $y_i \Big/ \sum_{j=1}^{N} y_j$ represents the GDP share of the i-th city.

- the Theil index (Theil 1967) can be written as:

$$Th = \frac{1}{N} \sum_{i=1}^{N} \frac{y_i}{\sum_{j=1}^{N} y_j} \ln\left(\frac{y_i}{\sum_{j=1}^{N} y_j} \right)$$

- the Herfindahl-Hirschman index (Hirschman 1964) is given by:

$$HHI = \sum_{i \in L_J} \left(\frac{y_i}{\sum_{j=1}^{N} y_j} \right)^2$$

where J is an integer and L_J is the set collecting the J biggest cities in terms of their ATI. The value of J is set to *50*. This process retains its classical definition in economic reports, for which the value of J is limited to at most 50.

Furthermore, *HHI* can be used to calculate the normalized *HHI* index,

$$H^* = \frac{HHI - 1/N}{1 - 1/N}$$

the Gini index (Gini 1909) can be defined through the Lorenz curve, which in the present case gives the proportion f of the total Italian ATI that is cumulatively provided by the bottom x percent of the cities. The Gini index *Gi* is the ratio of the area that lies between the equality line and the Lorenz curve over the total area under the equality line. Formally, it can be written as:

$$Gi = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N}|y_i - y_j|}{2N^2\sum_{i=1}^{N} y_i}$$

The Shannon entropy is:

$$\widetilde{H} = -\sum_{i=1}^{N} p_i \ln(p_i)$$

where p_i is the probability of finding some state *i*. Formally, one can introduce the quantity

$$H = -\sum_{i=1}^{N} \frac{y_i}{\sum_{j=1}^{N} y_j} \ln\left(\frac{y_i}{\sum_{j=1}^{N} y_j}\right)$$

Similar to Theil and Herfindahl-Hirschman, such a definition can be seen as a generalized concept of entropy. For simplicity, *H* is called financial entropy.

This result is

$$H = \ln(N) - Th$$

The Theil index is also used to compare the ATI value of each city with the mean value of the whole set. Instead, the Gini coefficient is used to compare the value of each city with the value of every other one. The Theil and Gini indices numerically represent a population's degree of dispersion with respect to a variable (Miskiewicz, 2008; Palan, 2010; Iglesias & de Almeida, 2012). In contrast, the HHI index is applied to describe a company's concentration with respect to the entire market (Alvarado, 1999; Palan, 2010; Rotundo & D'Arcangelis, 2014). It is applied here for measuring city financial aggregation within Italy.

One question this study examines is the cluster effects or sub-levels of the global system on the total. In this respect, it is worth mentioning Fan & Sun (2008) for the inequality measure in China over the period 1979-2006, Walks (2013) for Canada, Bartels (2008) for the U.S.A. However, the novelty of the present research is to provide a comparison of the whole Italian situation with a specific cluster of Italian cities with a strong socio-cultural meaning.

Cluster and network effects have not previously been considered in depth. This study is concerned with one peculiar cluster where the connections are historical-religious in nature, those with a hagiotoponym. This choice has a precise motivation: to describe the economic reality of such cities which originated in the cult of a saint and compare them to those in the entire nation, Italy. The three mentioned indices are extracted and compared to the total group of Italian cities. This will provide economic insights on the urbanization grounded on socio-religious movements, and this also leads to understanding the relationship between such qualified cluster and the overall Italian situation.

The analysis suggests that hagiotonomynic cities share an economic situation which is comparable all the other Italian cities with the exception of very big and rich cities like Rome, Milan, and Turin. Specifically, the considered sample reflects the overall situation of medium-sized

cities. This approach and the findings suggests researchers should also examine such clustering contributions on a global scale at various administrative or economic levels in further work.

2. Data

ATI data are obtained from the Research Center of the Italian Minister of Economic Affairs. Contributions are disaggregated at a municipal level to the Italian GDP for five years: 2007-2011, and averages over the relevant time interval. It is important to know that a municipality or city is denoted in Italy as a comune.

Three technical points are stressed at the methodological level. Italy is organized into regions, provinces, and municipalities. Each municipality belongs to one and only one province, and each province is contained in one and only one region. Some administrative modifications of the Italian political system have led to a varying number of provinces and municipalities during the quinquennium, while the number of regions has remained constant at 20. The ATI data corresponds to a different number of cities every year. In particular, the number of cities has changed from 8096, 8094, 8094, 8092, 8092 yearly from 2007 through 2011, respectively.

The latest one in 2011 is the basic one. In 2011, the number of provinces and municipalities is 110 and 8092, respectively. Therefore, city mergers are taken into account at various times, according to Italian administrative law statements;[1] 8092 municipalities is the reference number. The resulting ATI cities are linearly adapted as if these final cities pre-date the merging or phagocytosis. All examined data result from an unweighted average of the 5 yearly official data for the 2007-2011 time period.

[1] The reader is addressed to *http://www.comuni-italiani.it/regioni.html*.

The cluster selection deserves additional research and many considerations of different types. The data collection relies on the identification of Italian cities having a toponym recalling a saint. First, a preliminary list of cities is constructed through the application of four sorting : (i) by employing the string "sa", (ii) by extracting from the previous list the city names containing "San,' "Santo ," "Santa," "Sant' ',' with the blank space at the end of the strings, (iii) by removing the string "san" without a space after the word, from the previous list, and (iv) by examining all such cases carefully in order to be sure that the hagiotoponym was a saint. For example, cities like Camposanto, Sant'Angelo (24 times), Santa Croce (5 times), Santa Luce, Santo Spirito, and similar non-human cases are rejected. Cities containing Notre-Dame and Madonna are also added to the list. Moreover, after much thought, Michele (11 times) and Raffaele (once) are added, although they are not humans, but archangels. They are anthropomorphic and can be here assimilated to human saints. This result in a list of 637 municipalities.[2]

3. Results

The usual statistical characteristics of the distribution of ATI values, of the 8092 Italian cities and of the 637 Italian hagiotoponyms are reported in Table 1. The values of the economic indices are given in Table 2. At the country level, the Gini coefficient is rather high: it points to a high level of disparity among Italian cities. When considering the hagiotoponyms cluster, the Gini index becomes remarkably smaller. This means that ATI is fairly distributed among

[2] The frequencies of saint appellations is 639. Indeed, there are two municipalities whose toponym contains a couple of saints (*Santi Cosma and Damiano* in Lazio and *San Marzano di San Giuseppe* in Puglia).

hagiotoponyms. The reason for this discrepancy should be found in the presence of outliers only in the whole Italian cities distribution.

The *HHI* index for hagiotoponyms also indicates the lack of disparities. Not only the index is low for the whole country, indicating a small difference in the ATI value of cities toward the Italian GDP, but also the fact that a saint named city is be associated minimally scattered values. For such a Catholic country, this is somewhat expected because the cult of the saints is widespread across the entire nation. Therefore, the saint cities reflect the national reality of overall medium-sized urban agglomerations with the exception of outliers like Rome, Milan, and similarly huge urban areas. This finding is also confirmed by the Theil index, which is much smaller for the hagiotoponym samples than for the entirety of Italy. This indicates a greater homogeneity in the Hagiotop. set. The fact that it occurs for the three indices is not a-priori expected. Recall that the *HHI* index and the *Th* and *Gi* indices allow different insights onto the distributions of measures (ATI). On one hand, *HHI* based on the second moment of the measurement distributions informs on the distribution variance, thus the spread of the level of competition among cities and their interactions, while both *Th* and *Gi* indices provide measures of the data dispersion. *Th* based on an entropy idea, the zero moment of the probability distribution, is associated with a number that synthesizes the degree of probable dispersion of an agent in the population (Palan, 2010).

Table 1. Statistical characteristics of the distribution of Italian city ATI values

Statistical indicator of $\langle ATI \rangle_{5yr}$	*(i)*	*(ii)*
	Italian cities	*Hagiotop.*
Minimum	332,190	775,239
Maximum	4.47×10^{10}	1.24×10^{9}
Points	8,092	637
Mean	87,391,347	54,719,782
Median	23,827,615	23,627,546
RMS	6.68×10^{8}	1.10×10^{8}
Std Deviation	6.62×10^{8}	96,604,556
Variance	4.39×10^{17}	9.33×10^{10}

Std Error	7,364,451.9	3,827,611.9
Skewness	49.14	5.69
Kurtosis	2,956.78	47.75

Source: Research Center of the Italian Minister of Economic Affairs.

Notes: Two cases are considered: (i) the set of all the 8,092 Italian cities; (ii) the set of 637 hagiotoponyms.

Table 2. Economic indicators of the distribution of Italian city ATI values.

Economic indicator of $\langle ATI \rangle_{5yr}$	*(i)*	*(ii)*
	Italian cities	*Hagiotop.*
N	8,092	637
$\ln(N)$	9.00	6.46
H	7.27	5.69
Th	1.73	3.14
$HHI \times 10^2$	0.733	0.646
$H^* \times 10^2$	0.721	0.489
Gi	0.759	0.624

Source: Research Center of the Italian Minister of Economic Affairs.

Notes: Two cases are considered: (i) the set of all the 8,092 Italian cities; (ii) the set of 637 hagiotoponyms. It is worth noting that the maximum level of entropy is $\ln(N)$.

4. Conclusions

Due to the Catholic nature of Italy, the statistical properties of the ATI of the Italian cities which contain in the toponym a reference to a human saint are discussed, and relevant scientific

questions can be addressed on the pertinence of socio-economic features due to a saint name defining a city. Results are interesting. Hagiotoponym cities can be viewed as a proxy of the overall national reality of medium-sized cities when outliers are removed.

References

Alvarado, F.L. (1999). Market Power: a dynamical definition. *Strategic Management Journal*, *20*, 969-975.

Bartels, L. (2008). *Unequal Democracy: The Political Economy of the New Gilded Age.* Princeton, NJ: Princeton University Press.

Cerqueti, R., & Ausloos, M. (2014). Statistical Assessment of Regional Wealth Inequalities: the Italian Case. *Quality & Quantity*, doi:10.1007/s11135-014-0111-y.

Dagum, C. (2008). Inequality decomposition, directional economic distance, metric distance, and Gini dissimilarity between income distributions. In: Lemmi, A. & G. Betti (Eds.), *Advances on Income Inequality and Concentration Measures* (pp. 131-161). Routledge.

Fan, C.C., & Scott, A.J. (2003). Industrial agglomeration and development: a survey of spatial economic issues in East Asia and a statistical analysis of Chinese regions. *Economic Geography, 79(3)*, 295-319.

Fan, C.C., & Sun, M. (2008). Regional Inequality in China, 1978-2006. *Eurasian Geography and Economics*, *49(1)*, 1-20.

Gini, C., (1909). Concentration and dependency ratios (in Italian). English translation in: *Rivista di Politica Economica*, *87* (1997), 769-789.

Hirschman, A.O. (1964). The paternity of an index. *The American Economic Review*, *54(5)*, 761-762.

Iglesias, J. R., & de Almeida, R.M. C. (2012). Entropy and equilibrium state of free market models. *European Journal of Physics B*, *85*, 1-10.

Magdalou, B. & Nock, R. (2011), Income distributions and decomposable divergence measures. *Journal of Economic Theory*, *146(6)*, 2440-2454.

Miskiewicz, J. (2008). Globalization Entropy unification through the Theil index. *Physica A*, *387(26)*, 6595-6604.

Mussard, S., Seyte, Fr., & Terraza, M. (2003). Decomposition of Gini and the generalized entropy inequality measures. *Economics Bulletin*, *4(7)*, 1-6.

Palan, N. (2010). Measurement of Specialization - The Choice of Indices. *FIW Working Paper* N° 62.

Rotundo, G. & D'Arcangelis, A.M. (2010). Ownership and control in shareholding networks. *Journal of Economic Interaction and Coordination*, *5(2)*, 191-219.

Shorrocks, A.F. (1980), The Class of Additively Decomposable Inequality Measures. *Econometrica*, *48*, 613-625.

Shorrocks, A.F. (1984), Inequality Decomposition by Population Subgroups. *Econometrica*, *52*, 1369-1386.

Theil, H. (1967). *Economics and Information Theory*. Chicago: Rand McNally and Company.

Walks, A. (2013). Income Inequality and Polarization in Canada's Cities: An Examination and New Form of Measurement. *Res. Paper 227, Neighbourhood Change Research Partnership, Univ. of Toronto,* August 2013.