A territorial analysis of infrastructures in Italy

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Abstract

At a regional level the study of infrastructures becomes really complicate when we consider: the territorial equipment and the different potentiality of its development.
Usually to this corresponds no homogeneity of the socio-economical conditions characterizing the various territorial areas.
Today one of the most interesting question is to establish if and in which way these elements are linked among themselves, therefore if it is possible that the level of infrastructures of an area contributes to determine its development or vice versa. To reach this goal we need to determine the quality and quantity of infrastructures. In the reality the research of synthetic indicators and of sources of information - about the characteristics of the infrastructure's outfit- are interesting instruments to development policies.
Even if with different approaches all the literature regarding the development and the competitiveness of modern productive systems agrees with the growing importance of the quality and quantity of the infrastructures.
When we live the theoretical level to effectuate a check of the quantity and quality of the infrastructures in the reality the difficulties encountered aren't of easy solution nor few: findable ness of basic data, control of the minimum requisites of homogeneity and comparability, individuation of correct modality of statistic treatment, indicators' building and so on.
This research analyses the territorial diffusion of the infrastructures in the Italian regions. This is obtained through the application of quantitative and qualitative statistic indicators. Through the whole aggregation of data we try to determine a general indicator that measures the total level of the infrastructures.

Introduction

Italy of the infrastructure is really complex for what regards territorial equipment and development potentiality. To this complexity corresponds even an analogue no homogeneity of the socio-economical condition characterizing the various sub-national areas.
Particularly, under the aspect of the explanation of territorial differentials of development, the infrastructures are considered among the elements that can determine the potentiality of development of an area as well as the geographic localization and the agglomerative and sectorial structure.
But when we live the theoretical level to effectuate a quantitative check of infrastructure outfit the difficulties encountered aren't of easy solution nor few: findableness of basic data, control of the minimum requisites of homogeneity and comparability, individuation of correct modality of statistic treatment, with a particular attention to standardization, building of significant and comparable

synthesis indicators, individuation and quantification of significant relations between infrastructures and competitiveness, and so on.
This research analyses the territorial diffusion of the infrastructures in Italian regions to evaluate the quantitative and qualitative aspects. This is obtained through the utilization of synthetic indicators on the territorial outfit; these indicators are elaborated on the base of "physic" quantitative revelations of the various infrastructure categories (physical indicators relating to economic and social infrastructure). To come to data aggregation we will use a general indicator representing the level of total quantitative infrastructure.
For the empiric analysis we used data expressing a physic quantification of the phenomenon, more than a monetary one, that can't express a clear definition of the actual condition of infrastructure at a territorial level.
In the successive phase we built qualitative indicators.

The methodological approach

From a methodological point of view the most relevant problems are linked to the identification of a suitable procedure to build representative indicators of the current outfit for the main infrastructure categories, this procedure must be adequate to the predisposition of a classification list of the various areas considered upon the base of the more or less high level of the infrastructure outfit.
We individuated 48 physical indicators, 25 of them for the economic infrastructures (relating to 4 main categories: transports, communications, energy and water supply) and 23 for the social infrastructures (relating to 5 main categories: instruction, health service, social infrastructures, sport and culture) (Mazziotta C., 1998:pag.18).
The following phases give a synthetic representation of the procedure:

- **a)** *building of the elementary indicators for each infrastructure category.*
  The elementary indicators of the physic outfit are built upon the definitions and the units of measurement of each category. Naturally to come to indicators of synthesis quantification for each main category was necessary to manage the indicators for the so-called intermediate categories.
- **b)** *Normalization of the elementary indicators.* With the data obtained before wasn't possible any comparison (even in the same category among the levels of outfit of the various territorial unities that we considered), so we normalized the elementary indicators. For this purpose the elementary indicators were linked to a suitable load, that was differently individuated for the net infrastructures (territorial area) or precise infrastructure (population).[1]
- **c)** *Standardization of normalized index.*
  The results obtained to this point don't give indicators comparable among the various categories because they are expressed in different unity of measurement. The standardization will be used to obtain indicators cleansed from the specific unity of measurement and that can give the opportunity to arrange a classification lists-one for every infrastructure category considered- from which it would be clear the correlative outfit level of every territorial unity. The used method is to compare the normalized index to their medium value and multiply for one hundred, obtaining in this way scale of the same extent (among 0 and 100) and of immediate comparability.
- **d)** *Aggregation of the standardized indicators in an indicator of synthesis.*
  The standardized indicators for the intermediate categories including the main categories are

[1] That is generally obtainable distinguishing the net infrastructures (space serving) to the precise infrastructures (population serving) and comparing the indicators respectively to the territorial area or to the population.

aggregated with an arithmetical mean, weighting only in that cases in which criteria sufficiently objective are present to determine the weights (for ex, width of the roadway in the various kind of roads). From indicators of synthesis for every main category we obtained an only indicator of the inclusive infrastructure outfit that was possible through, the calculation of a geometrical mean.[2]

Results' presentation

Relating to the individuated methodology of analysis we obtained the following results, we present them in relation for single categories:

Roads

The elementary indicator for roads is given by the length (in km) of every road category. We are speaking of motorways, state-roads, provincial and communal-roads. The data of the road-length are weighted for the width of the roadway. Six kinds of roads exist; they differ from the velocity of mileage, with a different width of the roadway (see pic.1).

1.Width of the roadway and velocity of mileage.

Kind of road	**Interval of velocity**	**Width of the platform**
		(m)
I	110< Vp < 140	25,00
		32,00
II	90 < Vp < 120	23,00
		30,00
III	80 < Vp < 100	18,60
IV	80 <Vp < 100	10,50
V	60 < Vp < 80	9,50
VI	40 < Vp < 60	8,00

Considering that we don't know exactly the width of the various road-categories, we formulated some hypothesis about it, we realistically assumed that the width of the roadways come from the arithmetical mean of the roadways of the roads of the I kind for the motorways.

The width of the state-roads, just as for the provincial-roads is given by the average of the roadways of the II, III and IV kinds. V and VI kinds are referred to communal roads.

The quantitative data show a really slight prevalence of the roads in North regions (102%), rather than in South regions (101%), while Centre is a little bit under the average (94%). These results are

[2] The different procedure adopted to calculate the indicators of synthesis of the main categories (arithmetical mean) and the inclusive indicator of synthesis (geometrical mean) is justified because inside the same main category could be admitted a certain grade of fungibility among the various services given by the various infrastructure typologies (for ex, a road and a railway are someway fungible because they serve the need of mobility), while this fungibility appears really remote among main different categories (for ex, between transportation and energy). The easiest procedure is to obtain the arithmetical mean not weighted of the various standardized index, but that means that we considered the various infrastructure categories as if they were perfectly exchangeable. The total fungibility can be acceptable at a first approximation if we apply it to the elementary categories belonging to the same main category: for ex, in the field of road-transports the synthetic indicator can represent an acceptable mediation between a motorway scarce outfit and a really strong diffusion of the ordinary road-net. The fungibility is really more problematic if the compensation is between a scarce roads outfit and a good outfit of schools or of water installations. In similar cases –when we must aggregate the normalized indicators of the main categories- it is more appropriate to proceed trough *geometrical mean,* that for its formal characteristics involves a less fungibility among the considered indicators.

mainly influenced by the various road typologies we can find in the various areas considered: in the south regions weight more the provincial, state and communal roads, with a reduced presence of motorways; while in the central-north areas are prevalent the high viability roads to the state, provincial and communal roads.

Analysing the qualitative aspect we understand that normalizing the road-surface upon the orographic characteristics, considered that the mountainous areas needs the majors links the results have a different configuration.
North prevails (106%) followed by South (99%) and in the end by Centre (91%).
It was calculated the incidence of cars number compared to the quantity of the road-infrastructures. The obtained results confirm the last prevision underlining the scarcity of the infrastructure in confront of the potential ask of means of transport (higher values at South (47%), lower at North (24%)).

Railways.

For what regards railways weighting system was chosen, it was used by Mazzotta, with this system railways are weighting depending on the kind of line, it can be simple or double, and inside this category it is possible to distinguish in electrified and not electrified lines. The standardization was made upon the space serving for the quantitative indicators. The results are enough clear, they show a clear-cut prevalence of railways in North Italy (110%), in Centre (96%)and finally in South (92%). Data show a sharp unbalance in railways structure outfit in the various areas of Country: particularly in centre-north areas prevails the double electrified line while in southern areas the double line is completely absent, Campania is under the standard.

Even under the qualitative aspect the results obtained – weighting with regard to the surface –show a clear prevalence of North, (118%), on southern areas of Italy (87 %); even if it is important to

underline that some indicators inside each geographic macro-area are opposed (there are northern regions that have values below average regard to the national average, and southern regions, for ex, Sicily, that have values above average).

Average trend of qualitative-quantitative indicators-Data per one hundred
Fig.II

	Aspects			
Classification	Quantitative	Variations from the average	Qualitative	Var. from the average
North	120,9	18,0	117,5	18,0
Centre	95,5	-7,3	92,0	-7,5
South and Islands	92,1	-10,7	89,1	-10,5
National average	102,8		99,5	

The synthetic railways indicators together with roads close the definition of indicators of land transport; they define the global category of transportation together with all the indicators of carriage by sea and air transportation.

Ports.

It was already said that the elementary indicator for ports was built upon the length of berths and on the square area. Because of the special nature of these infrastructures we consider only the coastal regions. Between southern and northern regions the gap is clear both qualitatively and quantitatively. This is even more underlined because south includes the islands too, this area of Italy for its geographical position should have a larger number of ports and berths in comparison to all the other regions. (See fig. III)

Fig. III - Average trend of qualitative-quantitative indicators –Data per one hundred

	Aspects			
Classification	Quantitative	Var. of the average	Qualitative	Var. of the average
North	159,99	80,5	92,8	68,8
Centre	39,04	-40,4	12,5	-11,5
South and Islands	80,33	0,9	11,8	-12,1
National average	79,46		23,9	

Studying the qualitative aspect we obtain results that don't get into line with quantitative results. The qualitative indicators are built upon ports efficiency. We divided the lines number to the ports number to obtain a medium indicator of *intermodality* of transportation in the regions groups it is normalized in connexion to the population. North regions present the greater results in confront of south regions.
The second kind of qualitative indicator is built considering the capacity of silos, of cold stores and of different kind of stores as elementary indicator. The choice of this indicator comes from a precise thought: to use a port-unity depends on services that it can offer (capacity to contain goods in stores and silos).
Even in this case the final results prove a better general quality situation of northern ports, and a less capacity to contain of southern ports, respectively: 92,8% against 11,8% of southern ports.

Airports.

Among economic structure of transport airports presented many difficulties for what regard the statistic survey. The main reasons are linked to the traceableness of statistic data. These data are mainly old [3], that have all the necessary characteristics to build the elementary indicators for the airports, the runways area.

The news introduced is that the weighting system is based upon the number of airplanes transited in one year: Intercontinental airports 5.77, International airports 3.54, and National airports 0.67. This time results show a clear prevalence of South that has a superior area of runways in comparison with the national average (118%), even if there aren't intercontinental airports in southern areas- Intercontinental airports are just in Malpensa and Fiumicino.
The results change if we use the weighting system: we can see an improvement of "conditions" in the centre (111%), followed by south (102%), and in the end North, (91%).

Electrical Energy.

The data taken into consideration for this category are referred to the length of electrified grid. The followed procedure is easier of the one used for the transport structures. We consider the grid length of distribution quantitatively comparing to space serving. Results show a slight prevalence of north areas 106%, followed by the areas of central Italy 99% and in the end South 96%.
The qualitative data overturn the situation. Comparing the distribution lines and the customers we obtain that south rise to 108%, centre to 106%, north to 85%. So we can interpret these results in this way: certainly north has a greater grid length comparing to south, but comparing to customers it could offer a more efficient qualitative service (see fig. IV).

Fig. IV - Average trend of qualitative-quantitative indicators-Data per one hundred

	Aspects			
Classification	Quantitative	Var. of the average	Qualitative	Var. of the average
North	105,6	5,4	85,7	- 14,5
Centre	99,5	- 0,8	106,2	5,9

[3] Data refer to the 1993 ICAO publication "appunti di Elementi di costruzioni".

South	95,6	-	4,6	108,8	8,6
National average	100,2			100,2	

Waters.

For what regard water supply the indicator to take into consideration is the resident population in centre with sufficient water supply. The lack of data is due even to the inactivity of interested corporations that didn't give any answer to our requests.
Data elaborated by Mazzotta reveal a deep diversity among the geographic macro areas.

North has superior values to the national average (135%), centre with values on line (108%); south with values below average (43%).

Education.

The enrolled students in every schools category give the elementary indicator for the scholastic infrastructures: nursery, elementary, intermediate, high and finally university.
Two kinds of elementary indicators are calculated and after normalized upon the student population to which we refer.
The results obtained are enough stable, either on the students quantity that on service quality as the spaces disposability.
The synthetic indicator on classes and the one on the students show a substantial stability, that means that there is not a big difference among areas.
Results are a bit divergent when we speak of universities, where the differences are persistent and deep.

Fig. V - Average trend of qualitative-quantitative indicators (university)-Data per one hundred

	Aspects			
Classification	Quantitative	Var. from average	Qualitative	Var. from average
North	118,4	9,9	111,3	4,6

Centre	146,4	37,9	147,3	40,5
South and Islands	60,7	-47,8	61,7	-45,1
National average	108,5		106,8	

The base indicator to individuate the infrastructure grade (referred only to professors) shows the following values: 118% North, 146% Centre, 61% South.
Under the qualitative aspect, the incidence of the professor number in comparison to the student population, presents deep unbalances: Regions of central Italy have the qualitative levels above national average; followed by North while the southern universities must manage the big numbers of enrolled students, that determine a comparison professors-students that is really below the national average.

Health Service.

The elementary indicator used to evaluate the quantitative aspect of sanitary infrastructures is based upon quantification of beds.

Fig. VI - Average trend of qualitative-quantitative indicators-Data per one hundred

	Aspects			
Classification	Quantitative	Var. from mean	Qualitative	Var. from mean
North	111,2	11,1	191,7	102,4
Centre	100,7	0,6	36,2	-53,2
South and Island	88,5	-11,7	40,2	-49,2
National average	100,1		89,4	

The surveys show a beds quantity above to the national mean in North regions (111%), Centre (100%), and south really below the average (88%).

To evaluate the qualitative aspects it was built an indicator upon the base of doctors and paramedical compared to the institutes.
The elaborated results present the following scenery: in northern regions quality of the health service is above national average (191%), while in the central and southern regions the quality level is averagely low (respectively equal to 40% and 36%).

Sports Infrastructures.

Collected data relating to sports infrastructures can determine the indicator connected to the sports-sites and to every sports-infrastructures. The results obtained from the elaborations present a deluding condition for what regard the sports infrastructure of south regions.
For southern Italy data are below the national average (58%), centre (88%), and to the top North regions that have values above the average (143%).

It is not possible to formulate a qualitative indicator because of the lack of data regarding the sports population using the infrastructures we spoke about.

Culture.

The elementary indicator for the cultural infrastructures changes depending with the kind of the infrastructure we consider. For theatres sold tickets represent the elementary indicator.
From the elaboration of this elementary indicator, it is obtainable the synthetic indicator per macro areas. Results underline a condition of low cultural consumes in south regions (56%), while north and centre regions have values above the national average (respectively 138% and110%).
Among the cultural infrastructures considered we have museums and galleries; the elementary indicator is calculated from the comparison between visitors and the number of institutes. The results are coherent with the previous results: North 113%, Centre 111%, and South 79%.

Results total synthesis.

After the first phase of the research in which the indicators of every infrastructure category are built in the second phase the aggregate indicators are elaborated for the two big infrastructure classes: economic and social.
The followed procedure is based upon the calculus of a mean of the available results for every region (for this reason Ports, Energy, Communication are excluded from the calculus).
Finally it is calculated a geometrical mean for the two categories in order to obtain the total infrastructural degree, whose results show the same trend already discovered in the diasaggregated analysis.

Conclusions.

It is clear from the present research that the regional condition of Italian infrastructures is enough conflicting. North regions represent the shuttlecock of the infrastructure development while Centre regions and mainly South regions represent the tail lamp of a three velocities Italy. The results confirm the trend of the " two Italy", one under-supplied of every kind of infrastructures, the other one with a supply above the national average.
To determine the "qualitative" indicators- for quality we mean efficiency of the service- we calculated various indicators depending with the infrastructure examined, this is a totally unexplored field.
Results obtained confirm a total divergence in the quality of infrastructures in the Italians regions. The best quality results of infrastructures come from North regions while Centre and South regions are below the national average.
It is possible to hypothesize that the reduction of the infrastructure development is integral part of the economic, social and cultural develop of an area.
To demonstrate under the two aspects- quantitative and qualitative-the strong regional differences to the development of the infrastructure supply give the necessary inputs to the intervention policies.
It is possible to understand from this research that it is not enough to satisfy the quantitative aspect of the infrastructure supply but it is necessary a strong intervention for what regard the qualitative aspect.

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