

Infrastructure, Services and Competitiveness: The Italian Case*

Infrastrutture, servizi e competitività: la situazione italiana

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Riassunto: Il lavoro qui presentato intende fare il punto sul tema della relazione tra infrastrutture e sviluppo, sul quale l’Autore, insieme ad altri colleghi, ha sviluppato riflessioni metodologiche ed applicazioni empiriche ormai da molti anni. Dopo aver richiamato le non lievi difficoltà che si frappongono alla quantificazione della dotazione infrastrutturale presente sul territorio – e, ancor più, dei servizi che essa è in grado di fornire – il lavoro presenta alcuni dei principali risultati ottenuti dall’analisi della relazione infrastrutture-sviluppo condotta sulle regioni europee e sulle province italiane. In estrema sintesi, tali risultati mostrano un netto ritardo dell’Italia rispetto ai principali *competitors* europei e, con ancor maggiore evidenza, la persistenza di una situazione fortemente squilibrata (con qualche accenno di miglioramento) del territorio meridionale rispetto al resto del paese.

Keywords: infrastructure, growth, competitiveness.

1. Introduction

The theme of infrastructure endowment as an essential component of competitiveness, rightly extended to the level and quality of services the infrastructure is capable of providing, has long been the centre of the attention for policy makers, both in Europe and in Italy (lastly, see the Italian National Preliminary Strategic Document, 2005, in preparation for the EU Structural Funds planning for the period 2007-13). The aim of expanding infrastructure generally refers to creating conditions for accelerating growth, strengthening the economy and making it more competitive, while also reducing disparities and achieving greater social and economic cohesion. The present paper summarizes the main results produced in many years of work on this theme¹, focusing on two specific issues: i) measuring the different levels of infrastructural endowment in the regions of the main European countries and in the Italian provinces; ii) testing the relationship between infrastructural endowment and territorial competitiveness, according to the potential regional development approach.

It should be stressed that these analyses require a reference to small territorial contexts, which form the natural catchment area for the infrastructure and services. Any summarizing judgements for the entire national territory thus become pure numerical references, substantially devoid of operational implications in policy terms. This

The research, whose results are summarized in this paper, has received various funds over the years from public and private bodies, including: the European Commission, Confindustria, CNEL, MIUR – Ministry of Education, Universities and Research, Department for Development Policies and Cohesion.

¹ For more details, see the recent analyses carried out by Di Palma and Mazziotta (2002 and 2003), Mazziotta (2004), Mazziotta and Cacciamani (2002).

explains the constant reference in this paper to the regional dimension, meant not only as a spatial container, but also as a privileged context for analysis and policy in the infrastructure field.

2. The Infrastructure-Development Relationship

Infrastructure can be considered as part of the total capital stock of an economy, the other part being private capital. Theoretically, these two components must be present in the *best* possible combination in order to ensure an effective resource allocation, but this rarely happens in real life. Consequently, one of the most important objectives to achieve in order to ensure a balanced growth is to have an endowment of collective basic capital (infrastructure) consistent with private capital (directly productive accumulation).

In this context, one of the most interesting theoretical assumptions is referred to the “potential regional development” approach (Biehl, 1994), according to which a better infrastructure endowment increases the productivity of private investments and reduces their production costs. Consequently, a better infrastructure regional endowment (even if this is not the only important element) will result into a higher potential revenue and employment.

Since the potential development, according to this approach, is a function of “public” capital stock, private resources, traditional production factors as private capital and qualified work, are necessary to fully *exploit* this potential development, but they do not *determine it*. The higher the public capital endowment is, the more it is possible to adequately compensate the mobile production factors thus maintaining or attracting them in that region. An excellent combination of public and private resources helps a region reach an actual *output* level similar to the potential one.

According to this approach, within the several model applications on growth mechanisms, public capital is often included in the aggregate production function and is also considered an important source of positive input on endogenous development. The empirical results of this approach usually assume that the relationship between infrastructure endowment and development level is analyzed and quantified, meaning that the existence of a significant correlation between infrastructure endowment and productivity of the private sector is verified². These results widely confirm the assumption that public capital produces “wide, positive and statistically significant” effects on the product or on the production capital (Munnell, 1993).

Similarly, a good statistical result is, on average, obtained also for the “quasi-production functions”, where the variable for the infrastructure endowment is not the only variable explaining the development level, but it is associated with other variables, representative of other competitiveness factors.

² A generalized Cobb-Douglas form is usually considered

$$Y = A e^{\lambda t} (K_p)^{\beta} (L)^{\alpha} (K_g)^{\gamma},$$

where: Y is the product; A is the technology average level; K_p is the private (productive) stock capital; L is the work needed; K_g is the public (infrastructure) capital stock. In logarithmic terms, it is presented as a linear function:

$$\log Y = \log A + \lambda t + \beta \log K_p + \alpha \log L + \gamma \log K_g$$

and allows to identify α , β and γ parameters as the partial elasticity of production when compared to input factors: production capital, work and infrastructure capital respectively.

In truth, it must be acknowledged that these results are not always univocally determined, since their generalization is affected by various factors within the analysis, such as the definition and measurement of the infrastructure, the level of territorial disaggregation, the functional specification used, and so on (Pedone, 2003). Nevertheless, beyond these important “technical” problems, when focusing on quantifying the contribution of public capital to the competitiveness of certain territorial areas, there are two substantial questions to keep in mind:

- i) the different degree of efficiency of the expenditure, determined by the type of infrastructure considered, the period of installation in relation to the infrastructure’s useful life, and the territorial location of the infrastructure itself;
- ii) the different capacity of the infrastructure endowment to produce services for the community (families and enterprises), i.e. to transform a theoretical potential into actual usefulness.

The two themes are obviously connected and, nevertheless, it is preferable to keep them separated due to the consequences that the manner of dealing with each of them entails in terms of quantification methods and significance of the results. In fact, the first question concerns the determination of the quantity of infrastructure capital installed on the territory, while the second concerns the level of effectiveness achieved by that capital with regard to meeting the (collective) needs of the end users. In other words, it could be said that the first question deals with the immediate results (output) of the public expenditure used for the creation of infrastructure, while the second question aims to quantify the impact (outcome) that expenditure has on the competitiveness of the territorial systems involved.

If we examine the applicable literature, it can be seen that in the first theme, i.e. the infrastructure endowment and its relationship with the economic development, there are numerous methodological contributions and empirical works, now even referring to our own country. On the other hand, the second theme, that of the quantity and quality of the services produced, is much less present in literature; or rather, there are contributions and applications to this or that service, but there are no systematic and complete analyses at the level of categories and territories, such as there are on the amount of the public capital. Even this paper does not go beyond this limit. The following paragraphs will describe the situation of infrastructure and competitiveness, while on services it is possible only to mention some future prospects.

3. Methodological Approaches to Measuring Infrastructure

There are two main approaches to measuring public capital: estimating it in physical terms or using the monetary yardstick to estimate it in terms of value.

Capital (also public capital) in monetary terms is usually valued using the *perpetual inventory method* (PIM), suggested by Goldsmith (1951) and now used by most national statistics institutes. According to this approach, capital endowment is reconstructed as the sum of fixed investment in the years prior to that in which the valuation is made, the number of years chosen to coincide with the average useful life of the various categories of capital goods included.

The simplicity and directness of the PIM is evident, essentially based on two reasons: i) PIM dispenses with the need for supplementary inquiry, as one can use the time series

on investment for major categories of public works that are calculated and published by the statistical institutes; ii) PIM circumvents the problem of assigning a price to each type of capital good (which is complicated indeed, both conceptually and practically), as the estimates of investment already available in the national accounts can be used.

Nevertheless, the monetary measurement of public capital risks providing a distorted view of the level of territorial competitiveness determined by the infrastructure endowment. The different morphological conformations of the territories, the differentiated structures of the construction costs of the public works, and the different degrees of efficiency (or corruption) of the spending process of the public funds are all reasons that make the estimate of the infrastructure endowment through the parameter of the actual expenditure of little significance (for a methodological reflection on the subject, see Mazziotta, 2005). Hence the value of estimating infrastructural endowment based on physical indicators³.

The standard procedure for constructing composite indicators of infrastructural endowment based on physical data is as follows (see Biehl, 1986; Mazziotta, 1998; for a somewhat different approach, see Rinaldi *et al.*, 2001, Brunini *et al.*, 2002).

Construction of the elementary indicators. Obviously, this first step depends on the availability of basic statistics. Here, it is worth noting that the usual difficulty of obtaining significant and recent data is now being compounded by the liberalization of some infrastructure “markets” (e.g., in telecommunications or electricity and gas distribution), which reduces the availability of basic statistics, especially on a local basis, owing to reasons of confidentiality vis-à-vis potential competitors.

Normalization of the elementary indicators. Since the data thus acquired refer to regions of differing size and population, the indicators must be normalized. Generally, this means relating the index numbers to land area (for “network” or “space-serving” infrastructure) or population (for “population-serving” infrastructure). In order to identify possibly congested areas, it might be fruitful to use the volume of industrial or economic activity rather than physical or demographic characteristics. As a consequence, the normalized indicators would differ notably⁴.

Standardization of normalized indicators. Since the normalised indicators are still expressed in different units of measurement (kilometers of roadway per square kilometer of land area, say, or number of telephones per thousand inhabitants) standardization is needed. One common method is to use the highest normalized indicator for a given category of infrastructure observed in any of the territorial units surveyed as the top of a scale, instantly making all the others comparable.

Aggregation of standardized indicators. The procedure so far gives us a series of indicators for each geographical unit, one for each category of infrastructure considered. Aggregation, at this point, is unavoidable. A common procedure is averaging. Usually, the arithmetic mean is used to aggregate elementary indicators within a category (greater fungibility) and the geometric mean to combine different main categories (less substitutability)⁵.

³ Some authors (see Picci, 2002, Golden and Picci, 2005) maintain that the two approaches are actually complementary and, by comparing the results, get interesting indications on significant phenomena such as corruption in public works projects.

⁴ For a comparison of the results produced by the two normalization methods (land area and economic activity), see Di Palma and Mazziotta (2002).

⁵ On the possibility of different weighting systems as a function of the different measures of variability, see among others Mazziotta (1998), Brunini *et al.* (2002), and Vitali and Merlini (1999).

4. Infrastructure and Development in Europe and in Italy: some empirical results

4.1 The European situation

A study conducted between 1998 and 2000 (Confindustria and Ecoter, 2000b) updated the infrastructural endowment previously available (Biehl, *et al.*, 1990) for the NUTS 2 regions of the five European major countries (EU5: France, Germany, Italy, Spain, United Kingdom), which account for 80 per cent of the Union's population and GDP. The endowment refers to four categories (transport, energy, communications, education), grouping some twenty elementary categories.

Grouping the 132 regions of the five countries into infrastructural endowment classes, designated by a lower and upper bound to the composite indicator for all four categories together, it results that more than half of the regions are in the two intermediate classes (Table 1). Of the remainder, two thirds are in the "high" class and one third in the "low". The two bottom classes consist mainly of Italian and Spanish regions. Of the 21 regions so classified, 60 per cent are Spanish and nearly 30 per cent Italian. In the top two classes, 85 per cent of the regions are British (17 of the country's 35 regions) or German (14 of 38); just 4 are French, 1 Spanish and 1 Italian (Liguria).

Table 1 Classification of European major countries' regions by total infrastructure endowment

Country	Distribution of regions by class						
	Very low	Low	Lower-middle	Upper-middle	High	Very high	Total
Germany	-	-	11	13	8	6	38
Spain	2	10	2	2	1	0	17
France	1	-	14	3	3	1	22
Italy	-	6	7	6	-	1	20
United Kingdom	-	2	5	11	7	10	35
Total	3	18	39	35	19	18	132

Source: Di Palma and Mazziotta (2003).

Assuming the regional development potential approach (section 2), quantified by means of a quasi-production function⁶, we obtained that, as we expected, per capita GDP is correlated positively with infrastructural endowment (an elasticity of output to

⁶ The quasi-production function (see Biehl, 1994) is quantified employing the following variables:

PCGDP: per capita GDP, a proxy for level of regional development;

INFR: composite indicator of infrastructural endowment;

PER: measure of peripheralness, defined as distance from the main economic "centre" (here, the Frankfurt area);

DPOP: population density, a proxy for degree of agglomeration;

INSER: share of employment in industry and services, a proxy for regional economic structure;

ATT: economic activity rate (labour force participation), proxying for the regional economy's capacity to use labour potential.

infrastructure of around 0.4), with the participation rate, and with the share of industrial and service employment. Per capita GDP also tends to be negatively correlated with distance from the economic centre (Table 2).

The quasi-production function not only indicates the growth contribution of each of the variables considered, including infrastructural endowment, but also gives an estimate of the theoretical values (calculated via regression) for per capita GDP of the regions. These values can be interpreted as indicators of expected (“potential”) levels of development given regional production capacity according to the model’s variables and assuming it is utilized at normal intensity.

This means that an effective level of development (actual per capita GDP) lower than potential (calculated per capita GDP) will mark regions that are unable to attract enough labour and private capital for formal (average) utilization of productive potential. Conversely, actual output higher than potential will characterize regions with full utilization of resources if not outright overexploitation of capacity⁷. In other words, it

Tab. 2. Estimate of the quasi-production function for EU5 regions (dependent variable: PCGDP)

<i>Variable</i>	<i>Coefficient</i>	<i>T-Stat</i>	<i>Regression statistics</i>	
Intercept	-3,20	-1,73**	R ²	0,826
lnDPOP	-0,07	-3,15**	R ² adjusted	0,816
lnINFR	0,38	5,27**	Standard error	0,138
lnATT	1,25	7,04**	No. observations	132
lnINSER	1,55	3,52**	F - Statistic	82,84
lnPER	-0,07	-4,44**	F - significance	0,000

** significant at 5%

Source: Di Palma and Mazziotta (2003).

could be said that the failure to reach the potential income level by a given territory indicates a competitive deficiency in that territory, which is unable to fully exploit its resources; on the contrary, the opposite situation denotes a capacity for development that, by synergistically exploiting its potentials, leads to a growth that is greater than that envisaged as attributed to it considering its starting situation.

Comparing the results for the five countries (Table 3) and defining “normal” (average) utilization as a situation in which effective per capita GDP is no more than 1.5 percentage points above or below potential, we see that every country has some regions in which development potential is not fully exploited, running from a low of 42 per cent of the regions in Germany to a high of 64 per cent in France, with Italy and the UK at 50 per cent and Spain at 60 per cent.

⁷ Overexploitation in the most highly developed regions might indicate a tendency to “congestion” of the factors determining an area’s competitiveness, especially the quantity and quality of infrastructural endowment.

Tab. 3. Classification of EU5 regions by utilisation of production potential and country

<i>Country</i>	<i>Number of regions</i>			<i>Total</i>
	<i>Overutilisation</i>	<i>Normal Utilisation</i>	<i>Underutilisation</i>	
Germany	20	2	16	38
Spain	7	0	10	17
France	4	4	14	22
Italy	6	4	10	20
United kingdom	13	5	17	35
Total	50	15	67	132

Source: Di Palma and Mazziotta (2003).

Underutilization marks three fourths of the regions whose per capita GDP is lower than average. These include the regions of southern Italy, those of the former GDR in Germany, and Extremadura, Galicia, Andalusia and Castilla-Mancha in Spain.

This situation suggests the possibility of a sort of “threshold effect” whereby the less developed regions often need greater infrastructural endowment than the highly developed ones in proportion to their level of economic activity. As infrastructure must reach a minimum amount and density to be functional, the backward regions are reasonably expected to be at a level of development lower than that corresponding to their infrastructural endowment.

4.2 The Italian situation

The main result (Table 4) of a study of the Italian provinces (using the same methodology described in Section 3) is the dichotomy between the developed portion of the country (the Centre and North) and the backward part (the South).

Table 4 Classification of Italian provinces by total infrastructure endowment and macroregion

<i>Macroregion</i>	<i>Distribution of provinces by class</i>					
	<i>Very low</i>	<i>Low</i>	<i>Average</i>	<i>Upper-mid.</i>	<i>High</i>	<i>Total</i>
North-West	–	1	–	16	3	20
North-East	–	–	3	5	13	21
Centre	1	2	4	11	2	20
South	7	22	5	–	–	34
Italy	8	25	12	32	18	95

Source: Di Palma and Mazziotta (2003).

Just one province in the Centre-North (Rieti) is in the low-endowment class and three in the lower-middle class, while no southern province is in the above-average classes⁸.

⁸ The study, made possible by the research carried out by Confindustria-Ecoter (2000a), focused on 9 main categories of infrastructure, subdivided into 50 elementary categories. However, the greater wealth of available data at national level comes at a price: the non-comparability of the results concerning the

The situation of the South, in short, is critical; 29 out of 34 provinces (85 per cent) have infrastructural endowment of less than 75 per cent of the national average, whereas in the rest of the country 30 per cent are above the 125 per cent mark. Considering in the analysis also the size of population of Italian provinces (Table 5), the most relevant result is that 33 million Italians have above-average infrastructural endowment, or 57 per cent of the population, and all live in the Centre or North; while the 24 million with below-average endowment are mostly in the South (21 million or 85 per cent).

Table 5 Italian provinces by total infrastructural endowment of Italian provinces by macroregion and dimension of capital city

<i>Macroregion and class by population dimension of capital city</i>	<i>Provinces and population by infrastructural endowment (compared with national average)</i>					
	<i>Above average</i>		<i>Below average</i>		<i>Total</i>	
	Number	% Pop.	Number	% Pop.	Number	% Pop.
North-West	19	98.8	1	1.2	20	100.0
North-East	18	88.1	3	11.9	21	100.0
Centre	13	79.6	7	20.4	20	100.0
South	0	0.0	34	100.0	34	100.0
Under 100,000 inhabitants	27	46.4	30	53.6	57	100.0
100,000-300,000 inhabitants	16	59.8	11	40.2	27	100.0
Over 300,000 inhabitants	7	66.2	4	33.8	11	100.0
Italy	50	57.2	45	42.8	95	100.0

Source: Di Palma and Mazziotta (2003).

The potential development approach was applied also for the Italian provinces, quantifying a quasi-production function like in the European analysis⁹. The results (Table 6) confirm the statistical significance of the model and its good fit with the function. The elasticity of output with respect to the explanatory variables shows a strong positive correlation with infrastructural endowment, with production structure, and with the labour force participation rate; the degree of agglomeration does not appear to affect the level of development substantially, and its coefficient is actually negative, perhaps because of the strong correlation between infrastructural endowment and population density, which makes the latter variable less visible. The elasticity of output with respect to infrastructure, i.e. the relative contribution of public capital to GDP growth, is high, just under 0.3. This result is all the more important in that it comes in the presence of other explanatory variables.

As in the study of European regions, we assume that the theoretical levels of GDP estimated for Italian provinces are a good approximation of the potential output and derive the state of normal, under or over utilization of local production potential for each province. The results (Table 7) show the broad numerical equality between over- and under utilizers (39 and 37 provinces respectively); 19 provinces, one fifth, showed normal utilization.

Italian regions in the “European” and “Italian” studies. For reasons of data availability, the study was restricted to the 95 provinces in existence before 1993.

⁹ The distance from the economic “centre” was eliminated because not significant in this case.

Table 6 Estimate of the quasi-production function for Italian provinces (dependent variable: PCGDP)

Variable	Coefficient	T-Stat	Regression statistics	
Intercept	1.85	2.59**	R ²	0,863
lnDPOP	-0,05	-2.86**	R ² adjusted	0,857
lnINFR	0,29	6.44**	Standard error	0,109
lnATT	0.66	3.72**	No. observations	95
lnINSER	1,55	3,52**	F - Statistic	141.38

** significant at 5%

Source: Di Palma and Mazziotta (2003).

Crossing degree of utilization with location, we find that over exploitation — which can be interpreted as a sign of vitality but also, at times, of latent congestion — characterizes above all the provinces of northern Italy (over half of them, including Milan). The southern provinces (about half of them) display under utilization of productive potential, confirming their general lack of attractiveness owing, among other things, to inadequate infrastructural endowment. Note that the meaning of the state of balance or overexploitation found in the other half of the southern provinces is almost always different from that of the developed provinces of the North. In the South, we often find situations in which low levels of output and activity correspond to modest endowment of exogenous factors for growth (a number of provinces in Sicily and Sardinia, notably, fit this picture). Finally, 60 per cent of the provinces of central Italy display under utilization of potential, including infrastructural endowment (much of Tuscany and Lazio, save the provinces of Florence and Rome, which show overexploitation).

Tab. 7 Classification of Italian provinces by utilisation of production potential and macroregion

Macroregion	Number of provinces			Total
	Overutilisation	Normal Utilisation	Underutilisation	
North-West	8	7	5	20
North-East	14	3	4	21
Centre	6	2	12	20
South	11	7	16	34
Italy	39	19	37	95

Source: Di Palma and Mazziotta (2003).

It should also be pointed out that recently ended projects (Bracalente *et al.*, 2005) have led to an interesting joint analysis of the physical availability of infrastructure in the Italian regions in the mid-1990s and the expenditure for public investments in infrastructure for the period 1996-2002 (DPS-UVAL, 2005). This analysis has brought out, in a sufficiently clear manner, a territorial distribution of the spending aiming for the reduction, more or less accentuated, of the sizable availability differences that can

currently be found especially in the southern regions. It is still too little too soon to be able to speak of a trend reversal, but the phenomenon certainly deserves to be observed.

5. Conclusions

The analyses above presented offer support for the theoretical hypotheses concerning the contribution of infrastructure to competitiveness and growth. This emerges both from the international comparison and from that between different parts of Italy. In particular, we can sum up the main results obtained as follows:

- the Italian regions still have, compared to those of the main European countries of similar population and economic level (especially Germany and the United Kingdom), a situation of clear competitive disadvantage as far as infrastructure endowment is concerned;
- this is confirmed by the high number (50%) of regions that are in a situation of underutilization of their potential, i.e. which are unable to exploit their resources, including public capital, as best as possible;
- within the country, the economic and production gap existing between the Centre-North and the South is also confirmed from the standpoint of public capital endowment;
- the reconstruction of the potential product levels for the Italian provinces confirms the indications of the descriptive analyses mentioned above. In particular, the higher number of provinces with an actual income level higher than the potential level are in the northern part of the country, bearing witness to a sure competitive advantage. On the contrary, the provinces that underutilize their production potential are concentrated in the South, confirming their low appeal for production investment opportunities, also because of a public capital endowment that is still unsatisfactory.

Having acquired these results, it is not, however, possible to overlook the limits that the type of analysis carried out presents for the future, in particular with regard to the availability of databases that are adequate for the needs of an in-depth analysis. In fact, as it has been said, the need to progress from the purely quantitative dimension of the infrastructure endowment to the determination of the services that endowment is able to provide for the community is becoming increasingly felt. On the other hand, this substantial knowledge improvement – in itself full of conceptual difficulties – is seeing the obstacles against its achievement grow also as an effect of the privatization processes that have involved the service providing companies, from the railways to electricity, to telecommunications, to motorways, which today give less information than in the past, and which are less disaggregated from the territorial standpoint, citing privacy reasons with regard to potential competitors.

Perhaps only ISTAT – the National Statistics Institute, thanks to its nature as an independent authority, is able to overcome such difficulties. The recent establishment of a Central Directorate for territorial information needs and the upcoming conclusion of an experimental project on the quantification of infrastructure as an informational support for the EU Structural Funds (ISTAT, 2006) are important signs towards this direction, which justify cautious hopes for the future.

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