Productivity and Infrastructure in the Italian Regions.

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Abstract.

We address the issue of whether public infrastructure play an important role in determining factor productivity in Italy, and we show that the evidence is mixed.
Public capital is significant in explaining output in most cases. However, when the attention is drawn on the long-run properties of the data, or when care is taken to rule out contemporaneous short-run effects, then public capital results to be either non-significant, or significant but of negligible importance. We conclude that the influence of infrastructure on output is probably due, to a great extent, to short-run demand-side phenomena.

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1 Introduction.

The huge public debt affecting the Italian economy is an obvious reason of concern for economists and policy makers alike. Jappelli and Ripa di Meana (1990) argue that policies whose goal is to reduce the debt/output ratio cannot abstract from the role that infrastructure play in the economy. If infrastructure do influence output significantly, then cutting public capital investment, by reducing future potential output, could even worsen the problem. On the other hand, if that is not the case, then policy makers, in a sense, could do without caring too much on what kind of budget cuts they make, as long as they make them.

The interest in the relationship between infrastructure and output or, more to the point, factor productivity, however, is not limited to this issue. In the United States, much attention has been dedicated to the analysis of the causes of the productivity slowdown of the last two decades. A whole thread of the literature, starting from the seminal paper of Aschauer (1989), has tried to impute the decline of factor productivity to the decline in public investment[2].

The role played by infrastructure in the economy has been analyzed by a countless number of works. At a simple and intuitive level, we note that infrustructure affect factor productivity by "assisting" public capital: a given truck is much more productive on a freeway, than on a country road. Moreover, new infrastructure embodies technological progress: to build a brand-new mass-transit system is tantamount to the introduction of a *new* technology into a local economy. Infrastructure, also, *allows for* technological progress: weren't roads available at all, we wouldn't have trucks. At the same time, all these effects probably take time to manifest themselves, since they involve creation of new business, relocation of existing activity, and learning[3].

The point of interest, obviously, is not whether public capital is significant in determining productivity, a thesis that very few people, if anybody, would question. What is interesting to understand is to what extent infrastructure affect productivity beyond its direct provision of amenities, on one side, and what are the mechanisms that make them influence production. Both questions have important policy implications. An answer to the first one

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2 See Eberts (1990), Munnell (1990), Holtz-Eakin (1994), and Holtz-Eakin and Schwartz (1994).

3 For a revue essay, also illuminating other points touched by this work, see Gramlich (1994).

would help policy makers in choosing the optimal amount of public investment; an answer to the second one could provide useful guidelines on how to make public investment succesful.

Using Italian regional data, this work tries to address the first of these two questions. We try to determine the importance of infrastructure in determining production in the Italian regions[4] over the period 1970-1991. Only very recently the availability of the necessary data has made this type of study possible for the Italian economy. We conclude that infrastructure are significant in explaining regional output, but that this is probably due to the presence of short-run demand-side, as opposed to supply-side, effects.

Section 2, with reference to a few representive works, examines the existing empirical evidence on the issue, both for the U.S. and for Italy. Section 3 deals with the analysis of the empirical results. Section 4 concludes.

2 The Existing Evidence.

Aschauer (1989) shows the results of various regressions of different concepts of factor productivity on factor inputs, including public capital, for the U.S. as a whole. The results are quite astounding: public capital seems to be highly significant in influencing productivity, with positive elasticities of around 0.35. Similar results are found by Munnell (1990a) who, again for the U.S. as a whole, finds elasticities of output with respect to public capital of comparable magnitudes.

Munnell (1990b) analyses the impact of public capital on productivity using instead a panel of U.S. state data. The results of her pooled OLS regressions indicate a coefficient for public capital lower (0.15) than in the time series studies mentioned above, but still highly significant.

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4 Italy is divided into 20 regions, sometimes, for descriptive purposes only, lumped into five macro-regions.
The regions (and the macro-regions) are: Piedmont, Val d'Aosta, Liguria and Lumbardy (North-West); Trentino-Alto Adige, Veneto, Friuli Venezia Giulia and Emilia Romagna (North-East); Tuscany, Marche, Umbria and Lazio (Center); Abruzzo, Molise, Apulia, Campania, Basilicata and Calabria (South); Sicily and Sardinia (Islands). South and Islands together are called the *Mezzogiorno* of Italy.

The first wave of works on the topic left the impression that public capital was indeed very important in determining productivity, and that its decreased growth rates were a prominent candidate to explain the productivity slowdown that the U.S. economy has experienced in the last decades.

After a first phase of enthusiasm, however, some caution was asked for by other less-optimistic results. Holtz-Eakin (1994) criticizes the econometric analysis carried out by Munnell (1990b), and argues that, in a cross-state analysis of productivity, state specific effects are potentially important. Holtz-Eakin then rejects the hypothesis that individual state effects are not relevant and finds evidence against the hypothesis that public capital plays a role in determining output. The same result also emerges when different econometric techniques, such as instrumental variables panel estimation and estimation using long differences of the data, are used.

Holtz-Eakin and Schwartz (1994) take a different approach, and develop a neoclassical growth model "à la Solow" that incorporates infrastructure as one of the production inputs. They check whether the data conform to the predictions of their model, and again find essentially no role for public capital.

Evidence for Italy is scant, due at least in part to lack of the necessary data. Bracalente and Di Palma (1982) compute a series of indexes to measure infrastructure for the Italian regions for the year 1977. Using both OLS analysis and rotated-factor regression analysis, they find that infrastructure are significant in explaining regional development. The determination of the direction of causality, however, remains an open question in that work.

Jappelli and Ripa di Meana (1990) estimate a series of reduced-form equations for output, where both private consumption and public investment are used as regressors. The estimated coefficients of public capital are significant and bigger than the coefficients of private consumption; the authors interpret this result as evidence in favor of the hypothesis that the effect of public capital is important in determining output.

Picci (1994) uses a data set developed by Rossi et al. (1993) and by Picci (1995a) on aggregate public capital for the post WWII period and for the between-war period, to estimate a number of regressions similar to the ones considered by Aschauer (1989) and Munnell (1990). The results generally indicate a significant role for public infrastructure, with very high output elasticities. This type of analysis permits, to some extent, to address the question of the directions of the casual relation between infrastructure and output. Granger-causation analysis between multifactor productivity (or "Solow residuals") and the growth rate of public capital gives however ambiguous results, depending on the sample period considered.

3 The Analysis of Regional Data.

In what follows, we analyze the incidence of infrastructure on output using a recently developed dataset on regional infrastructure covering the period from 1970 to 1991, for a total of 22 annual observations. Regional public capital stocks have been computed using the perpetual inventory technique. The necessary regional public investment time series have been obtained by apportioning the national aggregate in Rossi et al. (1993) using the yearly data on "public works" collected by Istat (Istat, various years). The whole procedure is fairly involved; full details are in Picci (1995a).

Private capital also has been taken from Picci (1995a), where it has been computed using a benchmark for the regional capital stock for the census year 1981 and regional gross private investments for the remaining years. Output is regional gross product, and labor is regional units of labor (source: SVIMEZ (1993); ISTAT (1990a, 1990b, 1992).

Table 1 shows the average growth rate for per capita output, labor units, private and public capital, together with their beginning- and end-of-sample levels, for Italy as a whole and for its five macro-regions. The *Mezzogiorno* (comprising the Southern and the Insular regions) has a per-capita income much lower than the national average. Convergence has not occurred over the two decades considered, and the two low income macro-regions have both scored below-average per-capita income growth rates.

Labor units increased by little and rather evenly across Italy[5].

Private capital has increased dramatically, mostly in the *Mezzogiorno*. In comparison, public capital has increased by less, whith growth rates of around 3.5% yearly across Italy. A more detailed break-up of the data would show that most of the increase of the capital

5 However, while in the North of Italy this growth is reflected by a sensible increase in the ratio of labor units over population, with a more or less constant population, in the *Mezzogiorno* population has also grown.

stock - both private and public - in the *Mezzogiorno* occurred during the first part of the sample period, while the huge effort to industrialize the less-developed Southern and Insular regions was still ongoing. During the ’80’s, with the dismission of the "Cassa del Mezzogiorno" (a state agency aimed at the development of the *Mezzogiorno*), the massive investments in that part of Italy that had characterized the previous decades came to an end.

Note that, according to the data, and contrary to intuition, the less-developed *Mezzogiorno* has a stock of infrastructure bigger than the two industrialized Northern macro-regions. Picci (1995b) compares measures of regional infrastructure endowment computed using perpetual inventory data - let’s call them, "PI" (perpetual inventory) indexes -, with the indexes in Biehl, Bracalente, Di Palma and Mazziotta (1990), based on the physical consistency of the capital stock - let’s call them "BBDPM" indexes -. Both indexes are obtained by deflating regional capital stocks either by regional population - in the case of "population-serving" infrastructure, such as schools, hospitals, etc. - or by regional area - in the case of "space-serving" infrasructure, such as roads and railroads. A comparison of the indexes gives some indication on the relative efficiency of the different regions in producing infrastructure: a PI index higher than a BBDPM index, would show relative inefficiency in building infrastructure, indicating the presence of little infrastructure in relation to the amount of resources spent to produce it, and vice-versa.

Picci (1995b), while warning about the risk of drawing hasty conclusions, shows that, in this respect, there is a very sharp difference between the *Mezzogiorno* and the rest of Italy: all the *Mezzogiorno* regions have PI indexes generally much higher than the BBDPM indexes. This is particularly true for Campania, Calabria and Sicilia, the three big Southern regions plagued by organized crime. On the other hand, only Liguria, among the Northern regions, shows the same carachteristic. This should come as no surprise: Liguria, a mountainous and densely populated region, is certainly characterized by higher costs in building infrastructure. For all the other Northern and Central regions, PI indexes are lower then BBDPM indexes. In other words, there is a case for overestimation of the public capital stock computed using the permanent inventory technique for Southern Italy in general, even more so for Campania, Calabria, Sicily, and also for the Northern region of Liguria. Figure 1 shows both indexes for all regions. The 45 degrees line divides "efficient" regions (below) from "inefficient" ones (above).

The empirical analysis is carried out by estimating a production function where public capital is used in conjunction with private capital and labor input to assess its importance in determining output.

The estimated equation is:

$$ly_{rt} = \alpha_0 + \alpha_1 lk_{rt} + \alpha_2 llab_{rt} + \alpha_3 lkpub_{rt} + \varepsilon_{rt} \ , \tag{1}$$

where y is output, k is private capital, lab is labor, $kpub$ is public capital, and l denotes logs. The r and t subscript indicate, respectively, region and time.
The error term has the following structure:

$$\varepsilon_{it} = f_r + \delta_t + \eta_{rt} \ .$$

f_r is a region specific component; δ_t is a time specific component, and η_{rt} is a idiosincratic i.i.d error.

Different specification of the models - and, as we have seen, often different results - follow from different assumptions about the error term. Not considering f gives pooled OLS, the technique used by Munnell (1990). Holtz-Eakin (1994), in his analysis on U.S. state productivity, argues that state effects are potentially important. Once he considers them, he overturns Munnell's results.

It is important to stress that detecting a significant public capital coefficient does not imply that public capital causes output. First, the relation could be explained by reverse-causation, with policy makers responding with increased public investment to better economic conditions. Moreover, even if infrustructure do influence output, a distinction between "supply" and "demand" effects should be drawn. It could be that the significant infrastructure coefficient in the estimated equation is due to its effect on the underlying determinants of productivity. On the other hand, such a coefficient could result from the effects of the increased public expenditure on demand. This type of demand effect could be particularly important in Southern Italy, where the size of public investment, especially during the first part of the '70's, was a considerable fraction of output (see figure 2).
Is there a way to discriminate between these two type of effects? It seems reasonable to

expect that short-lived demand effects should be detected by analysis that focus on the short-run time series properties of the data, such as fixed-effects OLS regressions. On the other hand, long-run supply effects should be detected by focusing on the long run cross-sectional dimension of the data, for example by estimating long-differences of the data.

The first and second columns of table 2 show, respectively, results for pooled regressions and fixed-effects estimates of regional production functions for the Italian regions[6]. In the pooled OLS regression results, the estimated coefficient for public capital is embarassingly negative and significant.

By estimating OLS regressions separetely for the 20 regions (results not reported here but available from the author), we obtain generally positive and significant estimates of the public capital coefficients, as in Picci (1994), for the Italian economy, and in Aschauer (1989), for the US economy. The (unweighted) average of these 20 estimated coefficients, that tend to be bigger for the Southern regions, is equal to 0.504.

The fixed effects estimates, unlike the pooled OLS estimates, show significant and positive public capital elasticity. The F-test on the null hypothesis that all fixed effects are equal (that is, that there are no fixed effects) is strongly rejected. As in Holtz-Eakin (1994) we are led to conclude that OLS pooled regressions are not consistent. Unlike in Holtz-Eakin, assuming fixed-effects does not change the results obtained with the aggregate time series approach. The estimated public capital ouptut elasticities is very high, and comparable to the results obtained by running separate OLS regressions. Note also that the estimated labor output elasticity is implausibly bigger than one.

Random effects estimates, shown in column c of table 2, provide similar results. The Hausman test, however, rejects the null hypothesis that the regional effects are uncorrelated with the right-hand side variables of the regression. In this case, random effects estimates are biased, while fixed effects estimates are still consistent.

Fixed effects estimation accounts only for variation in the time series dimension of the data, and leaves no room for cross-sectional variation. At the opposite end of the spectrum, OLS regressions on long-differences of the data consider only cross sectional variation.

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6 All panel data regressions include time effects.

Column d of table 2 shows an OLS regression of the 20 long-differences available. Long-differences, for each region, have been computed as the differences of the log of the variables in 1991 with the log of the variables in 1970. The coefficient of labor is still high and significant, while the coefficient of private capital is still close to zero. The coefficient of public capital is now also non-significant and with a negative sign.

We are thus confronted with seemingly contradictory results: on the one hand, fixed effects estimates find significant public capital output eleasticities. Long-differences estimates do not find any role for public capital. Before we seek an explanation for these discrepancies in the results, we try to gather more evidence by controlling for the presence of possible outliers in the data. In the description of the data on public capital, we argued that their quality may be lower for Southern Italy. We also added that the problem could be particularly relevant for Calabria, Campania and Sicily, and also for the Northern region of Liguria.

Column a-c of table 3 shows the same the exercise of table 1, with the exclusion of those four regions from the sample. The estimates of the public capital coefficient are about the same as in the previous case, both for panel data and for long differensces estimation.

Columns a,b and c of table 4 show the same exercise, but with the exclusion of the larger set of possible outliers: the whole of Southern and Insular Italy, and Liguria. Only eleven regions are left in the sample. The estimated coefficient for public capital is now small, below 0.2 for the fixed and random effects estimates, but still highly signinficant. As before, formal testing indicates that pooled OLS estimates are not consistent. Long differences of the data have not been performed for this sub-sample of the data due to lack of degrees of freedom.

Note that, as we focus our attention on Northern and Central regions only, the magnitude and the significance of the estimated coefficient for *private* capital increases. A possible explanation of this result could be that our data for private capital in Southern Italy also is of bad quality. Note also that the estimated coefficient on public capital is positive and significant only when the attention is drawn on the short-run time series properties of the data, and that it is smaller when the *Mezzogiorno* is excluded from the analysis. As we have noted, the *Mezzogiorno* was characterized by a very high public investment/GNP ratio, and as such was more likely to be subject to short-run effects of infrastructure on output. These results are consistent with the presence of short-run demand-side effects of public capital on output, and with weak (or absent) long-run supply effect.

As we noted above, a significant public capital coefficient could be due to reverse causation. To control, at least in part, for this possibility, we consider whether lagged public capital also is significant. If infrastracture are important in determining the long run determinants of productivity, then they should still be significant once their lagged values are considered. Also, it is probably reasonable to assume that infrastructure, formed in good part by networks that take time to be completed, take longer than private capital to become fully productive, and that for this reason its productive capacities are better proxied by a lagged value. Good part of the effect of infrastructure on productivity, moreover, should depend on lengthy processes such as the start-up of new business and the relocation of established ones.

The results of fixed and random effects estimates for Italy and for the two subsample of regions are shown in table 5. The estimated coefficients are positive and significant in all cases. They are small when the whole group of 20 regions is considered, and very similar to the results of the previous exercise otherwise: around 0.4 when only Calabria, Campania, Sicily (and Liguria) are excluded from the sample, and below 0.2 when the whole Mezzogiorno is excluded from the sample.

Reverse causation then does not seem to be the reason for the significant infrastructure coefficients that have been detected.

In order to consider the possible presence of common trends among the data, we repeat some of the exercises seen so far using the first differences of the data. Table 6 give the results for Italy as a whole and for the two sub-sample of the regions. The estimated public capital coefficients are small and mostly (barely) significant, but their magnitudes are much smaller than in the previous exercises carried out on the levels of the data. Note that the estimated coefficients of labor and of private capital are much smaller compared to when the variables are considered in levels.

As a last exercise, we consider a usual assumption about technology, namely the presence of constant returns to scale. In our case, we distinguish between constant returns to scale in the private inputs only ($\alpha_1 + \alpha_2 = 1$ in equation 1), and constant returns to scale in all inputs ($\alpha_1 + \alpha_2 + \alpha_3 = 1$ in equation 1).

Table 7 and 8 show the results of these two exercises. The estimated public capital output elasticities are very high and significant. F-tests performed on the fixed effects specification of the estimated equations, however, lead to reject the hypothesis of constant returns to scale in both versions at all conventional levels (results available upon request).

4 Conclusions.

We have tried to determine how important was public capital over the ’70’s and the ’80’s in determining the level of economic activity of the Italian regions.

We have argued that there may be problems in taking at face-value data on public (and private) capital for Southern Italian regions. For this reason, the analysis has been carried out on three different groups of regions: the whole group of 20 regions that together form Italy, the whole group with the exclusion of the three big southern regions of Calabria, Campania and Sicily and also of Liguria and, last, Northern and Central Italy only (also with the exclusion of Liguria).

The time series dimension of the data is where short-lived demand-side effects of public capital on output may be detected. Year-by-year variation of output, determined by multiplier-like effects of variation of public investments, are good game for fixed- or random- effects analysis. Such effects, on the other hand, wouldn’t be detected when the cross sectional variation is privileged in the analysis. In this respect, our analysis is in accordance with the presence of sizeable demand-side effects. Public capital is significant in explaining output when fixed effects estimates are used. No effects whatsoever are seen in the regressions of the long differences of the data.

If the influence of public capital is due to demand effects, moreover, then we should expect it to be bigger when Southern regions, for which the relative importance of public investment in the economy is bigger, are included in the sample. This also is in agreement with the evidence presented above: the estimated public capital coefficient is generally less important when we restrict our attention to Northern and Central Italy.

Considering public capital lagged one period, to rule out reverse-causation, does not change the general picture; considering the data in their first differences also shows a (barely) significant, but now limited, effect of public capital on output.

We conclude that, analyzing the available data from 1970 to 1991, public capital has had a significant effect in determining output. However, most of the effect that has been detected can probably be imputed to the short-run demand-side effects that increased expenditure has on output.

One last question that needs to be answered is how these results relate with previous empirical studies of the Italian economy.

The work of Bracalente and Di Palma (1982) does not consider in any way the time-variation of the variables involved. It simply concludes that, in a given year, regions with good infrastructure had a good economy. This observation, that could be given many different explanations, is not in contradiction with the conclusions of this work, and it is not informative on the magnitude of the effect of public infrastructure on economic activity. Jappelli and Ripa di Meana (1990) and Picci (1994), on the other hand, consider the time variation of the data, but within an aggregate time series context. Their results are confirmed by the present work. Unlike in Holtz-Eakin (1994), the aggregate time series results here are not contradicted when the assumption of regional fixed effects is made. They are contradicted, however, when the cross-sectional dimension of the data is considered.

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Table 1

Summary statistics.

Output per capita	N. West	N. East	Center	South	Islands	Italy
Avg. growth rate:	3.36%	4.04%	3.57%	3.49%	3.16%	3.52%
1970	12.20	10.63	10.36	6.75	7.06	9.66
1991	20.81	19.66	18.12	11.71	11.74	16.80

Per capita output: million of ’85 lire.

Labor Units	N. West	N. East	Center	South	Islands	Italy
Avg. growth rate	.38%	1.15%	1.12%	.89%	.89%	.83%
1970	6243.0	3942.0	3829.3	4048.0	1887.0	19949.4
1991	6786.5	4891.5	4726.7	4806.5	2238.6	23449.8

Private Capital	N. West	N. East	Center	South	Islands	Italy
Avg. growth rate	6.35%	5.38%	8.19%	11.78%	9.90%	7.34%
1970	164674.5	125344.0	76512.4	56237.5	35740.2	458508.7
1991	384359.3	267076.8	208139.1	195326.8	110079.0	1164981

Public Capital	N. West	N. East	Center	South	Islands	Italy
Avg. growth rate	3.87%	3.86%	3.06%	3.44%	3.69%	3.56%
1970	72718.0	67924.9	72717.1	103456.1	52944.7	369760.9
1991	131819.2	122936.9	119383.7	178190.3	93955.5	646285.6

Private and public capital: billion of 1985 lire.

Table 2

Dependent variable: Gross Regional Product.
All variables are in logs.

	Italy.			
Variable:	a) OLS	b) F.E.	c) R.E.	d) L.D.
Constant	2.445	-	.200	.453
	(21.63)		(1.28)	(3.98)
Private Capital	.248	.097	.145	.011
	(20.76)	(7.81)	(12.59)	(.293)
Labor	.863	1.080	.737	.807
	(49.41)	(18.79)	(39.13)	(3.56)
Public Capital	-.063	.430	.355	-.012
	(-4.15)	(15.51)	(14.58)	(-.08)
R^2	.993	.945	.948	.459
Test: H_0 : no FE. P-Value:		.000		
Hausman Test: FE vs. RE. P-Value:			.000	

OLS: Pooled OLS;
F.E.: Fixed Effects;
R.E.: Random Effects;
L.D.: Long Differences.
t-statistics are between parentheses.

Table 3

Dependent variable: Gross Regional Product.
All variables are in logs.

	Italy excl. Cal, Camp, Sic, Lig.			
Variable:	a) OLS	b) F.E.	c) R.E.	d) L.D.
Constant	2.184	-	.134	.512
	(17.21)		(.81)	(2.95)
Private Capital	.224	.088	.126	.012
	(18.46)	(6.47)	(9.98)	(1.27)
Labor	.849	1.22	.758	.789
	(45.21)	(18.58)	(32.16)	(2.39)
Public Capital	-.005	.413	.374	-.090
	(-.26)	(13.68)	(14.04)	(-.48)
R^2	.994	.945	.951	.438
Test: H_0 : no FE. P-Value:		.000		
Hausman Test: FE vs. RE. P-Value:			.000	

OLS : Pooled OLS;
F.E.: Fixed Effects;
R.E.: Random Effects;
L.D.: Long Differences.
t-statistics are between parentheses.

Table 4

Dependent variable: Gross Regional Product.
All variables are in logs.

	North and Center excl. Lig.		
Variable:	a) OLS	b) F.E.	c) R.E.
Constant	1.151	-	.197
	(7.78)		(1.52)
Private Capital	.200	.390	.418
	(11.80)	(16.67)	(20.91)
Labor	.700	.846	.588
	(31.53)	(13.48)	(26.56)
Public Capital	.236	.171	.178
	(9.37)	(6.61)	(7.27)
R^2	.997	.977	.991
Test: H_0 : no FE. P-Value:		.000	
Hausman Test: FE vs. RE. P-Value:			.019

OLS : Pooled OLS;
F.E.: Fixed Effects;
R.E.: Random Effects;
t-statistics are between parentheses.

Table 5

Dependent variable: Gross Regional Product.
All variables are in logs.
Public capital is lagged one period.

	Italy		Italy excl. Cal, Camp, Sic, Lig.		North and Center excl. Lig.	
Variable:	a) F.E.	b) R.E.	c) F.E.	d) R.E.	e) F.E.	f) R.E.
Constant	-	1.623	-	.117	-	-.018
		(13.42)		(10.41)		(-.143)
Private Capital	.246	.279	.102	.154	.418	.447
	(17.62)	(21.42)	(6.25)	(10.41)	(16.32)	(20.70)
Labor	1.342	.832	1.196	.738	.810	.553
	(20.38)	(38.83)	(18.40)	(31.69)	(12.54)	(24.29)
Lagged Public Capital	.013	.013	.410	.359	.179	.192
	(3.26)	(3.12)	(12.77)	(13.02)	(6.66)	(7.48)
R^2	.919	.944	.945	.953	.977	.981
Test: H_0 : no FE. P-Value:	.000		.000		.000	
Hausman Test: FE vs. RE. P-Value:		.000		.000		.038

F.E.: Fixed Effects;
R.E.: Random Effects;
t-statistics are between parentheses.

Table 6

Dependent variable: Gross Regional Product.
All variables are first differences of logs.

	Italy			Italy excl. Cal., Camp., Sic, Lig.			South and Center exc. Lig.		
Variable:	a) OLS	b) F.E.	c) R.E.	d) OLS	e) F.E.	f) R.E.	g) OLS	h) F.E.	i) R.E.
Constant	.014	.158	.014	.015	-	.014	.007	-	.008
	(4.34)	(2.00)	(4.16)	(4.26)		(4.17)	(1.45)		(1.60)
Private Capital	.011	.013	.013	.017	.021	.017	.060	-.179	.011
	(.55)	(.486)	(.558)	(.80)	(.77)	(.81)	(.74)	(-1.46	(.12)
Labor	.542	.524	.534	.529	.506	.526	.546	.487	.527
	(9.79)	(9.16)	(9.97)	(8.47)	(7.90)	(8.42)	(6.47)	(5.52)	(6.20)
Public Capital	.120	.158	.136	.083	.129	.089	.073	.211	.108
	(1.78)	(2.00)	(1.98)	(1.20)	(1.64)	(1.27)	(1.07)	(2.56)	(1.51)
R^2	.622	.623	.626	.659	.670	.661	.784	.797	.459
Test: H_0 : no FE. P-Value:		.568			.279			.072	
H. Test: FE vs. RE. P-V:			.999			.999			.999

OLS : Pooled OLS;
F.E.: Fixed Effects;
R.E.: Random Effects;
H. Test: Hausman Test.
t-statistics are between parentheses.

Table 7

Dependent variable: Gross Regional Product.
All variables are in logs.
Constant returns to scale in the private inputs $\alpha_1 + \alpha_2 = 1$.

	Italy		Italy excl. Cal, Camp, Sic, Lig.		North and Center excl. Lig.	
Variable:	a) F.E.	b) R.E.	c) F.E.	d) R.E.	e) F.E.	f) R.E.
Constant	-	-.068	-	.102	-	.198
		(-.404)		(.584)		(1.48)
Private Capital	-	-	-	-	-	-
Labor	.908	.844	.922	.853	.594	.585
	(72.69)	(76.92)	(66.45)	(70.84)	(24.71)	(33.21)
Public Capital	.472	.300	.484	.291	.203	.182
	(19.37)	(16.31)	(17.86)	(15.15)	(8.09)	(11.73)
R^2	.960	.947	.958	.944	.887	.893
Test: H_0 : no FE. P-Value:	.000		.000		.000	
Hausman Test: FE vs. RE. P-Value:		.000		.000		.905

F.E.: Fixed Effects;
R.E.: Random Effects;
t-statistics are between parentheses.

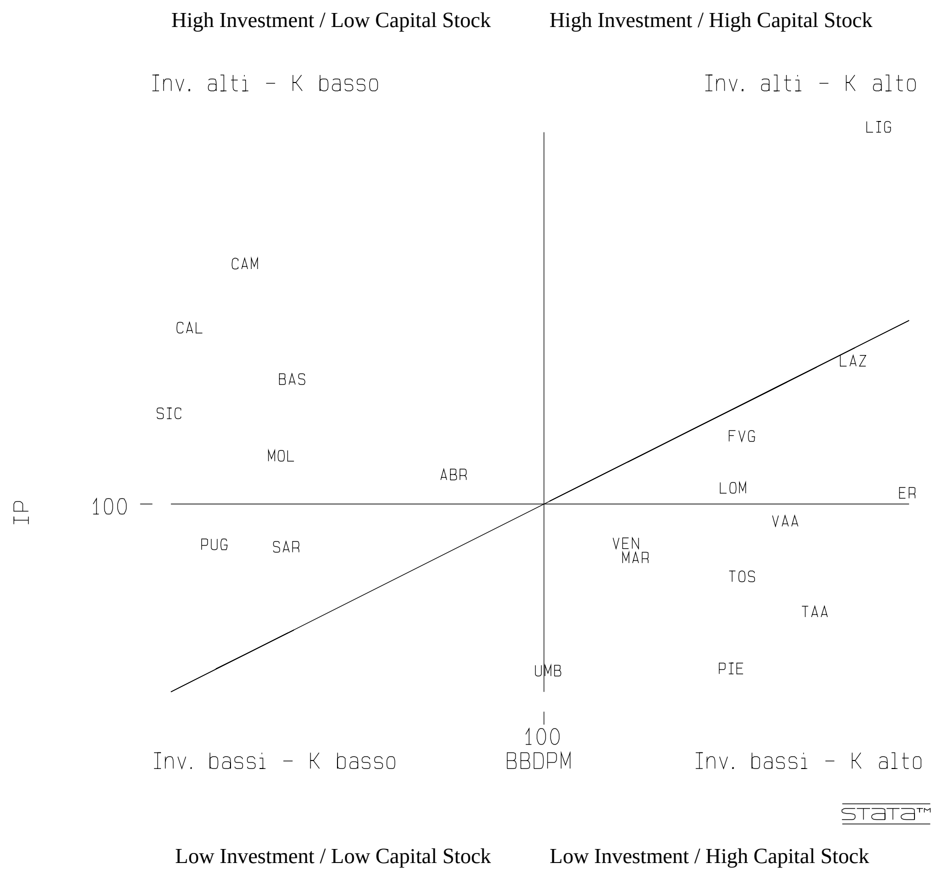
Table 8

Dependent variable: Gross Regional Product.
All variables are in logs.
Constant returns to scale in the private and public inputs $\alpha_1 + \alpha_2 + \alpha_3 = 1$.

	Italy		Italy excl. Cal, Camp, Sic, Lig.		North and Center excl. Lig.	
Variable:	a) F.E.	b) R.E.	c) F.E.	d) R.E.	e) F.E.	f) R.E.
Constant	-	2.07	-	2.190	-	1.425
		(27.36)		(25.76)		(18.96)
Private Capital	-	-	-	-	-	-
Labor	.439	.593	.457	.623	.384	.420
	(17.22)	(27.52)	(15.55)	(25.57)	(18.21)	(20.02)
Public Capital	.436	.216	.433	.197	.138	.117
	(13.47)	(8.45)	(11.73)	(6.95)	(4.86)	(4.26)
R^2	.947	.930	.945	.953	.867	.849
Test: H_0 : no FE. P-Value:	.000		.000		.000	
Hausman Test: FE vs. RE. P-Value:		.000		.000		.002

F.E.: Fixed Effects;
R.E.: Random Effects;
t-statistics are between parentheses.

Figure 1



Public Investment and Infrastructure.

The regions are:

North-West: Piedmont (PIE), Val d'Aosta (VAA), Liguria (LIG) and Lumbardy (LOM);

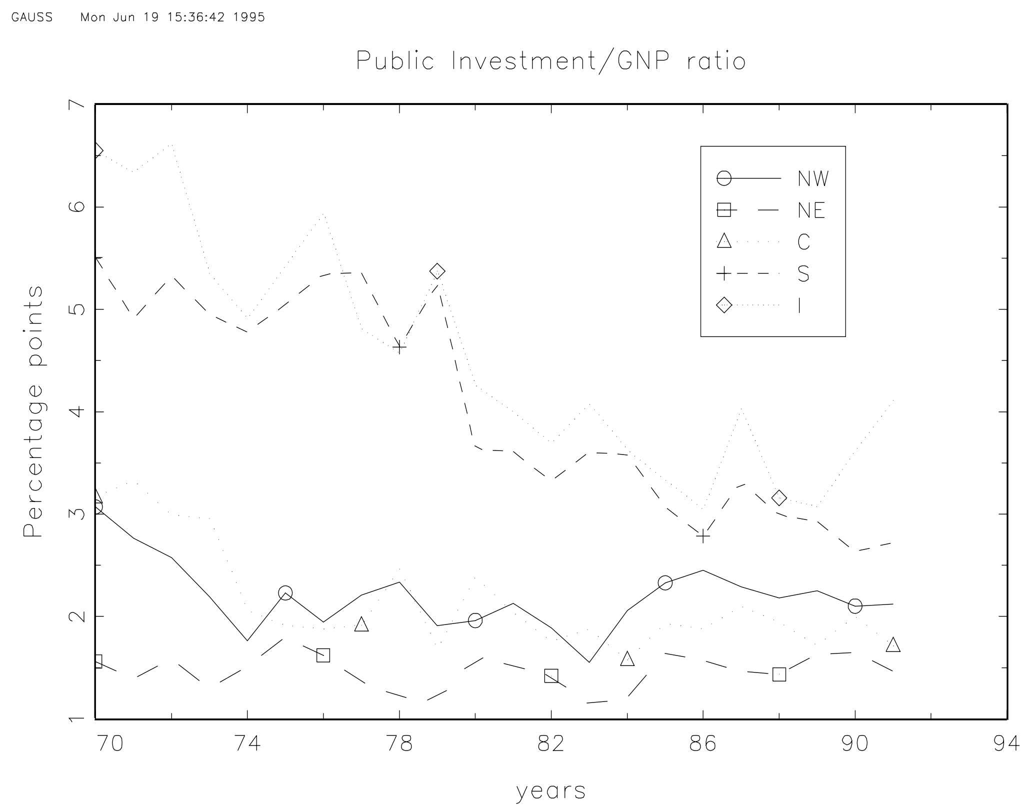
Noth-East: Trentino-Alto Adige (TAA), Veneto (VEN), Friuli-Venezia Giulia (FVG) and Emilia-Romagna (ER);

Center: Tuscany (TOS), Marche (MAR), Umbria (UMB) and Lazio (LAZ);

South: Abruzzo (ABR), Molise (MOL), Apulia (PUG), Campania (CAM), Basilicata (BAS) and Calabria (CAL);

Islands: Sicily (SIC) and Sardinia (SAR).

Figure 2



NW: North-West;

NE: North-East;

C: Center;

S: South;

I: Islands.