Explaining labour productivity differentials on Italian regions

by Valter Di Giacinto and Giorgio Nuzzo *

1. Introduction

The "Mezzogiorno issue", i.e. the underdevelopment of southern Italian regions, is one of the most investigated cases o regional in equality in economic literature [1]. Mostly, economic studies have focused on growth rates, investigating the existence of absolute and/or conditional convergence. Evidence of catching-up is usuall found out for the period ranging from the 1960s up to the mi d 1970s, but then the process came to a halt. Only recently, in the second par of the nineties, southern regions have been able to achieve a slightly larger growth rate than the Italian average. Even if some authors (Bagnasco 1977) argued on the existence of a "Third Italy", developing along the so called 'Adriatic belt' (Balloni 1979) and including the southern regions that were able to promote an effective catching-up process (namely Abruzzo and Molise), Italy has still represents a dualistic economy, all the southern regions still enjoying a lower level of per capita income compared to average level observed in the Centre-North.

A basic decomposition of the indicator shows how differentials in labour productivity still play a fundamental role in explain ing regional differential in per capita income [2].

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[1] Myrdal (1957), Eckaus (1961), Chenery (1962), Lutz (1962), Fabiani and Pellegrini (1997)

[2] Per capita GDP can be seen as the product of three elements: labour productivity; employment rate; share of working age population on total population. Di Giacinto and Nuzzo (2004) carry out such decomposition on Italian regional data. The main findings of this analysis suggest that a persistent gap in labour productivity explains most of the per capita GDP differential at the regional level. However the negative contribution stemming from th lower employment rate grew significantly over the period of analysis.

The explanation of aggregate labour productivity differentials over Italian regions appears still to be a central point in the study of regional (under)development in Italy and is dealt with, in the paper, in three stages:

In a first step the role of the regional industrial structure is analysed. Subsequently, in the spirit of the growth accounting literature, the regional differentials in output per worker are decomposed in terms of differences in physical and human capital endowments and in total factor productivity. Finally, the role of a series of potential determinants of the regional TFP level is assessed by means of a regression analysis carried out using spatial econometric methodology.

The paper i structured as follows. In Section 2, an analysis of structural effects of the industry mix on labour productivity is performed by means of a *shift-share* technique. Section 3 is devoted to the analysis of the different sectoral and regional capital stock endowments. New estimates of human capital broken down by region and industry are produced by the authors pooling information from the Istat Labour Force Survey (LFS) and Bank of Italy's Survey o Households Income and Wealth (SHIW). In Section 4, a regiona production function is estimated, using regional panel data disaggregated by industry to correct for composition effects, and the importance of different regional endowments in physical and huma capital and of total factor productivity (TFP) in explaining labour productivity disparities is assessed. In Section 5 an empirica evaluation of the role played by some of the relevant factors suggested by the related literature (e.g. infrastructure, social capital, R&D expenditures, public institutions performan ce, financial markets development, industrial districts diffusion, geographical factors), in explaining regional TFP differentials is undertaken. A brief summary

of the results concludes.

2. Labour productivity and the industry mix

While it is recognized to be a key factor for the purpose of explaining regional development patterns [3], most studies on economic convergence omit to consider the crucial role played by the industry mix.

As a matter of fact, if we look at Italian southern regions, while there is evidence of a catching up process if we consider the whole economy, while, considered separately, the manufacturing sector and service sectors shows quite different patterns, the latter showing a clear tendency to diverge from the national average (fig. 1).

Fig.1

LABOUR PRODUCTIVITY FO SOUTHERN REGIONS
(index numbers, Italy=100)

Source: Crenos up to 1979 and Istat from 1980

[3] According to Paci e Pigliaru (1998) *"part of the Southern regions' large potential for converging was exploited up to 1975 through a process of sectoral shift from low to high productivity sectors. Since then, however, an important divide became evident - four out of eight Southern regions experienced a relative slow down of growth and an halt of their process of convergence, in spite of the fact that they were still lagging remarkably behind the Center-Northern regions; in the other Southern regions convergence did not stop in 1975…being (un)successful in convergence coincides with being (un)successful in expanding the industrial sector".*

These findings suggest the opportunity to focus our analysis, in the first stage, on the different structures of the local economies.

In order to assess the extent to which different specialisation affects regional labour productivity, the shif-share approach, as se forth in Esteban (2000), is utilised.

Esteban's shif-share technique attributes the regional l abour productivity differentials to three possible causes:

1) an industry-mix component;

2) a productivity differential component;

3) an allocative component.

While other studies deal with differentials in productivity across European regions (Esteban 2000, Paci 1997) or Italian provinces (Limosani 2001), herein the shift-share analysis is performed on differentials in productivity among the Italian regions compared to the Italian average covering a wide time period (1951 to 2001).

The methodology proposed by Esteban (2000) can be described, formally, in the following terms.

Letting p_i^j denote sector's *j* share of employment in region *i*, so that $\sum_j p_i^j = 1$. In addition, we denote by p_{ita}^j the Italian mean sector's *j* share observed at the national level. Similarly, we denot x_i^j e x_{ita}^j as sector'*s j* output per worker, respectively for region *i* and for Italy.

Aggregate labour productivity can be computed as an employment weighted average of productivity at the industr-level:

$$x_i = \sum_j p_i^j x_i^j$$

$$x_{ita} = \sum_j p^j_{ita} x^j_{ita} .$$

Esteban (2000) shows that the regional differential in output per worker between region i and the national average, $x_i - x_{ita}$, can be viewed as the sum of three different effects:

$$x_i - x_{ita} = \mu_i + \pi_i + \alpha_i$$

a) an industry mix-component, μ_i, measuring the differentials in productivity due to the specific structure of its economy, computed assuming that the productivity per wor ker in each sector is the same across all regions. Formally, we have:

$$\mu_i = \sum_j (p^j_i - p^j_{ita}) x^j_{ita}$$

μ_i taking positive values if the region is specialised in sectors with a higher than average productivity at the national level;

b) the productivity differential component π_i, which singles out intra-industry differences. Here, it is assumed that the region's economic structure coincides with the national average and, formally, the component is be written as follows:

$$\pi_i = \sum_j p^j_{ita} (x^j_i - x^j_{ita})$$

where π_i is positive if productivity at the industry level is higher than the corresponding national aggregate, when averaged using national employment shares as weights;

c) the allocative component α_i is a combination of the two previous terms and measures the efficiency of each region in allocating its resources over the different economic sectors. Its expression is the followin

$$\alpha_i = \sum_j (p_i^j - p_{ita}^j)(x_i^j - x_{ita}^j)$$

and it takes positive values if the region is specialised, relative to the Italian average, in sectors where regional productivity is above the Italian average.

Tab. 1

SHIFT-SHARE ANALYIS OF LABOR PRODUCTIVITY (1)
(percentage differences with respect to Italy)

	Labour productivity $x_i - x_{ita}$	Industry-mix component μ_i	Productivity differential component π_i	Allocative component α_i
		1963		
North	5.65	1.28	3.92	0.45
Center	7.44	5.59	1.23	0.62
South	-15.76	-6.13	-12.29	2.66
		1971		
North	4.17	1.01	3.31	-0.14
Center	8.18	8.11	0.18	-0.11
South	-12.45	-6.97	-6.67	1.20
		1981		
North	6.49	2.10	4.43	-0.04
Center	4.23	2.37	1.49	0.37
South	-14.38	-5.34	-10.62	1.58
		1991		
North	8.32	3.32	4.82	0.18
Center	3.22	1.34	1.76	0.12
South	-15.95	-6.40	-11.16	1.61
		2001		
North	6.55	2.14	4.57	-0.15
Center	1.50	0.37	1.08	0.05
South	-13.27	-4.23	-9.74	0.70

Source: elaboration on data provided by Crenos and Istat (for 2001). (1) The analysis is performed on 6, 17 and 21 economic sectors respectively for 1963, 1971-1991 and 2001 years.

Table 1 shows how the productivity differential component explains most of the labour productivity gap of the South. This component reduced rapidly in the sixties, while in the seventies it raised again and still accounts for around two thirds of the total productivity differential.

The industry mix component plays a significant role in explaining southern gap as well, its importance slightly reducing only in

the nineties. Finally, the allocative component appears to be small and decreasing to a, nowadays, negligible value.

3. Capital stock endowment

In the spirit of the growth accounting approach (see Solow 1957 and Denison 1967) we look for an explanation to the industry level productivity differentials by relating these to different regional endowments in physical and human capital and in total factor productivity (TFP).

In order to be able to perform such analysis at the regional - industry scale estimates of the physical and human capital stock mus be available with this level of breakdown. Estimates of the forme were recently made available by Crenos, an Italian regional research centre, while for the latter we use our own estimates, obtained according to the methodology described below.

3.1 Physical capital

Regional physical capital stock figures – broken down by industry – were taken from the Crenos database (see Paci and Pusceddu, 2000, for more details) and cover the period 1970-1994.

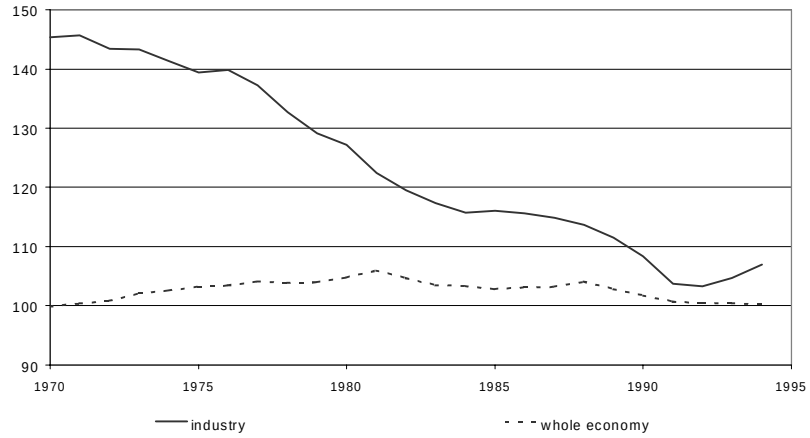
According to these estimates, physical capital per worker was higher than the national average in the Mezzogiorno regions, in particular in the manufacturing sector (fig. 2), although the advantage decreased significantly in the 1980s and 1990s. This evidence demonstrates the vast impact of public investment (direc [4] or indirec through and investment incentives) in the South, and how it slowed down in the '90s. Moreover, in the 60s, the South was characterized

[4] After 1964, state-owned firms had to locate 40 % of their total investments (over the period 1957-1964 the share was 20 %) and 60 % of their new plants in the South.

also by a lower labour cost [5].

Fig. 2

STOCK OF PHYSICAL CAPITAL PER WORKER IN THE SOUTH
(Index number, Italy=100)



Source: Crenos

A shift-share analysis using the methodology described in Section 2 allows us to assess the extent to which the regional differentials in physical capital endowment are due to composition effects. For the South, the industr -mix component is negative, since economic activity in southern regions appears to be relatively concentrated in the less capital-intensive sectors (like the services sector), while the intra-industry differential is mostly positive, although declining in the eighties. The allocative component is quite significant but declining as well.

To sum up, on the basis of relative endowments, labour productivity differentials between southern and centra -northern regions do not appear to be motivated by a lack of physi cal capital pe worker.

[5] The national wage agreements included often different wage levels for the workers of th southern regions. The wage differential in the '60s and at the beginning of the '70s is estimated to be around 30 per cent by Siracusano et al. 1986.

Tab. 2

SHIFT-SHARE ANALYIS OF PHYSICAL CAPITAL PER WORKER (1)
(percentage differences to Italy)

	Physical capital/unit of labour	Industry-mix Component	Industry-by-industry differential	Allocative Component
		1971		
North	2.32	-2.23	7.09	-2.54
Center	-6.70	9.70	-13.07	-3.33
South	0.36	-2.46	10.38	-7.56
		1981		
North	-0.17	-0.58	1.33	-0.92
Center	-8.21	3.58	-10.89	-0.90
South	5.95	-1.43	10.52	-3.15
		1991		
North	1.01	0.81	0.97	-0.77
Center	-3.52	2.49	-5.34	-0.66
South	0.68	-3.01	5.48	-1.78

Source: elaboration on Crenos database

3.2 Human capital

In order to be able to perform the analysis disaggregated at the regional-sectoral level, and in the absence of estimates already available, we produced our own estimates of human capital broken down by the 20 Italian regions and 12 economic sectors.

The methodology used herein to estimate human capital shares the same approach recently introduced by Bils *et al.* (2000), Klenow *et al.* (1997), Hall and Jones (1999), Acemoglu and Zilibotti (1999) and Aiello and Scoppa (2000), based on mincerian earnings functions This methodology is preferred to the simple count of the regional average years of schooling[6] or to an approach à la Mankiw *et al.*

[6] The average years of schooling are in the South lower (4.3 in 1971, 5.4 in 1981 e 6.4 in 1991) than for the Italian mean (respectively 4.8 in 1971, 5.7 in 1981 and 6.8 in 1991). This difference is up to now significant. According to the Labour Force Survey, in 2001 the percentage of graduated out of the whole population was 5.8 per cent, while in Italy was 6.8 per cent.

(1992)[7] for the reason that it permits an on-market evaluation of the effectiveness of the education input in the production process.

Earnings functions, proposed by Mincer (1974), assess the individual gains, in terms of earnings, stemming from cumulated education and labour experience (this variable entering the equation also as a quadratic term). In formal terms we have:

$$\log(W_i) = \cos t + \gamma S_i + \psi_1 T_i + \psi_2 T_i^2 \qquad (1)$$

where W denotes individual earnings, S and T the years of schooling and experience and where the index i denotes the individual

Estimates of private returns to investment in human capital were obtained using data from the Survey of Household Income and Wealth (SHIW) conducted by the Bank of Italy. Data from the 1993, 1995, 1998 and 2000 waves were pooled together, yielding, after removal of double counting due to presence of panel components, a sample of around 18,000 individuals. Separate estimates of γ, ψ_1 and ψ_2 coefficients were obtained for 9 different industries. Regional and sectoral[8] figures for the schooling and experience variables were obtained by averaging the individual data from Istat labour force surveys (LFS); more specifically, the 4 quarterly surveys conducted in 1996 were employed, yielding a sample of around 281,000 individuals.

The value of labour experience T is computed as the difference between the individual age and his/her years of schooling (afte subtracting six years, since schooling in Italy usually starts at such age). The figures thus obtained contain only cross -sectional

[7] Mankiw *et al.* (1992) assume a human-capital production technology identical to that of other goods.

[8] Agriculture, hunting and fishing; energy and mining industry; manufacturing industry; building; commerce; hotels and restaurants; transports and communications; financial, monetary and real estate intermediation; services to firms and other professional and business activities; public sector, defence and social and public assurance; education, health care and other social services; other public and social services to people.

information. Time dynamics for the schooling and experience series was subsequently derived by assuming that both grew, over the estimation period (1970-1994), at the average growth rate recorded, at the regional level, in population censuses of 1971, 1981, and 1991 (see Table A1 in the Statistical Appendix). Moreover, following Aiello and Scoppa (2000), in order to take into account regional heterogeneity in the probability of being unemployed (and therefore not to accumulating years of experience) regional time series of experience were corrected by multiplying for the factor $(1-U_{it})$, where U_{it} denotes the unemployment rate in region *i* and year *t*.

Once estimates o γ_j, ψ_{j1} and ψ_{j2}, S_{ijt} and T_{jt} are available human capital stock in year *t* for each region and sector is computed using the expression:

$$H_{ijt} = \exp(\text{constant} + \gamma_j S_{ijt} + \psi_{j1} T_{jti} + \psi_{j2} T_{ijt}^2) \qquad (2)$$

Since schooling and experience data are only available for dependent workers, a basic assumption underlying the chosen methodology is that human capital on employees is a good proxy of the human capital of all the workers (including self-employees [9].

Figure 3 displays the time series of the estimated human capital levels, averaged over the different sectors and expressed as indices with respect to the Italian aggregate, for the main geographical areas of the country. Our findings suggest that the gap in the human capital stock of the South is significantly large, and, while it shows a clear tendency to converge in the period from 1970 to mid 1980s, the gap widens again in subsequent years.

Fig. 3

[9] According to the Istat Labour Survey, in 2003 the number of employees was 72.7 per cent out of the whole number of workers. Such share does not change significantly in different territorial areas: North 73.0 %, Center 72.0 % and South 72.8 %.

HUMAN CAPITAL DYNAMICS

(weighted mean of sectoral values, index numbers Italy=100)

Source: our elaboration

4. A decomposition of labour productivity differentials

By making reference to an aggregate production function recent empirical studies have evaluated the role of capital endowments and TFP level in explaining labour productivity pattern over Italian regions. Marroccu *et al.* (2000) estimate regional TFP level using panel data broken down by region and industry, but neglecting the role of human capital differentials their estimates of TFP are necessarily distorted. Aiello and Scoppa (2000) perform a similar exercise including regional human capital estimates, but, using data for total regional economy with no industry breakdown their analysis is not able to control for regional variation in aggregate productivity that is simply due to the industry-mix effect, and not to differences in capital endowments or TFP.

Our contribution aims at overcoming such shortcomings by estimating a regional production function using industry level data and including estimates of human capital with a regional and sectoral disaggregation.

The empirical analysis is based on a panel Cobb-Douglas

production function broken down by region and industry and augmented to include human capital as in Mankiw, Romer and Weil (1992). In formal terms, we have:

$$Y_{ijt} = A_{ij} K_{ijt}^{\alpha} (L_{ijt} * h_{ijt})^{\beta} \qquad (3)$$

where *Y* denotes value added, *K* stands for physical capital, *L* for unit of labour and *h* is the labour-augmenting human capital level respectively for region *i*, sector *j* e year *t*. The coefficien *A* measures TFP, and in the panel data environment of the empirical analysis is treated as fixed region/industry effect.

Dividing (3) by the labour input we get

$$y_{ijt} = k_{ijt}^{\alpha} (h_{ijt})^{\beta} L_{ijt}^{\alpha+\beta-1} A_{ij} \qquad (4)$$

where $y=Y/L$ and $k=K/L$ and, after a logarithm transformation, we can write

$$\log(y_{ijt}) = \alpha \log(k_{ijt}) + \beta \log(h_{ijt}) + (\alpha + \beta - 1) \log(L_{ijt}) + \log(A_{ij}) \qquad (5)$$

where labour productivity is expressed as the sum of four compo nents: physical capital, human capital, (dis)economy of scale and total factor productivity.

After subtracting the logarithm of the aggregate sector productivity, we obtain the following decomposition of the productivity differential

$$\Delta \log(y_{ijt}) = \alpha \Delta \log(k_{ijt}) + \beta \Delta \log(h_{ijt}) + (\alpha + \beta - 1) \Delta \log(L_{ijt}) + \Delta \log(A_{ij}) \qquad (6)$$

where $\Delta \log(z_{ijt}) = \log(z_{ijt}) - \log(\bar{z}_{jt})$, $z \in \{y, k, h, L, A\}$, and where $\bar{z}_{jt}$ is the aggregate value of the variable.

Tab. 3

DECOMPOSITION OF LABOUR PRODUCTIVITY (1)
(averages of annual figures over the period 1970-1994)

Regions	Whole economy					Manufacturing sector				
	% diff. in Producti-vity	% diff. in Physical capital	% diff. in Human Capital	% diff. in Scale effect	% diff. In TFP	% diff. in Producti-vity	% diff. in Physical capital	% diff. in Human Capital	% diff. in Scale effect	% diff. In TFP
Piedmont	2.5	-0.5	0.6	0.6	1.8	10.2	4.6	0.8	1.0	3.9
Vall d'Aosta	-4.9	14.2	0.3	-9.8	-9.5	4.1	5.9	0.5	-9.8	7.5
Lombardy	7.9	4.2	0.3	2.8	0.7	6.5	1.5	0.2	3.3	1.5
Liguria	-1.2	10.4	-0.5	-3.9	-7.1	3.6	-3.0	-0.8	-5.8	13.3
Trentino Alto Adige	3.6	0.7	-0.5	0.4	3.0	-1.8	-6.8	-1.6	0.6	5.9
Veneto	-0.2	2.9	0.7	-3.4	-0.4	3.4	2.2	0.8	-4.2	4.6
Friuli-Venezia Giulia	3.4	7.7	1.7	-2.3	-3.7	-0.9	-4.2	3.6	-3.9	3.6
Emilia-Romagna	10.3	-0.8	0.8	0.3	9.9	7.6	-4.1	0.7	0.2	10.9
Tuscany	2.7	3.2	0.6	-0.1	-1.0	9.5	-5.8	0.0	0.0	15.2
Umbria	-2.6	5.1	0.6	-4.9	-3.4	-11.0	-7.4	0.5	-5.2	1.1
Marche	-1.6	-1.7	-0.1	-2.9	3.1	-4.8	-10.4	-1.2	-2.7	9.6
Lazio	3.2	-10.0	1.4	1.0	10.8	-3.4	-0.9	2.1	-1.8	-2.7
Abruzz	-6.1	4.2	0.3	-3.7	-6.9	-21.2	-2.1	-0.8	-5.5	-12.8
Molise	-21.0	2.8	0.1	-7.4	-16.5	-26.8	-4.9	0.3	-10.4	-11.8
Campania	-13.6	-6.1	-0.9	0.5	-7.1	-20.3	8.9	-0.8	-2.0	-26.5
Puglia	-5.7	-8.1	-1.6	-0.4	4.5	-26.1	6.0	-2.3	-2.7	-27.1
Basilicata	-20.7	14.5	-1.8	-5.5	-28.0	-30.1	32.2	-2.6	-9.5	-50.2
Calab ia	-22.4	-3.8	-1.7	-2.0	-14.9	-34.0	17.7	-1.9	-6.9	-43.0
Sicily	-7.7	-0.9	-0.9	0.3	-6.1	-28.3	0.9	-0.5	-3.4	-25.3
Sardinia	-5.9	13.1	-2.7	-3.1	-13.1	-29.1	23.3	-2.3	-5.7	-44.4
Correlation with productivity differentials	-	-0.08	0.60	0.48	0.82	-	-0.55	0.58	0.55	0.90
Standard deviation	9.3	7.0	1.1	3.1	9.3	15.6	10.9	1.5	3.8	20.6

(1) Data on the whole economy and on the manufacturing sector are obtained aggregating respectively for 17 and 9 economic sectors, weighted for their own employment

Input elasticities were estimated together with fixed effects by LSDV using a panel of 8,500 observations related to 20 regions, 17 sectors and 25 years (1970 to 1994). Data on value added, physical capital stock and labour units are from the Crenos database while the human capital series are obtained according to the methodology

exposed in section 3.2[10]. Estimates o α and β are respectively equal to 0.49 and 0.53, thus implying slightly increasing returns to scale Table A2 in the Statistical Appendix reports the estimated TFP levels for the different regions and industries.

In Table 3 the components of the regional productivit differential are reported, taking averages of yearly figures over the period 1970-1994. The main finding is the predominance of the differen TFP levels in explaining labour productivity differentials at the regional scale. In the southern area inferior aggregate labour productivity is partially explained by the human capital gap as well. Aggregating the industry figures in five large sectors (agriculture, construction, energy and mining, manufacturing and services) revealed how the TFP gap suffered by southern regions (the last 8 regions in the order of Table 3) is mainly due to the large deficiency recorded for the manufacturing sector (last column of Table 3).

5. The determinants of regional TFP disparities

Given the key role played by total factor productivity in explaining regional labour productivity differentials in Italy, we conclude our empirical study performing an econometric analysis of some possible determinants of geographical TFP disparities.

Our analysis is conducted on levels rather than on growth rates[11] and focuses on the manufacturing sector where the southern gap is wider (fig. 8).

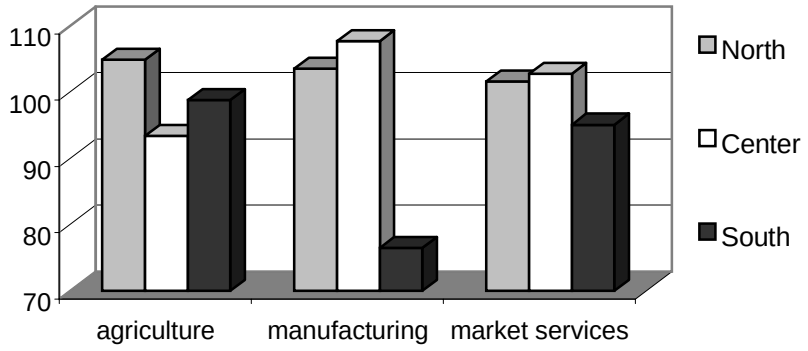
[10] The matching between the industries breakdown provided by Istat LFS and the Crenos database allows a final breakdown of the regional human capital series in 9 industries. In particolar, the same regional human capital stock figures were used for all the manufacturing sectors.

[11] Hall and Jones (1999) argue that "*levels capture the differences in long -run economic performance that are mostly directly relevant to welfare as measured by the consumption of goods and services*". Other Authors underline the following econometric pitfalls of the studies on growth rates: growth rates vary widely over time, while the typical explanatory variables have a significant persistence over time (Easterly et al. 1993); growth rates are stationary series, trendless and without any unitary roots, while explanatory variables have a large trend component (Jones 1995).

Economic literature dealing with TFP differentials is extensive and complex, not referring only to microeconomic features, bu considering also environmental factors, whose role our empirical analysis is mainly focused on.

Fig. 4

TFP DISPARITY IN GEOGRAPHICAL AREAS
FOR THE MAIN SECTORS
(index numbers, Italy=100)



Source: our elaboration.

Among the potential explanatory factors we concentrate on a set of variables that are underlined in the economic literature as having a clear-cut role in fostering TFP development and, at the same time, exhibit spatial variation across Italian regions (this rules out institutional factors that are constant within a given country).

Local expenditure in research and development is considered important, being one of main sources of technological innovations reducing the quantity of inputs (human and physical) needed in the productive process (Mairesse et al. 1991, Parisi et al. 2002). Beneficial geographical spillover through human capital transmission mechanism is also underlined (Camagni 1991).

Good transport infrastructure can also help productivity through a direct and indirect reduction of costs, and the enhancement of the

attractiveness of a territory for new investment, that can act as a vehicle of new technologies (Bonaglia *et al.* 2000)[12].

Literature on social capital underlines the positive effects on productivity levels deriving from enhanced transmission of information and cooperative behaviours (Dasgupta 2001)[13]. Public, as well social, institutions are deemed to be important, since they can reduce administrative costs and avoid market diversion (North 1990, Hall e Jones 1999).

Agglomeration economies within industrial districts, by fostering knowledge transmission among firms and workers, are also deemed to foster productive efficiency (see, e. g., Becattini 1998)[14].

Geographical location of a region is recently receiving some attention as well, since it can be a source of (dis)advantages in a context where economic activity is not homogeneously distributed in space, but concentrates in some areas, like in *core-periphery* models of the New Economic Geography (see Ottaviano and Puga, 1997, for a review). In a recent study, Fingleton (2001) shows that a measure o peripherality, the distance from Luxembourg (assumed as the economic core of the European economy), helps explaining the productivity gap observed on regions that are at the margin of the European area.

Finally, a long strand of literature has stressed the importance of efficient credit markets in fostering capital accumulation and growth, for example, by carefully selecting and financing innovative initiatives

[12] Bonaglia et al. (2000) addressed the issue of whether and to what extent public capital can enhance productivity and found that "*Overall, investment in transportation appears to be the most productive: according to the growth accounting approach railways in the North and roads and airports in the Center and South are the categories that mostly contributed to TFP growth*".

[13] As Dasgupta (2001) argues *"if network externaties are more in the nature of public goods, social capital is a component of what economists call "total factor productivity""*. Also Solow (1995) suggested that if social capital is a potent force in economic development, it should find itself reflected in total factor productivity growth.

(se, e.g., Levine 1997).

In order to quantify, at regional level, the importance of the factors outlined above, we used the following set of indicators (for more details see Appendix) [15]

- R&S. Expenditure in research and development per unit of labour;

- TRANSPORTS. Length of railway tracks and roads;

- SOCCAP. Within the wide notion of social capital the role of the external networks component is singled out, focusing on collective action institutions, which are proxied by a latent factor derived by a principal component analysis of various variables related to economic associationism in the late '60s[16]. The use of these variables aims at grasping the propensity of economic actors to cooperate.

- PUBEFF. It is a measure proposed by Golden and Picci (2004 based on the difference between a measure of the physical quantities of public infrastructure and a measure of the cumulative price government paid for public capital stock in the mid -1990s. The larger is the difference, the greater is the efficiency of public administration.

- CREDIT. This indicator is the number of banking branches per 1,000 inhabitants in 1971. This indicator catches up spatial disparities in financial sector development, posing less simu ltaneity problems with respect to indicators such as the amount of financial intermediation, due to the exogenous control on bank branching exercised by the central bank up to the end of the 1980s.

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[14] An econometric assessment of productivity performance of firms located in industrial districts was conducted by Fabiani et al. 2000.

[15] Whenever necessary predetermined values were chosen in order to overcome potential endogeneity of part of the explanatory variables.

[16] We excluded the variables related to economic associations of firms in the manufacturing sector, since these could be endogenous with respect to our dependent variable, while we focused on variables related to handicraft and commerce.

- DISTRICTS. It is a measure of the local degree of industr al districts diffusion over the Italian regions.
- DISTLUX. Kilometric distance from Luxembourg.

As shown in Table 5, southern regions systematically display lower endowments regarding the factors that are expected to foster TFP growth, apart from being g eographically more peripheral wit respect to the European core region (Table A3 in the Statistical Appendix provides some descriptive statistics for the individual regions).

Tab.5

SPATIAL DIFFERENTIALS IN EXPLANATORY FACTORS
(index numbers, Italy=100)

	R&S	TRANSPORTS	CREDIT	SOCCAP	PUBEFF	DISTRICTS	DISTLU
North	98,1	112,0	130,3	146,1	125,6	161,5	66,6
Center	113,4	97.3	120,3	102,5	119,1	112,1	95,0
South	95,2	89,6	49,8	39,1	56,6	13,9	145,8

Source: see Appendi

Using the proxies above outlined we performed an econometric analysis were the dependent variable was regional TFP level estimated in the previous step for the nine industries belonging to the manufacturing sector.

The first column of Table 6 displays OLS estimates for a model that includes only industry dummies, to control for regional differences in the industry mix of the manufacturing sector, and a geographical dummy designating the southern regions. Even when controlling for composition effects, the coefficient of the dummy referred to the Mezzogiorno area (DuSouth) reflects a large and statistically significant TFP gap (around 37 percentage points).

The following specification (Column 2) augments the basic model with the explanatory factors, expressed as percentage ratios to

the aggregate Italian values. Based on OLS estimation results all the regressors present the expected sign and are statistically significant, with the single exception of CREDIT. The DuSouth variable is no longer statistically different from zero, providing support to he efficacy of the selected pool of indicators in grasping regional TFP differentials between the northern and southern areas.

When using OLS to carry out regression analysis on spatial data it is advisable to check for departures from the null hypothesis that the error term in the model is uncorrelated across space. Following Anselin (1988) two types of Lagrange Multiplier (LM) tests were implemented[17]. The first assumes a spatial auto-regressive error model (spatial error), while the other assesses the omi ssion of a spatial lagged dependent variable. Both LM tests are highly statisticall significant, showing the likely presence of specification problems fo the model assumed to hold under the null. Therefore, we have set up two other specifications of the model: one inserting the lagged dependent variable (Column 3) and the other assuming spatially auto - regressive errors (Column 4). In both cases, coefficients measuring spatial interaction effects are positive and significant. Since the specification shown in Column 4 has a better fit (measured by the adjusted R^2), and since the *spatial lag* specification shows some evidence of autocorrelation in the residuals (even if the test is only significant at the 15 per cent level), the preference as the final specification was given to the *spatial error model.*

According to ML estimation results for this model all the regressors' coefficients have the expected sign and are significant, albeit only at the 9 per cent level in the case of CREDIT. Afte correcting for spa ial autocorrelation in the residuals all the estimated coefficients become slightly smaller compared to the OLS estimates,

[17] Spatial lags are computer by means of a row normalized spatial co ntiguity matrix.

Tab.6

ASSESING THE DETERMINANTS OF THE REGIONAL DIFFERENTIALS IN TFP LEVELS IN THE MANUFACTURING SECTOR (1)

	Column I		Column II		Column III		Column IV	
Variables	base OLS		OLS with determinants		Spatial lag model		Spatial error model	
	Coeff.	*p*-value	Coeff.	*p*-value	Coeff.	*p*-value	Coeff.	*p*-value
Constant	-0.0062	0.9066	-0.9560	0.0014***	-0.8826	0.0010***	-0.8367	0.0014***
DuSouth	-0.3718	>0.0001**	0.0201	0.8137	0.0246	0.7528	-0.0072	0.9220
R&S	-	-	0.0043	0.0015**	0.0039	0.0015***	0.0037	0.0020***
TRANSPORTS	-	-	0.0016	0.0210**	0.0014	0.0290**	0.0014	0.0132**
CREDIT	-	-	0.0003	0.3169	0.0002	0.3354	0.0004	0.0882*
SOCCAP	-	-	0.0005	0.0694*	0.0005	0.0393**	0.0006	0.0224**
PUBEFF	-	-	0.0021	0.0085***	0.0017	0.0160**	0.0015	0.0311**
DISTRICTS			0.0006	0.0270**	0.0005	0.0356**	0.0005	0.0148**
DISTLU	-	-	-0.0011	0.0692*	-0.0005	0.3587	-0.0011	0.0701*
Sectoral Dummies (2)	yes		yes		yes		yes	
Minerals and non-metallic mineral products	0.2160	0.0016***	0.2061	0.0018***	0.1663	0.0066***	0.2277	0.0035***
Chemical products	-0.3478	0.0000***	-0.3400	0.0000***	-0.2659	0.0001***	-0.3584	0.0000***
Metal products and machinery	0.1293	0.0293**	0.1136	0.0525*	0.0926	0.0863*	0.1293	0.0611*
Transport equipment	0.2304	0.0015***	0.2190	0.0019**	0.1770	0.0069***	0.2382	0.0045**
Food, beverages and tobacco	0.3166	0.0000***	0.3088	0.0000***	0.2455	0.0001***	0.3318	0.0000***
Textiles and clothing, leather and footwear	-0.0112	0.8502	-0.0303	0.6087	-0.0166	0.7595	-0.0073	0.9163
Paper and printing products	0.2275	0.0057***	0.2129	0.0074***	0.1673	0.0232**	0.2302	0.0179**
Wood, rubber and other industrial products	-0.0436	0.4865	-0.0543	0.3767	-0.0354	0.5283	-0.0386	0.5997
Rho					0.2468	0.0007***		
Lambd							0.3258	>0.0001***
R^2	0.6774		0.7256		0.7462		0.7536	
R^2 adjusted	0.6603		0.6987		0.7212		0.7294	
N. observations	180		180		180		180	
			χ^2	*p*-value	χ^2	*p*-value		
LM Tests								
Spatial error			12.47	0.0006***	2.06	0.1509		
Spatial lag			10.38	0.0021***				

(1) The regressand and the regressors have been expressed in logarithmic terms. (2) The sector excluded is Ferrous and non -ferrous mineral and metals. The number of * from 1 to 3 den tes statistically significance at the 10, 5 and 1 per cent level.

with the exception of the one related to CREDIT. DuSouth's coefficient is negative but clearly not statistically different from zero, confirming the ability of the model in capturing the North-South dichotomy characterizing the Italian economy.

Using estimated coefficients it is possible to quantify to wha extent the South would have caught up should each region in the area have achieved, coeteris paribus, values equal to the Italian averages for the single TFP determinants. Closing the large gap in PUBEF would have induced the largest recovery, a 6.1 percentage points increase, followed by DISTRICTS (4.3 points), SOCCAP (3.6), CREDIT (2.0), R&S (1.8) and TRANSPORTS (1.5) per cent.

6. Concluding remarks

In this paper we attempted to do some further progress in the empirical explanation of wide labour productivity differentials across Italian regions. In a first step, using the shif -share technique recently proposed in the literature, the role of the industry mix in determining such disparities is assessed. Composition effects appear to justify about one third of the productivity gap suffered by the Italian Mezzogiorno regions, leaving the majority of the differential still unexplained. The second part of the analysis is, hence, devoted to a decomposition of the industry-by-industry productivity disparities in terms of different physical and human capital endowments and total factor productivity on the basis of a panel data estimation o a local production function. To carry out the exercise with the desired level of disaggregation new figures for the human capital stock broken down by region and industr were first obtained.

Our findings suggest that regional TFP differentials play a fundamental role in explaining labour productivity performance over

the Italian territory, while the gap in human capital also seems to have contributed in determining the gap incurred by Southern regions.

Aggregate TFP disparities in the Mezzogiorno area appear to be driven by a particularly wide gap in the manufacturing sector. Therefore, the final part of the paper is devoted to an econometric analysis of the regional determinants of total factor productivity in this sector. A set of explanatory factors suggested by the related literature – namely R&S investment, transport infrastructure, the efficacy of political and social institutions, agglomeration economies, financial markets development and geographical factors – was tested and found capable of motivating the large TFP gap suffered by Mezzogiorno regions, also when controlling for industry mix effects and residual spatial autocorrelation.

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APPENDIX

- R&S. Average expenditure on research and development per unit of labour over the period 1978-1995. Index numbers, Italy=100 Source: elaboration on Crenos database.

- TRANSPORTS. Length of railway tracks and roads. It is the mean of the length of railway tracks and roads in 1964 and in 1995. The indicator is obtained by weighting these lengths with the surface extension of the regions. Index numbers, Italy=100. Source: Istat.

- SOCCAP. The indicator is the first component, explaining 45% of total variance in a principal component analysis set up by Arrighetti et al. (2001), carried out on the following variables, also provided in the ISL-University of Parma database:

i. the membership rate to artisan associations in 1970, calculated as the ratio between the number of artisan firms belonging to artisan associations and the number of artisan firms on the official register.

ii. the ratio of the total numbers of valid votes cast by artisans in the commission elections to the total of officially registered artisans in 1970. Source: Historical Archive "Giorgio Coppa" held by National Confederation of Handicrafts (CNA);

iii. the percentage share of agricultural firms supplying products to agricultural mutual ties or similar out of the total number o agricultural firms existing in 1970 (ISTAT 1974);

iv. the percentage share of members to collective purchases o commercial voluntary unions out of the total number of commercial licences in official registers in 1965 (Source: Minister of Industry, Commerce and Handicraft, 1966);

v. a dummy variable that equals one if in the province there was a credit guarantee consortium associated to Artigianfidi created before 1975 Source: Artigianfidi Research Unit. Index numbers, Italy=100. Source: Istat.

The provincial variable provided by Arrighetti *et al.* (2001) was transformed to a regional variable by weighting provincial data by population.

- PUBEFF. It is an indicator proposed by Golden and Picci (2004) based on the difference between a measure of the physical quantities of public infrastructure and a measure of the cumulative price government pays for public capital stock, controlling a regional level for possible differences in the cost of public construction. In particular, we used the corruption index “G” that refers to 1997 and where “G” stands for general, meaning that it is computed across all categories of public goods. Index numbers,

Italy=100.

- CREDIT. This indicator is the number of banking branches per 1,000 inhabitants in the 1971. Index numbers, Italy=100. Source: Bank of Italy.
- DISTRICTS. The indicator is calculated as follows. Firstly, we multiply, for each municipality in the province, the number of manufacturing employees by the continuous degree of industria l district diffusion of the LLMA to which the municipality belongs, as provided by Cannari and Signorini (2000). Then, we sum the figure of all the municipalities in the province and divide this aggregate by the total number of manufacturing employees. Index numbers, Italy=100. Source: elaboration on Istat.
- DISTLUX. Kilometric distance from Luxembourg of the regional main town.

STATISTICAL APPENDIX

Tab. A1

SCHOOLING IN REGIONS IN 1971, 1981 AN 91
(average years of schooling)

	1971	1981	1991
Piedmont	5.0	5.8	6.9
Valle D'Aosta	4.9	6.1	7.3
Lombardy	5.1	6.1	7.1
Trentino Alto Adig	5.3	6.2	7.2
Veneto	4.9	5.8	7.0
Friuli Venezia Giuli	5.1	5.9	7.1
Liguria	4.9	5.9	7.0
Emilia Romagna	4.8	5.8	6.9
Tuscany	4.7	5.7	6.8
Umbria	4.4	5.6	6.8
Marche	4.4	5.6	6.7
Lazio	4.5	5.6	6.7
Abruzz	4.3	5.4	6.4
Molise	4.3	5.2	6.1
Campania	4.3	5.5	6.5
Puglia	4.3	5.4	6.5
Basilicata	4.1	5.2	6.2
Calabri	4.1	5.3	6.2
Sicily	4.2	5.3	6.3
Sardinia	4.2	5.3	6.2
Italy	4.7	5.7	6.8
North-west	5.0	6.0	7.0
North-East	5.0	5.9	7.0
Center	4.5	5.6	6.7
South	3.1	5.4	6.4

Source: elaboration on Istat Census

Tab. A2

TFP FOR SECTORS AND REGIONS

	Agriculture	Energy	Manufacturing	Construction	Market services	Non market services
Piedmont	82.13	97.10	102.88	106.94	108.21	92.51
Vall D'Aosta	50.71	98.17	106.54	162.36	93.52	77.68
Lombardy	100.77	128.61	100.44	109.88	100.98	86.61
Trentino Alto Adige	106.07	110.17	113.31	141.51	83.67	77.76
Veneto	105.45	73.59	104.84	121.42	102.64	84.71
Friuli Venezia Giulia	83.87	79.37	103.70	150.12	100.45	84.81
Liguria	105.84	105.42	103.28	72.65	93.89	97.71
Emilia Romagna	134.36	91.97	110.60	122.23	104.39	97.57
Tuscany	83.88	96.15	115.08	97.41	88.72	103.88
Umbria	78.24	96.03	99.88	139.40	87.89	101.36
Marche	82.31	102.79	108.67	121.74	107.01	92.64
Lazio	114.15	90.15	96.95	75.84	112.57	126.27
Abruzz	84.80	172.52	87.46	97.33	97.79	92.63
Molise	59.96	109.40	91.44	86.60	119.04	82.54
Campania	97.93	98.15	76.17	81.53	93.35	104.52
Puglia	117.63	59.22	76.50	101.20	104.86	117.43
Basilicata	53.66	83.56	61.80	94.81	98.95	82.92
Calabri	77.07	61.52	66.74	60.38	104.30	105.59
Sicily	117.15	113.30	79.01	80.70	86.70	99.71
Sardinia	92.31	85.52	65.38	113.31	85.20	88.94
North	104.89	104.26	103.54	114.81	101.57	89.31
Center	93.35	93.80	107.67	94.20	102.77	115.01
South	98.75	96.78	76.42	86.21	95.05	102.68

Source: our elaboration.

Tab. A3

DESCRIPTIVE STATISTICS OF REGRESSORS

(index numbers, Italy=100)

	R&S	TRANSPORTS	CREDIT	SOCCAP	CORRUPTION	DISTRiCTS	DISTLUX
Piedmont	75,4	119,0	138,3	110,7	160,0	155,2	60,3
Valle D'Aosta	155,0	23,3	112,0	67,6	83,5	47,6	47,1
Lombardy	107,1	114,2	137,1	115,8	113,4	200,7	57,0
Trentino Alto Adig	127,7	54,0	229,8	247,1	120,7	30,6	64,0
Veneto	97,9	120,5	46,3	133,8	119,2	204,9	79,7
Friuli Venezia Giuli	106,6	106,9	316,1	145,1	105,2	93,2	92,5
Liguria	117,8	157,0	91,7	111,1	65,3	10,9	68,5
Emilia Romagna	84,9	109,0	138,5	266,2	157,4	154,6	73,5
Tuscany	84,8	99,0	154,0	162,5	157,6	199,3	82,1
Umbria	87,3	88,2	115,6	45,5	174,2	97,1	92,5
Marche	85,0	100,4	118,9	117,3	128,2	267,1	90,4
Lazio	146,3	110,0	97,1	64,3	79,8	7,4	106,1
Abruzz	96,8	75,4	66,1	62,8	93,4	55,1	105,3
Molise	103,4	60,4	24,3	57,8	56,9	6,3	115,6
Campania	96,9	118,4	39,0	15,8	35,4	21,2	123,8
Puglia	81,6	69,7	47,5	95,1	70,5	13,4	128,4
Basilicata	86,5	41,3	45,2	19,8	52,1	4,2	126,2
Calabri	107,7	76,5	51,9	0,0	39,9	4,1	165,5
Sicily	100,1	63,0	68,0	26,2	59,3	4,3	185,8
Sardinia	90,8	25,0	27,4	60,0	81,9	6,6	158,3

Source: see Appendi