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Long Run Convergence and Labour Mix: The Case of the Italian Urban System 1951-1996

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**LONG RUN CONVERGENCE AND LABOUR MIX:
THE CASE OF THE ITALIAN URBAN SYSTEM 1951-1991**

ABSTRACT: The quality of labour force supply, i.e. the endowment of human capital of various kinds, is crucial to the pursuit of the long term goal of maximum wealth. In a paper presented at the Ersa Congress 1998 the author tested with partial success four theoretical hypotheses on the role of human capital in development processes and their spatial differences, within the framework of the convergence hypothesis in growth theory and by use (mostly) of regression analysis. The present paper tests those hypotheses again after adopting a finer disaggregation of the explanatory labour skill variables (from 11 to 40) and lengthening the observation period (from 1961-1991 to 1951-1991), and it tries alternative theoretical approaches. Regression analysis supports the hypotheses, with statistically improved results: income/product per capita can converge even under different structural conditions, but these influence the convergence process significantly in unexpected ways. After a synthetic review of the literature on the issues sketched above (2) and a presentation of data and methods (3), a regression analysis tests, employing the Italian urban system (95 provinces: EU Nuts3) as an empirical case for the general conceptual issues, the hypothesis of absolute convergence in long run development of per capita income/product (4) and the hypothesis of conditional convergence by human capital endowment, as can be inferred from observed labour occupations in 1951, 1961, 1971, 1981 and 1991 (5).

1. INTRODUCTION

The quality of labour force supply, i.e. the endowment of human capital of various kinds (including entrepreneurship), is crucial to the persistence and renewal of abundant information stocks and efficient information flows and therefore to the existence of strategic information-related activities. These activities ensure the ability to produce knowledge and to take decisions, hence the identification and maintenance of competitive advantage, and thus the pursuit of the long term goal of maximum wealth.

This causal chain can be applied, in an “industrial” approach, to the individual firm, to the filiere and to the economic system as a whole; similarly, a “spatial” approach allows its application to individual cities and regions as well as to the national system as a whole.

In fact, within the long term process of economic development spatial proximity activates cumulative processes of synergy and feedback, lying at the base of information dynamics and of competitive advantage; the resulting spatial division of labour structures over time the system of cities and regions in coherence with the pursuit of development. In the end, the pivot of spatial economic development is the supply input: the local endowment of human resources.

Continuing an established research line (Pompili, 1990; Pompili, 1992; Pompili, 1996; Pompili, 1997), this paper examines the role of human capital in the spatial modes of Italy’s development process. We ask ourselves:

- whether over time spatial disparities in income and productivity do shrink;
- whether initially less productive/profitable areas do grow at a faster pace;
- whether the previous expectation does apply net of the effect of structural and/or institutional disparities;
- whether human capital composition is more relevant than its overall intensity to this purpose.

Firstly, unlike other recent studies (see section 2), this one defines human capital as measured not by schooling (degrees or years) but by professional skills, in agreement with Girardi and Putzu (1997)’s conclusions on post-school accumulation of human capital. Due to the data’s nature, this corresponds partly to an analysis of structural change (cfr. Paci and Pigliaru, 1997), but accounting separately for human capital.

Secondly, it explores the convergence hypothesis among Italian provinces in the period 1952-1991, estimating relative dynamics not only of per capita income (as in Cosci and Mattesini, 1995) but also of product per employee, where all data are measured relative to the national average.

Results presented here suggest that, unlike most studies on Italy, theoretical hypotheses on the convergence process and on the role of human capital supply as generator of spatial dynamics get support from the empirical analysis, provided human capital is not specified just as schooling: per capita incomes and products per employee can indeed converge even notwithstanding different structural conditions, but these influence the convergence process significantly.

The paper is structured as follows: after a synthetic review of the literature on the issues sketched above (section 2) and a presentation of data and methods (section 3), a regression analysis tests, employing the Italian urban system as an empirical case for the general conceptual issues, the hypothesis of absolute convergence in long run development of per capita income/product (section 4) and the hypothesis of conditional convergence by human capital endowment, as can be inferred from observed labour occupations in 1961, 1971, 1981 and 1991 (section 5).

2. HUMAN CAPITAL, PRODUCTION SYSTEM AND URBAN SYSTEM

Advanced industrialised societies such as European ones have come to a stage where long run dynamics of the economic system, at any geographical scale, depends on processes of creation and diffusion of knowledge, incorporated both in physical capital and in human capital. Over time, knowledge accumulation, quantitatively in the form of human capital within labour, especially its most skilled segments, plays an increasing role not just in absolute terms but also in relative ones (substitution of other labour); this accelerating knowledge creation implies cumulative learning processes within the economic system, and outward competitiveness.

Information, a pure public good in traditional economic models, hence “perfect”, is not equally accessible to everyone in practice and therefore involves acquisition costs (Stigler, 1961), at the very least in terms of time spent to search for it and to assimilate it within the framework of accumulated knowledge capital.

This conclusion is reinforced in so far as information is subject to obsolescence and depreciation and renews itself over time (for analogy, see Johansen, 1959; Massell, 1962): access to information, also in the form of the ability to create/elaborate it, is not just a barrier to entry but above all an insurance against exit from the market.

Indeed, a market for private activities specialised in searching, processing and transferring information relevant to production (Stigler, 1951) develops and takes on a fundamental role in the survival and development of firms in a context of increasing complexity (Castellano and Varchetta, 1986; Colemont et al., 1988) and therefore of areas where firms are located.

This development at the local level confirms the point of increasing needs of local knowledge capacity to keep access to information networks, which is an alternative explanation to the more common hypothesis of spatial diffusion. Precisely from the fact that knowledge is a private good we draw the explanation of the diversity of firms, cities and regions in terms of their occupational structure, hence of the spatial division of labour, and of development paths that is being historically observed.

Being also spurred by long-run supply-side developments such as the increase in schooling (Psacharopoulos, 1987) and the recent development of information technologies, these activities are embodied in specific occupations and industries, but also modify the content of material occupations (Cerruti and Rieser, 1989) and of each industry. In a sense, this is the occupational facet of a general process of tertiarisation, or rather of a more systematic integration between manufacturing and services (Bailly et al., 1987), which bears an even more prominent role in so far as the creation and re-generation of information does not depend only on information inputs from the system of material flows but also and increasingly on the internal evolution of the knowledge system itself.

With respect to the traditional priority concern of the human capital paradigm (Nber, 1962) i.e. the relationship between schooling and wages, the focus is rather on its intuition of the importance of cumulative learning processes for productivity; in fact, human capital is accumulated in general terms through socially provided education (Psacharopoulos, 1987) but above all in specific terms on-the-job, privately (Killingsworth, 1982). This accumulation results in higher productivity both in a quantitative and in a qualitative sense, which justifies higher rewards and consumption levels, and lower unemployment risks.

Another crucial element in the qualitative process of development is the rate of entrepreneurship (Casson, 1982): if it is scarce relative to other resources these would be forced to be partly unemployed, with obvious negative consequences on the prosperity of the areas involved and even risks of cumulative vicious circles, if out-migration is induced as an individual response.

The current production system of advanced industrialised societies can therefore be viewed, at its foundations, as a system of inter-linked professional skills, whereas the downstream manufacturing-cum-distribution side is to our purposes a “black box” out of which localised performances result.

The strategic, long-run importance of economic activities and skilled occupations related to knowledge and innovation for the development and prosperity of advanced urban areas has been highlighted by several studies (Aydalot and Camagni, 1986), but it really has relevance for all types of cities and regions (Marelli and Pompili, 1991).

Indeed, knowledge accumulation allows the connection of urban areas as nodes in networks, which we measure indirectly through performance as an indicator of competitiveness; human capital growth translates into continuous per capita income growth at the global scale and in most local areas. Knowledge accumulation in labour reproduction and augmentation is the pre-requisite for durable growth through innovation in activities, in synergies and in infrastructure, for staying successfully in the market.

Occupation, rather than industries, are the truly permanent economic base of cities and regions; thus, in dynamic terms the main form of competition is not on price, but on innovation: labour differentiation and quality matters, not labour costs,. Over time, different evolutions are shaped both by global trends (e.g. 1960s vs. 1980s) and by specific local features, so that neither inward cohesion nor inward disintegration appear as deterministic end-states: if national cohesion is deemed desirable, then policies are needed, aiming mainly at self-sustaining human capital development, not just through education institutions but mainly through the workplace.

In traditional theories of long run development, the model of long waves (Kondratev, 1935) induced by technological paradigms (Schumpeter, 1912) can be grafted on the stages model of production structure development (Clark, 1951) or on the dualist model (Lewis, 1954), as an alternative to non-structural (neoclassical or keynesian) growth models.

The assumptions of exogenous and shared preferences and technology holding, the neoclassical prediction is that thanks to the law of diminishing returns low-wage regions shall enjoy faster product growth (convergence), especially were they open (perfect capital mobility and at least imperfect labour mobility). Another strand foresees instead diverging productivity trends, due to cumulative processes (Young, 1928; Verdoorn, 1949), hence the persistence of historical dualism.

Finally, differential effects of migration balances call for a hypothesis: if flows compensate initial endowments in either an aggregately or an industrially differentiated way, then convergence will occur through either productive homogenisation or specialisation (respectively), but if all skilled labour flows address richer areas, then disparities shall grow.

Aiming at an endogenous explanation of the long run growth rate by endogenising technological progress, the new growth theory (starting with Abramovitz, 1986; Baumol, 1986; Romer, 1986; Lucas, 1988) assigns an important role to human capital endowment and accumulation in preventing absolute convergence at the international scale, in that, by warranting increasing or at least constant returns, it allows growth rate sustainability. This literature agrees on the following results (Barro and Sala-i-Martin, 1995):

- negative partial correlation between rates and initial per capita incomes (beta convergence), at the national level typically conditional on, among others, investment in fixed and human capital, at the regional level typically absolute, i.e. to a common long run income level;
- stable growth pace in space (2% a year: gaps halve in 35 years, i.e. eliminating income disparities is a slow process), which may be supported by different theoretical interpretations: e.g. decreasing marginal returns on inputs with about-constant scale returns, according to the neoclassical model, vs. macro-sectoral structural change;
- reduction over time of product per capita dispersion (sigma convergence), for Oecd countries, at both the international and the interregional scale, at least up to the second half of the 1970s.

In so far as the sigma convergence hypothesis holds, alternatives to the beta convergence approach have developed, in order to examine convergence clubs of structurally similar countries (Chatterji, 1992) or the mobility of areas within multimodal distributions of per capita income (Quah, 1996).

The Italian debate on growth, mostly analyses on regional data (Goria and Ichino, 1994; Mauro and Podrecca, 1994; Paci and Pigliaru, 1995; Paci and Pigliaru, 1997; Paci and Pigliaru, 1997; Coppola et al., 1997), hardly detects a correlation between growth rate and human capital endowment, with the one exception of Coppola et al. (1997), who substitute the convergence approach with a production function approach. Instead, infrastructure endowment is generally significant and so are, occasionally, migration flows (Goria and Ichino, 1994) and the macro-structure, in essentially dualist terms (Paci and Pigliaru, 1997).

The few analyses on provincial data (Cosci and Mattesini, 1995; Girardi and Putzu, 1997; Ferri and Mattesini, 1997; Fabiani and Pellegrini, 1997; Arrighetti and Seravalli, 1998; Dall'Aglio, 1998) confirm the above results, and like the previous ones employ education proxies for human capital; when reviewing the Italian literature, Girardi and Putzu (1997) do note critically this choice, which overlooks on-the-job learning, technical-pragmatic knowledge, entrepreneurship.

On the contrary we stress that, schooling level being an entry requirement to most professions, information on labour force professional skills embody also information on its schooling and therefore they are more appropriate as proxies for human capital.

3. METHODOLOGY

The hypotheses to be tested in this paper are the following:

- if the national context ensures enough institutional homogeneity, spatial differences in income and productivity shall tend to shrink over time;
- if production inputs are sufficiently mobile and/or knowledge accumulation and diffusion are dynamic processes and/or overall demand grows, *a fortiori* initially less productive/profitable areas shall grow at a faster pace;

- if on the contrary structural and/or institutional differences are significant and/or knowledge and innovations are relatively immobile, the previous forecast shall apply net of the effect of such disparities and/or within subgroups of homogeneous areas;
- if human capital can be accumulated in differentiated modes, human capital composition shall provide better explanations of economic performance than its overall intensity.

The move from theory to empirical test implies the specification of one or more equations, i.e. the choice of dependent and independent variables, and the indication of the expected sign of the influence of the latter on the former. Table 1 gives for each variable name, meaning, prevailing expected sign, and source.

The number of variables in the database is 368, of which 8 are dependent variables, and all the others are independent, i.e. explanatory. We classified the variables in two types, the former being defined by the variable's initial (Y) and referring to dependent variables and to 8 more playing an explanatory role (with negative expected sign), whereas the latter includes all other independent variables, with positive expected sign, except for agricultural occupations.

Dependent variables represent performance, whereas independents represent quantities; there are no variables representing prices, in that we postulate that variables point not so much to the short run demand-supply game but to structural (qualitative over and above quantitative) traits of supply.

The measuring unit is always quantitative, plurimodal and relative, and finally as often static (one year only) as dynamic (a time interval).

The time reference, as to the type and number of periods, of raw data is to five years (1951, 1961, 1971, 1981, and 1991), which, with one exception explained below, provide for ten-year intervals aligned to census years (1951, 1961, 1971, 1981 and 1991), allowing a greater number of explanatory variables; these data allow the construction of dynamic variables referring to four periods (1950s, 1960s, 1970s and 1980s) which can be defined as long-run ones.

The spatial reference, in terms of unit type, is the local labour market, the area within which by assumption proximity-related cumulative processes produce effects hence the area which reduces the risk of spatial autocorrelation; note that occupational changes are treated as wholly endogenous, under the assumption of no migration. The local labour market has been operationalised as the province (EU's Nuts3 level), in that we built the whole database on a provincial basis; in terms of unit number, it identifies a different number of observation in the various years and periods: 92 in 1951 and 1961 and 1950s and 1960s, 94 in 1971 and 1970s, 95 in 1981, 1991 and 1980s.

The whole area of reference, of course, is always Italy, which includes a full hierarchy of urban areas as well as an array of core (the North-Western "Industrial Triangle"), intermediate or peripheral (the North-East and Central "Third Italy"), and marginal (the Southern "Mezzogiorno") regions.

We computed disparities in per capita income/productivity levels as the ratio of the provincial value to the national average (made equal to 1); we computed dynamics as the ratio of the final to the initial level relative to the national dynamics (made equal to 1). This way of constructing the indicators exempted us from deflating raw data, under the assumption of nationwide markets, hence of local inflation rates equalised in the long run. The distribution of all these variables tends to be fairly close to the normal (asymmetry < 1.2, kurtosis < 1.3).

In the absence of official estimates, the source of raw data is Istituto Tagliacarne (Chambers of Commerce's research centre): in order to reduce the risk of instability typical of this source we substituted the yearly value of income levels with the three-year average (this is why the first observation is 1952), employing the most recent revision of estimates. We computed productivity per active with work experience, rather than per employee, because this was the format of data on professions: the seriousness of the distortion depends on the degree of dishomogeneity of the spatial distribution of the unemployed *stricto sensu* (formerly employed) relative to that of employees.

However, tests for absolute convergence do not allow to:

- identify the underlying economic mechanism (inputs' diminishing marginal returns or technology's spatial diffusion);
- evaluate the impact of structural change (dualism or stages-of-growth hypotheses) and of human capital accumulation.

Thus the opportunity appears to test convergence conditioning it to structural indicators, in our case occupational indicators as proxies of human capital; for the sake of clarity, given that ours is the first study to use these data, we concentrate on these, without mixing them with schooling proxies of human capital, also for the reasons cited at the end of section 2, or indicators of other structural traits.

We computed disparities in occupations as local specialisation indexes, relative both to population (for per capita income) and to active population with work experience (for average productivity), and to the national average (made equal to 1). The source of raw data is Istituto Nazionale di Statistica (population census). The distribution of most of these variables tends to be not too close to the normal (asymmetry > 1.7 , kurtosis > 4 in almost half of the variables, with 13 variables (4%) with asymmetry > 4.33 , kurtosis > 25.5).

Data refer to 40 aggregations of labour occupations, made comparable from 1951 to 1981 (see Table 1 for definitions); the 1991 occupational classification is in practice not comparable to previous one at this level of detail and at the provincial scale. Out of the 1951-1981 professions, thirteen are specialist or administrative professions, with longer schooling and greater human capital intensity: teachers, writers-journalists-artists, clergy, health professions, law professions, nature professions, technical and engineering professions, quantitative and economic professions, technical white-collar, entrepreneurs and managers, skilled white-collar, semi-skilled white-collar, military and police personnel.

We employed further aggregations to test the hypotheses of dualism and of the stages of growth: intellectual occupations (the first 13) and urban manual occupations (all the rest save 2) both grow in absolute terms from 1951 to 1991, while agricultural occupations decline.

Consequently, active population with work experience decline in the 1960s and grow afterwards both in absolute terms and relative to resident population, itself growing in the 1950s, 1960s and 1970s and stable in the 1980s (thus the activity rate falls in the 1950s as well). The weight of urban manual occupations tends to be stable relative to both resident population and active population with work experience, especially in the 1960s and 1970s; in both cases intellectual occupations grow and rural occupations decline.

A note of caution may be in order: the disaggregation level of empirical instances of occupations and of urban areas, while adequate to investigate the contribution to growth of specific human capital, may give rise to the problem of discontinuities in local specific know-hows, i.e. of being unable to disentangle the effects of human capital from those of industrial specialisation.

We chose as statistical method classical ordinary least squares regression (Spss software). When testing conditional convergence, in order to identify the most effective set of growth determinants, we employed the stepwise procedure as a caution against multi-collinearity, under the unpalatable trade-off between estimate bias and inefficiency. As for heteroskedasticity, to which cross-section analyses are particularly subject, fixed-effects models, such as absolute convergence and dummy ones, seem to accept Ols with no particular caution (Hsiao, 1986); the use of relative data should also partially alleviate the problem.

4. ABSOLUTE CONVERGENCE

Firstly we evaluate sigma convergence for per capita income and productivity, then we control for the existence of convergence clubs, and finally we test the hypothesis of absolute beta convergence.

Starting from sigma convergence, computed as the ratio of standard deviation to the average of provincial levels of income and productivity, between 1952 and 1991 (Table 2) a L-shaped pattern signals a strong reduction of disparities among provincial per capita incomes in the 1950s and above all the 1960s, further but very slow reduction in the 1970s and 1980s.

The same table signals the same trends for product per employee, the turning point being put forward to 1981 so that convergence is still lively in the 1970s, and smaller disparities than for per capita income, which sums the dispersions of both product per employee and activity rate.

Activity rates are highly and increasingly homogenous in 1951, 1961 and 1971, but decreasingly so in 1981 and 1991, years in which they show greater spatial disparities than productivity. This variable seems to have greater interpretive value than territorial dummies (e.g. North-South) or subsamples, both devices employed in other studies (Cosci and Mattesini, 1995; Ferri and Mattesini, 1997).

Faster convergence in the 1960s is implied also by greater provincial variability of the rates of change of both performance indicators in that decade; on the contrary, variability is at its lowest in the 1980. The coherence of trends of both activity rates and of the two performance indicators with known trends of migration flows looks like supporting the marginalist interpretation in its traditional form, without human capital (unlike Goria and Ichino, 1994).

Analysing distribution by provinces, albeit without using transition matrices (vs Quah, 1996; Fabiani and Pellegrini, 1997; Dall'Aglio, 1998), over time, an increasing number of intermediate urban areas managed to

position themselves above the national level of per capita income, where they joined the core areas. However, at the same time the marginal areas' effort to close productivity gaps was apparently paid for with an increase of activity rate gaps: growth occurred by rationalisation rather than by development.

In fact, per capita incomes show a growing bimodality from 1971 to 1991, diverging due to the increase in the advanced provinces mode, a bimodality which was absent in 1952 and 1963. On the other hand, the initially majority group of weak provinces shrinks to minority until convergence works strongly (1971), to stabilise afterwards.

Productivity per employee, instead, does not warrant this hypothesis; from 1952 to 1981 the mode moves from below to above average values, bringing with it the whole distribution, which becomes increasingly concentrated: thus the convergence process operated in productivity for almost all our study period.

At this stage, we should try to identify possible convergence clubs, which we do with a methodology akin to Chatterji's (1992); the equation is:

$$Y_1 = \sum a_i Y_0^i \quad i = 1, 2, 3$$

In all four decades, both for income per capita and for productivity per active, even when the statistical possibility of two convergence clubs exists, as a matter of fact all Italian provinces belong to one club; the only exception concerns very few very poor provinces in 1951. However, provinces do not converge to the leading province: stable equilibria are near the national average for productivity (0,91-1,07), while they are above it for income (1,01-1,22): again the effect of activity rates?

Interestingly, correlations within income levels and within productivity levels are very high between all reference years, highlighting that the relative positions of urban areas within the urban system have not changed dramatically during the last 50 years (the lowest correlation is between 1952 and 1981). However, the correlation between income and productivity declines continuously over time, confirming the growing importance of activity rates.

In dynamic terms, correlations between decades are not significant (except for income between 1960s and 1970s), signalling that dynamic patterns differed in the four decades; besides, correlations between dynamics and initial level are always significant, yet sufficiently high only in the 1960s and, for productivity, 1970s, being signs of weaker and weaker convergence.

Beta convergence, the inverse relationship between initial level and subsequent dynamics of income and productivity (per capita and relative to the national average) is a necessary, although not sufficient (Galton's fallacy) condition for sigma convergence; the relevant equation is:

$$YD = a + bY \quad b < 0$$

Income regressions (Table 3) are always significant and with the expected negative sign, but show a lower convergence speed than the usual 2% yearly (6-13% over ten years) between 1952 and 1991 and, moreover, poor explanatory power, much poorer than in other studies (Fabiani and Pellegrini, 1997); the 1960s are the exception, with a convergence rate almost double than usual and with half the variance explained (supporting Cosci and Mattesini's (1995) findings). In the 1950s and 1970s initially weaker provinces behave in a sharply dichotomic way.

On the contrary, over the same years productivity regressions show a faster convergence speed (5% yearly in the 1960s and 1970s, 1.5% yearly in the 1950s and 1980s) and a better explanatory power; the gap is clearest in the 1970s, but minimal in the 1950s and 1980s. Both equations for the 1980s provide very poor results in terms of explanatory power, as in Cosci and Mattesini (1995) and in Girardi and Putzu (1997), but parameters are significant (unlike Cosci and Mattesini, 1995).

As a matter of fact, per capita income behaviour may depend both on the activity rate and on productivity per employee. Indeed, the level of per capita income is significantly related to the activity rate and the parameter value, greater than unity, suggests that provinces with higher activity rates are also those with greater productivity, thanks to likely effects of "industrial atmosphere". Over time this linkage increases its explanatory power and the parameter grows, suggesting increasing disparities in these effects (Table 4).

However, when related to both its determinants (initial levels of productivity per employee and of the activity rate), per capita income dynamics, while failing only in the 1950s to receive a significant influence from the latter, gets a parameter with the positive expected sign only for the 1970s, when large and significant influences with contrasting signs occur, similar to the catch-up discussed elsewhere (Coppola et al., 1997). In the 1980s the activity rate is just above the significant threshold and makes productivity not significant.

5. CONDITIONAL CONVERGENCE

First we evaluate convergence among local occupational structures, then we test the hypothesis of beta convergence conditional on the occupational structure, and finally we evaluate occupations as inputs for product/income.

Whether the occupational structure converges over time can be tested by an analysis of sigma convergence (Table 2). Above we wrote about low provincial disparities and doubtful convergence of activity rates; both hide much wider disparities in the three types of professions, disparities similar or even greater than those of income or productivity, and two distinct processes: divergence of manual rural professions and convergence of urban manual and intellectual professions (comparable data stop with 1981).

In greater detail, least and most diffused professions are respectively linked to raw-material-based production (agricultural labourers, fishermen, miners, metalworkers, textile workers e leather workers) and to services (teachers, health professions, electricians and gas and water workers, shopkeepers, rail and road drivers, hairdressers-cleaners, servants-wardens).

Measured relative to resident population (for comparisons with per capita income), between 1951 and 1981 occupations converge, save possibly for the 1950s: migration flows do not hinder greater functional homogeneity; exceptions tend to be manual skills in traditional manufacturing, indicating concentration in specialised districts.

Measured relative to active population with work experience (for comparisons with per capita productivity), occupations confirm the above trends, except for some divergence also in the 1960s and for teachers and clergy.

The joint contribution of occupations and the initial levels of per capita income/product to per capita income/product dynamic (Tables 5a, 6 and 7) is the object of conditional beta convergence analysis, i.e. holding some specific traits of local economies constant: steady-state income and productivity shall not be the same for all areas.

The tripartition among rural manual, urban manual and urban intellectual occupations allows to identify the stage-of-growth hypothesis (three significant parameters with increasing values), the urban-rural dualist hypothesis (identical parameters for the last two groups) and the hypothesis of distinction between labour and human capital proper (identical parameters for the last two groups). We tested the following equation:

$$YD = a + bY + \sum c_i A_i \quad b < 0 \quad i = 1, 2, 3$$

Relative to the absolute convergence hypothesis explanatory power improves, especially in the 1970s but not at all in the 1950s; besides, the significance of structural variables is incoherent (as in Cosci and Mattesini (1995), among others), especially in interpretive terms.

In fact, as far as income per capita is concerned, convergence speed increases in all decades, even though in the 1950s and 1980s it is still below the usual 2% a year; urban intellectual professions are almost always significant, but not in the 1960s, and in 1970s their parameter is lower than for urban manual ones: intense convergence seems to be related to the latter rather than to the former.

The same goes for product per active (where the only improvement is in the 1980s), where again intellectual professions contribute significantly more than urban manual ones only in the 1950s and 1980s, while the role of rural manual professions is ambiguous, as they are significant and with the expected negative sign only in the 1960s.

Summing up, stages-of-growth theory has to be rejected, dualist theory holds only for productivity in the 1960s, whereas (traditional) human capital theory takes credit for the 1950s and 1980s; however, surprisingly, urban manual professions play a greater role than intellectual ones in income dynamics both in the 1960s and in the 1970s.

We can further test the hypothesis of distinguishing between labour and human capital (stricto sensu) by disaggregating intellectual (specialist) professions in order to determine which ones most contribute to performance, over and above the contribution of the two other types of labour, separated because of their well-known different productivity. The (stepwise) estimated equation is:

$$YD = a + bY + \sum d_i H_i + c_2 A_2 + c_3 A_3 \quad b < 0 \quad i = 1, \dots, 10$$

On the whole, compared with the use of tripartite measures of human capital, results show a further but partial statistical improvement, both for income (1950s and 1960s) and for productivity (1950s); the gain of

explanatory power is greatest for income in the 1950s, but the same income shows the worst loss in the 1970s. Besides, no intellectual profession durably plays a significant role, indeed, in some cases the significant parameter bears the wrong (negative) sign; finally, professions that are significant for income differ from those significant for productivity.

This result, together with the emerging role of urban manual professions, suggest a broader view of human capital, like the one supported in this paper; therefore, employing all the 40 professions we estimate (stepwise) the following equation:

$$YD = a + bY + \sum d_i H_i \quad b < 0 \quad i = 1, \dots, 40$$

The gain in explanatory power is always significant: it is remarkable for both dependent variables in the 1950s and 1980s, and maximum for income per capita in the 1970s; it is lower for income in the 1960s and productivity in the 1970s, and minimum but still significant for productivity in the 1960s, the case best explained in terms of absolute beta convergence.

Again, though just one third of professions never play a significant role, none durably plays a significant role; when the role is significant, parameter signs are almost always positive for intellectual professions (but not for technical white-collars), for micro-entrepreneurship (small farmers and shopkeepers, not entrepreneurs and managers) and for infrastructural manual professions (construction and energy-gas-water); on the contrary, parameter signs are negative for rural, manufacturing, and service professions; thus, even manual professions count in diversifying steady-state incomes and productivity.

The analysis of the contribution of occupations alone to per capita income/product (Tables 5b and 8) means substituting the convergence logic with a production function logic (level explained by levels, dynamics by dynamics). The implicit assumption is that other inputs (fixed capital, infrastructure, technological knowledge, and so on, always per capita) are in the constant term, i.e. spatial differences do not exist for them or are the same as a linear combination of included inputs, which should have all positive signs. The relevant equation is:

$$Y = a + \sum c_i A_i \quad c > 0 \quad i = 1, 2, 3$$

or alternatively (estimating stepwise):

$$Y = a + \sum d_i H_i \quad d > 0 \quad i = 1, \dots, 40$$

As for the first specification, which already enjoys a remarkable explanatory power, we notice in income equations a scale effect from increasing returns (sum of parameters greater than unity), at its starkest in 1952 and 1961 and much weaker in 1971 and 1981, which however does not harm convergence in the 1950s and 1960s. Moreover, we observe an unexpected reversal of returns in favour of urban manual occupations and against intellectual occupations, save for 1961.

However, in productivity equations intellectual professions contribute significantly more than urban manual ones (save for 1981), hardly a result compatible with the previous one; yet, together with the negative impact of agricultural occupations on productivity, it supports stages-of-growth theory rather than the dualist hypothesis (as in Cosci and Mattesini (1995) and unlike Paci and Pigliaru (1997)).

When we employ all 40 professions, we obtain excellent results from a statistical viewpoint, with great gains in explanatory power compared to the previous specification, except for income per capita in 1981. Over time, the number of significant professions decreases, while the size of their contribution (the value of their parameter) is largest most often in 1961 and almost never in 1981: if the returns to human capital do not increase over time, we cannot explain the weak convergence of the 1980s in this way (vs Coppola et al., 1997).

A durably positive contribution is supplied by professions as diverse as engineers and other technical-scientific specialists (only 1961 and 1971), shopkeepers, chemical workers (save for 1981), non-metallic minerals workers (only 1971 and 1981); on the other side, the contribution of teachers is durably negative. Only 8 professions out of 40 never play a significant role: among these entrepreneurs and managers, mechanical-engineering workers and transport workers stand out. Thus, the theoretical expectations of simpler models do not seem to be fulfilled.

A note is due here on alternative explanations of relative income dynamics: first of all, the age and sex structure of labour, as opposed to its occupation structure, may have had an impact, in so far as better educated, hence better paid younger generations entered the local labour markets at different pace. However, the marginal macro-region, which is typically richer of youth age cohorts, experienced in the 1960s high migration towards the core and in the 1970s and 1980s very high youth unemployment, both phenomena effectively sterilising the age cohort effect.

As for the sex structure, its effect is at best ambiguous: as women's propensity to work declined well into the mid-1970s, especially in rural areas like the marginal ones, and climbed up since then, especially in advantage areas like the core ones, a convergence of incomes should have been observed throughout the period (which is not the case), given the lower pay earned by women in practice. However, this effect might be counter-balanced by the absolute change in the wage fund produced by a net change in employment.

A second alternative explanation focuses directly on rewards, in institutional terms: 1972 marked the final phasing-out of geographically different contractual wages in Italy, and this might explain convergence in the 1960s and the lack of it afterwards; however, the widespread (in the North) practice of company-level contracts means spatial wage differentials would persist even after 1972.

6. CONCLUSIONS

Although a complex picture shows up in the real world and raises important interpretive points, the general conceptual hypotheses put forward both on the direction of the convergence process and on the role of human capital as a non-price-centred supply dynamics generator of urban and regional performance are supported by the specific empirical analysis of the Italian case; this allows to extrapolate spatially more general conclusions, since Italy includes cities and regions spanning the whole range of development stages in Europe.

A first group of conclusions drawn from this paper refers to the result that, coherently with international literature, the convergence process is a pervasive reality:

- spatial dispersion of per capita incomes and per active products declines (sigma convergence) in each of the four decades, not just over the whole 1951-1991 period;
- less productive provinces enjoy faster growth (absolute beta convergence) in each of the four decades, not just over the whole 1951-1991 period;
- however, convergence may be faster (1960s and 1970s) or slower (1950s and 1980s) than the yearly 2% observed over the very long run, and may occur through spatial patterns that are very unstable from decade to decade; scale effects, though present, do not seem to have a crucial role, as a matter of fact there seems to be just one convergence club in Italy;
- even when convergence is faster, gaps halve in at least 15 years, and reduce to a quarter (ie to a level comparable to other advanced countries) in at least 30 years;
- convergence is less apparent in per capita incomes, despite wider disparities, because of the evolution of activity rates: it is much clearer and stronger in products per active (in the Italian case, *a fortiori* had we computed products per employee); thus, our distinction between income per capita and product per active proves to be useful;
- the stop to long distance spatial mobility of labour in the 1970s forced on the marginal region a trade-off between productivity and activity: the ensuing divergence in activity rates produces a slowdown in convergence processes as measured in per capita incomes: thus, spatial dualism shows up mainly in activity rates;
- as for public policy implications, spatial mobility of inputs, knowledge learning and spatial diffusion and global demand dynamics did and do favour, if warranted, a "natural" (market) process of reduction in spatial disparities, to which policies may contribute, if at all, in terms a speeding it up.

A second group of conclusions drawn from this paper refers to the result that with respect to the convergence process human capital, when appropriately specified, has greater explanatory power than alternative hypotheses put forward by recent studies:

- structural disparities, particularly in activity rates (also disaggregated by labour type), are significant in explaining the incompleteness of convergence (conditional beta convergence) and are more appropriate than *ad hoc* dummies;
- while the functional dualism hypothesis fails to get any support, income and product levels may support the stages-of-growth hypothesis and their dynamics may support the human capital (proper) hypothesis; however, the broader human capital hypothesis dominates all the above: this also implies that schooling proves to be less useful than professions;
- when human capital is meant as labour force professions, disaggregated in its detailed composition, and broadened beyond specialist intellectual professions, it has a much greater statistical explanatory power than more aggregate or selective measures, even though its interpretive power of the significance of

specific professions is not fully satisfying: the starkest example is the lack of a significant role for entrepreneurs and managers;

- in particular, the often significant role of urban manual professions suggests an hypothesis on the ways in which intellectual professions influence development: professions being rather interdependent than independent, intellectual professions play an indirect role in the productivity of urban manual professions, also modifying their information content (input complementarity);
- in any case, relative dynamics is not fully explained by initial levels and by professions: especially in the 1950s and 1980s there is room for complementary explanatory hypotheses (eg structural changes in the manufacturing-distribution “black box” cited in section 2); however, in a production function logic, professions appear a largely self-sufficient explanatory hypothesis;
- local professional structures tend to converge (with or without intense migration), save districts specialised in traditional manufacturing industries: by making provinces more homogeneous, this trend makes absolute convergence processes more likely, all the more so since spatially concentrated professions do not play a greater role than spatially diffused ones: looking at it in perspective, there might be just one way to development;
- in public policy terms, therefore, policies that extend schooling or support specific professions are not sufficient by themselves to ensure development: more promising policies are those favouring on one side the exchange of knowledge and experience between school and labour and on the other side the interdependence between intellectual and manual professions, both within and between firms.

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Table 1. Variables

symbol	s. definition
YP52	- relative provincial per capita income (Italy=1) in 1952
YP61	- relative provincial per capita income (Italy=1) in 1961
YP71	- relative provincial per capita income (Italy=1) in 1971
YP81	- relative provincial per capita income (Italy=1) in 1981
YP91	- relative provincial per capita income (Italy=1) in 1991
YPCD50	relative provincial dynamics of YP (Italy=1) from 1952 to 1961
YPCD60	relative provincial dynamics of YP (Italy=1) from 1961 to 1971
YPCD70	relative provincial dynamics of YP (Italy=1) from 1971 to 1981
YPCD80	relative provincial dynamics of YP (Italy=1) from 1981 to 1991
YA52	- relative provincial productivity per active (Italy=1) in 1952
YA61	- relative provincial productivity per active (Italy=1) in 1961
YA71	- relative provincial productivity per active (Italy=1) in 1971
YA81	- relative provincial productivity per active (Italy=1) in 1981
YA91	- relative provincial productivity per active (Italy=1) in 1991
YPAD50	relative provincial dynamics of YA (Italy=1) from 1952 to 1961
YPAD60	relative provincial dynamics of YA (Italy=1) from 1961 to 1971
YPAD70	relative provincial dynamics of YA (Italy=1) from 1971 to 1981
YPAD80	relative provincial dynamics of YA (Italy=1) from 1981 to 1991
ATTICP	relative provincial active population with work experience/ resident population (Italy=1)
ATINUR	+ relative provincial intellectual occupation (sum of 13 professions) / resident population (Italy=1)
ATMAUR	+ relative provincial urban manual occupation (sum of 24 professions)/ resident population (Italy=1)
ATMARU	relative provincial rural manual occupation (sum of 3 professions)/ resident population (Italy=1)
SINSEG	+ relative provincial teachers and lecturers / resident population (Italy=1)
SGIOAR	+ relative provincial writers journalists artists / resident population (Italy=1)
SCLERO	+ relative provincial clergy / resident population (Italy=1)
SSANIT	+ relative provincial doctors chemists osteetricians nurses health technicians / resident population (Italy=1)
SSGIURI	+ relative provincial magistrates lawyers notaries / resident population (Italy=1)
SNATUR	+ relative provincial agronomists veterinaries biologists / resident population (Italy=1)
STECNI	+ relative provincial physicists chemists engineers geometri periti industriali / resident population (Italy=1)
SMATEC	+ relative provincial mathematicians statisticians economists accountants / resident population (Italy=1)
IMPTEC	+ relative provincial technical white-collars / resident population (Italy=1)
IMPDIR	+ relative provincial entrepreneurs and managers / resident population (Italy=1)
IMPCON	relative provincial skilled administrative white-collars / resident population (Italy=1)
IMPESE	relative provincial semi-skilled administrative white-collars / resident population (Italy=1)
IMPSIC	relative provincial military policemen / resident population (Italy=1)
AZAGRI	relative provincial farmers / resident population (Italy=1)
LAGRIC	- relative provincial farm labourers farming machinery drivers shepherds / resident population (Italy=1)
LAPECA	- relative provincial fishermen and hunters / resident population (Italy=1)
MINATO	- sondatori perforatori e minatori / residenti provinciali relativi (Italia=1)
LIFOLA	fonditori e laminatori / residenti provinciali relativi (Italia=1)
ARTMET	+ fabbriferrai tornitori incisori orafi e argentieri / residenti provinciali relativi (Italia=1)
LIMECC	+ meccanici montatori riparatori e di precisione / residenti provinciali relativi (Italia=1)
LICASA	carpentieri in ferro e saldatori / residenti provinciali relativi (Italia=1)
LIMINM	frantumatori cementieri e operai addetti alla lavorazione dei minerali non metalliferi / residenti provinciali relativi (Italia=1)
LIALIT	panettieri pastai dolciari macellatori casari e vinificatori (+) / residenti provinciali relativi (Italia=1)
LITESS	filatori tessitori e tintori / residenti provinciali relativi (Italia=1)
LIABBI	maglieristi sarti cappellai e tappezzieri / residenti provinciali relativi (Italia=1)
LICUPE	conciatori calzolai e pellettieri / residenti provinciali relativi (Italia=1)
LILEMO	segatori tornitori falegnami e mobiliari / residenti provinciali relativi (Italia=1)
LICHIM	analizzatori petrolieri gommari e profumisti / residenti provinciali relativi (Italia=1)
LICAST	cartai cartotecnici tipografi legatori e fotografi / residenti provinciali relativi (Italia=1)
LIVEIM	verificatori e imballatori / residenti provinciali relativi (Italia=1)
COSTRU	capimastri muratori decoratori e conduttori di macchine edili / residenti provinciali relativi (Italia=1)
ENELGA	elettricisti elettrotecnici radiotecnici gasisti idraulici e termoidraulici /
AZCOMM	+ relative provincial shopkeepers / resident population (Italy=1)
LCOMME	relative provincial shop assistants travelling salesmen trade representatives / resident population (Italy=1)
ALBEPE	relative provincial hotel and bar managers porters chefs waiters barmen cinema and theatre managers / resident population (Italy=1)
LSTGUI	relative provincial railway drivers tram drivers lorry and car drivers / resident population (Italy=1)
LSTRAS	relative provincial transport workers (others) / resident population (Italy=1)
LSPAPU	relative provincial barbers hairdressers clothing street and office cleaners / resident population (Italy=1)
LSDOPO	relative provincial servants doorkeepers wardens / resident population (Italy=1)
LSERVI	relative provincial people in services or professions n.e.c. / resident population (Italy=1)

Notes: the last 43 variables are relative to residents or to active with work experience

Sources: Istituto Tagliacarne, I conti economici provinciali (YP)

Istat, Censimenti della Popolazione e delle Abitazioni (absolute census variables)

Our elaboration (other Y variables and relative census variables)

Table 2. Sigma convergence (st.dev./average)

	1952	1961	1971	1981	1991		1951	1961	1971	1981
observations	92	92	94	95	95		92	92	94	95
YP	0,392	0,350	0,246	0,241	0,237	resident population				
YA	0,346	0,307	0,199	0,135	0,131	ATINUR	0,452	0,337	0,277	0,226
ATTICP	0,127	0,123	0,115	0,150	0,154	ATMAUR	0,353	0,270	0,219	0,235
						ATMARU	0,412	0,484	0,550	0,565
	1950s	1960s	1970s	1980s		active population				
	92	92	94	95		ATINUR	0,440	0,326	0,248	0,164
YPCD	0,098	0,151	0,114	0,061		ATMAUR	0,318	0,224	0,151	0,116
YPAD	0,105	0,165	0,115	0,060		ATMARU	0,371	0,446	0,548	0,619

Note: the greater number of provinces increases the indicator of not more than 0,002w.r.t. a constant number of provinces

Table 3. Absolute beta convergence (regressions)

Dependent	YPCD50	YPCD60	YPCD70	YPCD80	YPAD50	YPAD60	YPAD70	YPAD80	YPCD50	YPCD60	YPCD70	YPCD80
Constant	1,082	1,442	1,155	1,057	1,124	1,576	1,509	1,149	1,113	1,705	0,910	1,105
t	41,55	38,77	23,63	40,07	33,27	38,35	37,18	26,23	14,08	16,47	10,55	21,89
YP	-0,101	-0,373	-0,124	-0,058								
t	3,87	9,62	2,52	2,21								
YA					-0,145	-0,520	-0,489	-0,154	-0,117	-0,415	-0,349	-0,021
t					4,66	11,82	11,68	3,46	3,91	9,33	7,07	0,37
ATTICP									-0,017	-0,229	0,455	-0,085
t									0,22	2,33	5,60	1,74
R2	0,142	0,352	0,064	0,050	0,194	0,608	0,597	0,114	0,148	0,524	0,429	0,055
adjust-R2	0,133	0,502	0,054	0,040	0,185	0,604	0,593	0,104	0,129	0,514	0,416	0,034
F	15,0	92,6	6,3	4,9	21,7	139,7	136,5	11,9	7,7	49,1	34,2	2,7
degrees fr.	90	90	92	93	90	90	92	93	89	89	91	92
n.observ.	92	92	94	95	92	92	94	95	92	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
estimate method: Ols
significance levels: =1% *=10% **=n.s.

Table 4. Growth accounting (regressions)

Dependent	YP52	YP61	YP71	YP81	YP52	YP63	YP72	YP81	YP52	YP63	YP72	YP81
Constant	-0,058	-0,059	-0,101	-0,503	-0,188	-0,223	-0,284	-0,437	-0,986	-0,907	-0,915	-0,910
t	1,39	1,45	1,79	5,15	0,67	0,91	1,64	5,95	30,39	32,31	37,48	78,56
YA	1,078	1,081	1,117	1,528					1,054	1,039	1,008	0,932
t	25,77	24,95	19,15	15,37					85,41	86,18	72,16	73,06
ATTICP					1,105	1,118	1,239	1,421	0,940	0,876	0,913	0,987
t					4,01	4,63	7,24	19,57	30,81	32,95	39,72	88,08
R2	0,881	0,874	0,799	0,718	0,151	0,192	0,363	0,805	0,990	0,990	0,989	0,997
adjust-R2	0,879	0,872	0,797	0,715	0,142	0,183	0,356	0,803	0,990	0,990	0,989	0,997
F	664,2	622,7	366,7	236,3	16,1	21,4	52,5	383,1	4306,1	4607,7	4114,3	13850,7
degrees fr.	90	90	92	93	90	90	92	93	89	89	91	92
n.observ.	92	92	94	95	92	92	94	95	92	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
estimate method: Ols
significance levels: =1% *=10% **=n.s.

Table 5. Stages-of-growth, dualism, human capital proper (regressions)

Dependent	YPCD50	YPCD60	YPCD70	YPCD80	YPAD50	YPAD60	YPAD70	YPAD80
Constant	0,974	1,339	0,658	1,025	1,020	1,791	1,625	0,920
t	12,44	13,14	8,25	19,60	9,35	16,24	17,23	10,82
YP	-0,169	-0,524	-0,537	-0,149				
t	2,84	6,74	7,20	2,04				
YA					-0,188	-0,653	-0,530	-0,133
t					3,02	8,18	7,80	2,11
ATINUR	0,090	-0,014	0,176	0,167	0,101	0,007	-0,047	0,191
t	1,82	0,17	2,75	3,01	1,92	0,09	0,79	4,20
ATMAUR	0,037	0,265	0,627	-0,027				
t	0,57	3,35	8,97	0,46				
ATMARU	0,052	-0,001	0,099	-0,002	0,051	-0,087	-0,028	0,027
t	1,52	0,27	5,09	0,17	1,03	2,20	1,36	2,37
R2	0,180	0,581	0,524	0,192	0,226	0,634	0,606	0,261
adjust-R2	0,143	0,561	0,503	0,156	0,200	0,622	0,592	0,236
F	4,8	30,1	24,5	5,3	8,6	50,8	46,0	10,7
degrees fr.	87	87	89	90	88	88	90	91
n.observ.	92	92	94	95	92	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
estimate method: Ols
significance levels: =1% *=10% **=n.s.

Dependent	YP52	YP61	YP71	YP81	YA52	YA61	YA71	YA81
Constant	-0,349	-0,419	-0,049	-0,223	1,047	0,623	0,931	1,107
t	2,59	3,17	0,44	3,12	7,02	4,77	8,62	13,64
ATINUR	0,507	0,753	0,477	0,493	0,343	0,540	0,241	0,026
t	7,19	9,34	6,33	8,12	4,16	5,98	2,73	0,34
ATMAUR	0,669	0,534	0,577	0,697				
t	7,28	5,79	7,42	15,16				
ATMARU	0,191	0,129	0,019	-0,045	-0,378	-0,171	-0,151	-0,123
t	3,29	3,05	0,70	2,67	5,08	3,48	5,43	8,63
R2	0,811	0,782	0,770	0,888	0,754	0,710	0,620	0,571
adjust-R2	0,804	0,775	0,762	0,884	0,749	0,704	0,612	0,561
F	125,6	105,5	100,2	240,4	136,6	109,2	74,3	61,2
degrees fr.	88	88	90	91	89	89	91	92
n.observ.	92	92	94	95	92	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
estimate method: Ols
significance levels: =1% *=10% **=n.s.

Table 6. Conditional beta convergence (regressions)

Dependent	YPCD50	YPCD60	YPCD70	YPCD80	YPAD50	YPAD60	YPAD70	YPAD80
Constant	1,186	1,690	0,875	1,027	1,138	1,606	1,465	1,194
t	24,44	28,49	7,55	38,95	29,98	38,23	36,06	15,53
YP or YA	-0,148	-0,636	-0,246	-0,138	-0,247	-0,676	-0,509	-0,175
t	2,64	7,80	4,10	4,10	5,32	8,64	12,68	2,73
SINSEG			0,175					-0,068
t			2,22					1,89
SGIOAR	0,078							
t	3,48							
SCLERO			0,088				0,059	
t			3,86				3,35	
SSANIT				0,112				
t				3,51				
SGIURI	-0,117	-0,197						0,088
t	3,40	5,43						4,05
SNATUR			0,027		0,024			
t			1,93		1,76			
STECNI		0,120				0,133		
t		2,31				2,38		
SMATEC		0,071			0,075			-0,077
t		1,79			3,12			2,42
IMPTEC	-0,051							0,043
t	2,46							2,38
IMPDIR	0,038		0,093					
t	2,90		2,94					
R2	0,384	0,642	0,432	0,162	0,300	0,632	0,642	0,279
adjust-R2	0,349	0,625	0,400	0,144	0,276	0,623	0,634	0,239
F	10,7	39,0	13,4	8,9	12,6	76,3	81,5	6,9
degrees fr.	86	87	88	92	88	89	91	89
n.observ.	92	92	94	95	92	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
estimate method: Ols (YP or YA), then stepwise (Pin<0,099 Pout>0,10)
significance levels: =1% *=10% **=n.s.

Tavola 7. Conditional beta convergence (regressions)

Dependent	YPCD50	YPCD60	YPCD70	YPCD80	YPAD50	YPAD60	YPAD70	YPAD80
Constant	1,010	1,480	0,876	1,143	1,100	1,451	1,528	1,210
t	27,55	18,18	9,48	29,98	27,16	23,10	19,35	26,32
YP or YA	-0,123	-0,521	-0,392	-0,092	-0,177	-0,570	-0,511	-0,113
t	2,34	7,39	6,22	2,07	2,67	10,90	8,85	2,29
SINSEG			0,122					
t			1,95					
SCLERO			0,048					
t			2,60					
SSANIT				0,119				0,143
t				4,38				4,68
SGIURI		-0,156						
t		4,44						
SNATUR					0,029			
t					2,23			
SMATEC		0,081			0,060			
t		2,22			2,59			
IMPTEC	-0,081				-0,071			
t	4,04				2,82			
IMPDIR	0,032							
t	2,69							
IMPSIC							-0,027	0,025
t							1,78	2,37
AZAGRI			0,038				0,020	
t			3,92				1,68	
LAGRIC	-0,010			-0,017			-0,018	
t	2,05			3,15			2,02	
MINATO				-0,009	-0,013		-0,009	-0,007
t				2,39	2,60		2,45	2,43
LIMECC							-0,073	
t							2,43	
LICASA		0,048				0,069		
t		2,94				4,03		
LIMINM				-0,018				-0,024
t				4,03				5,18
LIABBI			0,083					
t			6,28					
LICUPE			0,009	-0,010				-0,010
t			1,87	4,43				4,31
LILEMO				-0,014				-0,030
t				1,78				3,63
LICHIM				-0,049				-0,051
t				4,58				5,13
LIVEIM	0,042			0,027				0,037
t	3,02			2,43				3,42
COSTRU		0,114				0,102		
t		3,26				3,42		Isdopo
ENELGA			0,160				0,147	-0,080
t			3,52				2,97	2,85
AZCOMM	0,120							
t	2,50							
LCOMME			0,071					-0,040
t			2,62					2,01
LSTGUI				-0,070				-0,061
t				2,16				2,04
LSERVI					0,058		-0,044	
t					3,09		2,57	
R2	0,460	0,684	0,693	0,557	0,411	0,694	0,758	0,621
adjust-R2	0,422	0,666	0,665	0,504	0,370	0,684	0,735	0,565
F	12,1	37,3	24,0	10,6	9,9	66,6	33,2	11,2
degrees fr.	85	86	85	84	85	88	85	82
n.observ.	92	92	94	95	92	92	94	95

Notes:

independents refer to the year corresponding to the beginning of the reference period for Y

estimate method: Ols (YP or YA), then stepwise (Pin<0,099 Pout>0,10)

significance levels: =1% *=10% **=n.s.

for YPCD80, Smatec and Impcon significant at 10% make not significant YP81

Table 8. Production function approach (regressions)

Dependent	YP52	YP61	YP71	YP81	YA52	YA61	YA71	YA81
Constant	-0,054	-0,784	0,599	0,160	0,296	0,418	0,438	0,543
t	0,64	6,55	5,52	4,32	6,99	5,18	4,99	6,89
SINSEG		-0,219	-0,274			-0,161	-0,239	-0,130
t		3,19	4,05			2,92	4,43	3,74
SGIOAR					-0,061		-0,065	
t					1,84		2,50	
SSANIT				-0,112			0,107	
t				2,56			2,81	
SGIURI		-0,206	-0,098					
t		4,53	3,06					
SNATUR						0,026		
t						1,83		
STECNI		0,422	0,144			0,287	0,246	
t		6,40	3,11			4,81	6,09	
SMATEC					0,123			
t					2,69			
IMPTEC	0,093				0,145			
t	2,95				4,33			
IMPCON	0,318	0,139	0,178		0,217			
t	5,95	1,99	4,06		2,79			
IMPESE				0,291		0,187		0,289
t				8,19		3,39		6,83
IMPSIC			0,043				0,106	
t			2,14				5,24	
AZAGRI	0,166							
t	5,08							
LAGRIC	0,023				0,017	0,008		-0,012
t	3,73				3,11	2,16		1,83
MINATO	0,025				0,010			
t	3,59				1,74			
LIFOLA	0,047				0,034			
t	4,96				2,94			
ARTMET				0,059				
t				3,96				
LICASA		-0,097			-0,119	-0,065		
t		4,96			3,72	3,57		
LIMINM	-0,034		0,035	0,016	-0,044		0,037	0,014
t	2,20		3,61	2,68	2,98		3,42	2,16
LIALIT				0,065				0,030
t				5,27				2,10
LITESS	0,024							
t	2,79							
LIABBI		-0,075		0,020		-0,094		
t		3,64		2,12		4,01		
LICUPE	0,021			0,011				
t	1,76			3,54				
LILEMO	-0,104							
t	2,83							
LICHIM	0,049	0,038	0,040		0,037	0,053	0,048	
t	2,64	2,85	2,66		1,94	4,20	3,07	
LICAST	-0,084				-0,075			
t	2,87				2,75			
LIVEIM							0,038	
t							2,07	
COSTRU		-0,178				-0,081		
t		4,57				2,49		
ENELGA			0,124	0,323	0,178			0,260
t			2,12	7,32	3,01			5,61
AZCOMM	0,290	0,251	0,224	0,170	0,251	0,429	0,119	0,133
t	3,49	2,99	4,38	4,46	3,98	6,86	1,95	3,51
LCOMME	0,108							-0,127
t	1,89							3,84
ALBEPE	0,114							
t	4,18							
LSPAPU		0,145					0,166	
t		2,23					3,39	

R2	0,948	0,933	0,893	0,941	0,926	0,912	0,826	0,809
adjust-R2	0,938	0,925	0,882	0,935	0,914	0,901	0,805	0,792
F	92,4	113,2	78,0	151,5	75,4	83,8	39,5	45,7
degrees fr.	76	81	84	85	78	81	83	86
n.observ.	92	92	94	95	92	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
estimate method: Ols (YP or YA), then stepwise (Pin<0,099 Pout>0,10)
significance levels: =1% *=10% **=n.s.