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Conference Paper

Occupational structure and local dynamics: A test of convergence among Italian provinces

38th Congress of the European Regional Science Association: "Europe Quo Vadis? - Regional Questions at the Turn of the Century", 28 August - 1 September 1998, Vienna, Austria

Provided in Cooperation with:

European Regional Science Association (ERSA)

Suggested Citation: Pompili, Tomaso (1998) : Occupational structure and local dynamics: A test of convergence among Italian provinces, 38th Congress of the European Regional Science Association: "Europe Quo Vadis? - Regional Questions at the Turn of the Century", 28 August - 1 September 1998, Vienna, Austria, European Regional Science Association (ERSA), Louvain-la-Neuve

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**European Regional Science Association
38th European Congress
Vienna, Austria
28 August - 1 September 1998**

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**OCCUPATIONAL STRUCTURE AND LOCAL DYNAMICS:
A TEST OF CONVERGENCE AMONG ITALIAN PROVINCES**

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. This can be applied not only to the individual firm, to the filiere and to the economic system as a whole, but also to individual cities and regions as well as to the national system as a whole. The aim of this paper is to highlight the role of human capital in explaining spatial development processes and their differences. Four theoretical hypotheses on the role of human capital in spatial dynamics get support from empirical analysis: income/product per capita can converge even under different structural conditions, but these influence the convergence process significantly. 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) 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 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, both internal and external to manufacturing companies. 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.

However, the role of space is more crucial than that: the long term process of economic development is inherently featured with a spatial dimension. In fact, spatial proximity activates cumulative processes of synergy and feedback (both macro-functionally and micro-behaviourally) 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), 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 ability, 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 1963-1990, estimating relative dynamics of per capita income (as in Cosci and Mattesini, 1995) and of product per employee, where all data are measured relative to the national average.

Thirdly, it evaluates the contribution of human capital both through a regression analysis and a discriminant analysis.

First results, presented here, suggest that theoretical hypotheses on the role of (professional) human capital supply as generator of spatial dynamics get support from the empirical analysis: 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 (technology) and in human capital (competence), and as such a pre-requisite of creativity. 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, is not equally accessible to everyone in practice and therefore involves acquisition costs, 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 makes the perfect information hypothesis an abstract limit case (Stigler, 1961). 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 policy 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 spatial division of labour) and development paths that is being historically observed: inward cohesion is, if at all, dynamic.

Being also spurred by long-run supply-side developments like 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.

Occupations, 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, including labour costs, but on innovation, especially labour differentiation and quality. 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 (neo-classical or keynesian) growth models; the hypotheses 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 diverging productivity trend, due to cumulative processes (Young, 1928; Verdoorn, 1949), hence the persistence of historical dualisms.

Finally, differential effects of migration balances call for a hypothesis: if flows compensate endowments in either an aggregately or an industrially differentiated way, then convergence

will occur through either homogeneisation 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 (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 growth 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 conditional convergence hypothesis holds, variants 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 exception of Coppola et al. (1997), who substitute the convergence approach with a production function approach), whereas infrastructure endowment is generally significant and so are, occasionally, migration flows (Goria and Ichino, 1994) and the macro-sectoral structure, in essentially dualist terms (Paci and Pigliaru, 1997).

The few analyses on provincial data (Cosci and Mattesini, 1995; Girardi and Putzu, 1997) 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.

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 108, of which 6 are dependent variables, and all the others are independent, i.e. explanatory. We classified the variables in 2 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 four years (1963, 1972, 1981 and 1990, allowing 9-year intervals, for want of data aligned to census years 1961,

1971, 1981 and 1991, allowing a greater number of explanatory variables), which allow the construction of dynamic variables referring to three periods (1960s, 1970s and 1980s).

The spatial reference, in terms of unit type, is the local labour market, operationalised as the province (Ec's Nuts3 level), in that we built the whole database on a provincial basis (note that occupational changes are treated as wholly endogenous, under the hypothesis of no migration); in terms of unit number, it identifies a different number of observations in the various years and periods: 92 in 1961 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 100); we computed dynamics as the ratio of the final to the initial level relative to the national dynamics (made equal to 100). The source of raw data is Istituto Tagliacarne (Chambers of Commerce's research centre). The distribution of all these variables tends to be fairly close to the normal (asymmetry <0.7 , kurtosis <1.3).

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).

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 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 100). The source of raw data is Istituto Nazionale di Statistica (population census). The distribution of most of these variables tends to be not too far from the normal (asymmetry <1 , kurtosis <2 in half of the variables, only one variable with asymmetry=2.5, kurtosis=12).

Data refer to 11 aggregations of labour occupations: education health and liberal professions, technical and scientific professions, entrepreneurs and managers, skilled white-collar, unskilled white-collar, agricultural occupations, manufacturing occupations, building

occupations, trade occupations, transportation occupations, security and service occupations. The 1991 occupational classification is in practice not comparable to previous one at this level of detail and at the provincial scale.

We employed further aggregations to test the hypotheses of dualism and of the stages of growth: intellectual occupations (the first 5) and urban manual occupations (the last 5) both grow in absolute terms from 1961 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 1960s and 1970s and stable in the 1980s. The weight of urban manual occupations tends to be stable relative to both resident population and active population with work experience; in both cases intellectual occupations grow and agricultural occupations decline.

A note of caution may be in order: the highly aggregate level of empirical instances of occupations and of urban areas may be a weakness, but on the other hand it minimises 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.

After transforming the income per capita variables into dichotomic indicators, we employed also discriminant analysis (Sas software) to observe the extent to which the occupational structure foreshadows a dichotomy between urban areas that succeed and fail to keep up with the national evolution of per capita incomes.

4. ABSOLUTE CONVERGENCE

Starting from sigma convergence between 1963 and 1990 (Table 2) graph 1 shows a U-shaped pattern, i.e. it signals a strong reduction of disparities among provincial per capita incomes in the 1960s, further but slower reduction in the 1970s, and a comeback of disparities in the 1980s, which in 1990 were back to the 1972 level. The same graphs signals the same trends for product per employee, but a stronger convergence, especially 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 homogeneous in 1961 and 1971, but decreasingly so afterwards. 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 Gorla and Ichino, 1994).

Analysing distribution by provinces, in per capita incomes we observe a growing bi-modality, absent in 1963; this hypothesis is not warranted in productivity per employee. In the former case, the minority group of weak provinces shrinks until convergence works (from 38 to 32 in the 1970s), to expand afterwards (from 32 to 37). 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 number of highly dynamic urban areas fell dramatically after 1981, also signalling an individual trend reversal for many urban areas.

Interestingly, correlations were very high between all three reference years, highlighting that the relative positions of urban areas within the urban system have not changed significantly during the last 30 years, but in dynamic terms they were reasonably high only in the 1960s, signalling that dynamic patterns differed in the three decades, with weaker and weaker signs of convergence.

Beta convergence is a necessary, although not sufficient (Galton's fallacy) condition for sigma convergence. Graphs 2 and 3 point to its strength during the 1960s (for both income per capita and above all product per employee), although with some room for diverse behaviour among initially most backward provinces. Graphs 4 and 5 confirm its action during the 1970s, weaker than previously for income but stronger for productivity. Graphs 6 and 7 point to the lack of it and, if at all, to a weak diverging trend.

Income regressions show the usual convergence speed of 2% yearly (19-22% over 9 years) between 1963 and 1981; explanatory power is scarce, though (Table 3), albeit better than in Cosci and Mattesini (1995). On the contrary, over the same years productivity regressions show a faster convergence speed and a better explanatory power. Both equations for the 1980s provide very poor results, as in Cosci and Mattesini (1995) and in Girardi and Putzu (1997).

As a matter of fact, per capita income behaviour may depend 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 (likely effects of “industrial atmosphere”). Over time this linkage increases its explanatory power and the coefficient grows, suggesting increasing productivity disparities (Table 4). However, when related to both its determinants (initial levels of productivity per employee and of the activity rate), per capita income dynamics provides different results for the three decades, so that the gain in explanatory power is remarkable only for the 1970s, when large and significant influences with contrasting signs occur, similar to the catch-up discussed elsewhere (Coppola et al., 1997).

5. CONDITIONAL CONVERGENCE

We evaluate first convergence among local occupational structures, then we test the hypothesis of beta convergence conditional on the occupational structure, further we evaluate occupations as inputs for product/income and finally we substitute regression analysis with discriminant analysis.

Whether the occupational structure converges over time can be tested by an analysis of sigma convergence (Table 2). Measured relative to resident population (for comparisons with per capita income), occupations converge in 6 cases out of 11, but agricultural ones diverge and commercial occupations, industrial occupations and entrepreneurs-managers converge only during the 1960s. Measured relative to active population with work experience (for comparisons with per capita productivity), all occupations converge during the 1960s and 1970s save for agricultural ones (diverging) and education, health and liberal professions (the most homogeneous).

In so far as it can be derived from absolute convergence results, it is not a good omen that, while correlations of occupations with performance levels are positive (except for agricultural and building professions), correlations of occupations with performance dynamics are more often negative and weaker.

The joint contribution of occupations and the initial levels of per capita income/product to per capita income/product dynamics (Tables 5 and 6) is the object of conditional beta convergence analysis, i.e. holding some specific traits of local economies constant. The tripartition among agricultural, urban manual and intellectual occupations allows to identify the stages-of-growth hypothesis, the dualist hypothesis and the hypothesis of distinction between labour and human capital proper: relative to the absolute convergence hypothesis explanatory power improves (especially in the 1970s) but structural variables are weakly significant (as in Cosci and

Mattesini (1995), among others). On the contrary, the use of all 11 occupations provides a small but significant gain in explanatory power (maximum for 1970s income and minimum for 1970s productivity, which is the best explained by absolute convergence, while results for the 1980s are again disappointing) and almost always positive signs; steady state levels differ, surprisingly, especially by urban manual occupations (building, commercial and service occupations).

The analysis of the contribution of occupations alone to per capita income/product (Tables 5 and 7) means substituting the convergence logic with a production function logic (level explained by levels, dynamics by dynamics); the implicit hypothesis is that other inputs (fixed capital, infrastructure, technological knowledge, ... 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. We notice in income equations a scale effect (increasing returns), which however does not harm convergence in the 1960s and 1970s, and an unexpected reversal of returns in favour of urban manual occupations and against intellectual occupations in the 1980s. However, in (stepwise) productivity equations neither indicator is significant, hardly a result compatible with the previous one (and with stages-of-growth theory); the negative impact of agricultural occupations on productivity supports the dualist hypothesis (as in Paci and Pigliaru (1997) and unlike Cosci and Mattesini (1995)). On the contrary, the use of all 11 occupations provides excellent results in statistical terms, all of them being statistically significant, particularly intellectual ones (above all technical-scientific professions); however, the limited and negative contribution of entrepreneurs-managers and of education, health and liberal professions is surprising, as well as the weakening contribution of technical-scientific professions. Since over time human capital returns (coefficients) do not increase (except for white collar and manufacturing occupations), we cannot explain 1980s divergence by this route (unlike Coppola et al., 1997).

Being encouraging in static but not in dynamic terms, discriminant analysis confirms known results, showing that common wisdom hypotheses about the role of structural factors in spatial development are probably right in the long run, and explain historical processes of regional development; in this case, in fact, structural elements evolve in a parallel way together with economic indicators of productivity and personal prosperity. On the other hand, innovation and development are creative processes that may occur in unpredictable ways, that can be best assessed ex-post.

As a matter of fact, initial labour occupations seem unable to predict ten-year development trends. In fact, results for the three decades show up to one third of wrongly forecast performances and the variance explained is correspondingly small (26% in the 1960s, 10% in the 1970s and 13% in the 1980s). Introducing a North-South dummy (as if Italy were in fact made up of two different countries) or a trichotomic transformation (core-periphery-margin), do not improve results (unlike Cosci and Mattesini, 1995).

Instead, relative per capita income dynamics register better results, with the exception of the 1980s, if occupational structure joins previous per capita income levels: in the 1960s the contribution of occupational structure prevails, whereas the opposite is the case in the 1970s; however, even in this case at least half the variance in performance cannot be explained.

The dynamic analysis produces a high and stable number of misclassifications, even when the convergence approach is adopted, so that only 28 provinces always get their correct allocation; provinces with a tendency to be misclassified are at least 12, but present no clear geographical pattern, including both peripheral urban areas and marginal metropolitan areas.

On the contrary, labour occupations do come out as the determinants of development stages. In fact, results for the static analysis are good: the performance of most urban areas was correctly identified on the basis of labour occupations and these explained a high proportion of variance (81% in 1963, 62% in 1972 and 75% in 1981). A low and decreasing number of misclassifications occurs in the static analysis, where 65 provinces are always correctly classified; besides, if we exclude occasional misclassifications, only 5 provinces, all belonging to the area of intermediate development, including Rome, show a persistent tendency to get misclassified, usually in the sense of producing a lower income than warranted by the occupational structure, possibly because of a higher proportion of self-consumption and/or informal economy escaping official statistics (and, for Rome, public sector pay levels).

A note is due here on alternative explanations of relative income dynamics: first of all, the age and sex structures 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 advanced 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 on the role of human capital as a non-price-centred supply dynamics generator of urban and regional performance are at least partially supported by the specific empirical analysis of the Italian case, and allows to extrapolate spatially more general conclusions, since Italy includes cities and regions spanning the whole range of development stages in Europe:

- spatial disparities are more marked for income per capita than for productivity per employee, yet the latter converges more rapidly, suggesting an important role for the evolution of activity rates (linked to de-ruralisation); absolute convergence (the marginalist hypothesis) is a reality, but not the whole story, and it does not occur after 1981;
- the activity rate alone does not solve the 1980s puzzle and improves explanatory power more in the 1970s than in the 1960s; the halt to labour spatial mobility in the 1970s and activity rate divergence slow down and then block convergence, especially per capita income convergence;
- the highly aggregate hypotheses of dualism and of stages of growth do have explanatory power, but almost always a small and/or insignificant one, be it in the conditional convergence or in the production function approach, both in regression and in discriminant analysis;
- human capital disaggregation into 11 occupations always has a positive impact on explanatory power, the gain being largest for 1970s income and smallest for 1970s productivity (which is the best explained by absolute convergence), while results for the 1980s are again disappointing; signs are almost always positive and urban manual occupations (building, commercial and service occupations) play a major role;

- besides, we get excellent results also from a production function approach (on income and productivity levels), with a significant role of all occupations, especially intellectual ones (mainly technical-scientific professions), but with a surprisingly limited and negative contribution of entrepreneurs-managers and of education, health and liberal professions;
- the association between occupations and performance is significant, although weak, in dynamic terms in that structurally similar provinces do tend to behave similarly even in dynamic terms but individual correspondences are harder to detect, suggesting that the manufacturing-distribution “black box” (section 2) may play an important role in dynamics, although not in statics; however, occupational structure seems *prima facie* more helpful than age or sex structure or rewards institutions.

Open questions to be dealt with in future analyses belong to two types :

- methodological improvements: finer occupational disaggregation (30-35 occupations), extension to 1991 and the 1990s (after solving comparability problems), use of logarithms to improve the normality of distributions (but sigma convergence would be untestable), elimination of outliers (Genoa, Milan, Trieste, Rome), control of heteroskedasticity;
- innovation in variables (firstly physical infrastructure) and in analyses: on convergence clubs and on bimodality, especially separating Northern and Southern Italy (see Cosci and Mattesini, 1995), especially for the 1980s (cfr. Pompili (1996) for preliminary steps in this direction).

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Table 1. Variables

symbol	s. definition
YPC63	- relative provincial per capita income (Italy=100) in 1963
YPC72	- relative provincial per capita income (Italy=100) in 1972
YPC81	- relative provincial per capita income (Italy=100) in 1981
YPC90	- relative provincial per capita income (Italy=100) in 1990
YPCD60	relative provincial dynamics of YPC (Italy=100) from 1963 to 1972
YPCD70	relative provincial dynamics of YPC (Italy=100) from 1972 to 1981
YPCD80	relative provincial dynamics of YPC (Italy=100) from 1981 to 1990
YPP63	- relative provincial productivity per active (Italy=100) in 1963
YPP72	- relative provincial productivity per active (Italy=100) in 1972
YPP81	- relative provincial productivity per active (Italy=100) in 1981
YPP90	- relative provincial productivity per active (Italy=100) in 1990
YPPD60	relative provincial dynamics of YPP (Italy=100) from 1963 to 1972
YPPD70	relative provincial dynamics of YPP (Italy=100) from 1972 to 1981
YPPD80	relative provincial dynamics of YPP (Italy=100) from 1981 to 1990
PROFE61	relative provincial active population with work experience / resident population (Italy=100) in 1961
PROFE71	relative provincial active population with work experience / resident population (Italy=100) in 1971
PROFE81	relative provincial active population with work experience / resident population (Italy=100) in 1981
PROFE91	relative provincial active population with work experience / resident population (Italy=100) in 1991
ISSAL	+ relative provincial education, health and liberal professions / resident population (Italy=100)
TECSC	+ relative provincial technical and scientific professions / resident population (Italy=100)
IMDIR	+ relative provincial entrepreneurs and managers / resident population (Italy=100)
ICONC	+ relative provincial skilled white collars / resident population (Italy=100)
IORDI	+ relative provincial unskilled white collars / resident population (Italy=100)
AGRIC	- relative provincial agricultural occupation / resident population (Italy=100)
INDUS	+ relative provincial manufacturing occupation / resident population (Italy=100)
COSTR	+ relative provincial construction and infrastructure occupation / resident population (Italy=100)
COMME	+ relative provincial trade occupation / resident population (Italy=100)
TRASP	+ relative provincial transport occupation / resident population (Italy=100)
SERVI	+ relative provincial sundry service occupation / resident population (Italy=100)
PROIN	+ relative provincial intellectual occupation (sum of issal, tecsc, imdir, iconc, iordi) / resident population (Italy=100)
PROMU	+ relative provincial urban manual occupation (sum of indus, costr, comme, trasp, servi) / resident population (Italy=100)
PROMA	relative provincial manual occupation (sum of agric and promu) / resident population (Italy=100)
PRONA	relative provincial non-agricultural occupation (sum of proin and promu) / resident population (Italy=100)

Notes: the last 15 variables are relative to residents (last digit 1) or to active with work experience (last digit 0)

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

	1961	1971	1981	1991		1960s	1970s	1980s
observations	92	94	95	95		92	94	95
YPC	0,316	0,261	0,242	0,257	YPCD	0,113	0,120	0,062
YPP	0,277	0,216	0,135	0,148	YPPD	0,117	0,135	0,059
PROFE	0,123	0,114	0,150	0,155	PROFED	0,043	0,060	0,035
resident popul.								
PROMA	0,132	0,120	0,153					
PRONA	0,267	0,215	0,213					
PROMU	0,263	0,210	0,224					
PROIN	0,355	0,290	0,239					
AGRIC	0,484	0,550	0,565					
INDUS	0,510	0,452	0,472					
COSTR	0,261	0,225	0,193					
COMME	0,346	0,288	0,291					
TRASP	0,353	0,304	0,251					
SERVI	0,391	0,271	0,203					
ISSAL	0,147	0,124	0,108					
TECSC	0,541	0,523	0,404					
IMDIR	0,496	0,459	0,475					
ICONC	0,543	0,429	0,349					
IORDI	0,551	0,454	0,363					
active popul.								
PROMA	0,042	0,054	0,058					
PRONA	0,226	0,154	0,098					
PROMU	0,220	0,146	0,107					
PROIN	0,332	0,250	0,166					
AGRIC	0,446	0,548	0,619					
INDUS	0,440	0,375	0,361					
COSTR	0,314	0,292	0,280					
COMME	0,316	0,249	0,221					
TRASP	0,378	0,317	0,256					
SERVI	0,383	0,286	0,222					
ISSAL	0,181	0,151	0,159					
TECSC	0,496	0,466	0,322					
IMDIR	0,438	0,403	0,370					
ICONC	0,519	0,398	0,289					
IORDI	0,524	0,411	0,284					

Notes: for Y variables Y 1963, 1972, 1981, 1990 instead of 1961, 1971, 1981, 1991
the greater number of provinces increases the indicator of not more than 0,002 w.r.t. a constant number of provinces

Table 3. Absolute beta convergence (regressions)

dependent	YPCD60	YPCD70	YPCD80	YPPD60	YPPD70	YPPD80	YPCD60	YPCD70	YPCD80
constant	125,25	123,93	95,25	135,07	161,83	100,24	148,19	96,05	90,69
t	35,66	25,30	35,54	36,11	39,83	22,03	16,01	11,53	17,64
YPC	-0,219	-0,190	0,045						
t	5,99	3,78	1,70						
YPP				-0,323	-0,588	-0,007	-0,228	-0,429	0,057
t				8,09	13,83	0,15	5,39	9,57	0,99
PROFE							-0,221	0,498	0,035
t							2,60	6,32	0,69
R2	0,285	0,134	0,030	0,421	0,675	0,000	0,298	0,556	0,033
adjust.-R2	0,277	0,125	0,020	0,415	0,672	-0,010	0,282	0,546	0,012
F	35,9	14,3	2,9	65,5	191,3	0,0	18,9	56,9	1,6
degrees fr.	90	92	93	90	92	93	89	91	92
n.observ.	92	94	95	92	94	95	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
estimate method: OLS
significance levels: =5% *=10% **=15% ***=n.s.

Table 4. Growth accounting (regressions)

dependent	YPC63	YPC72	YPC81	YPC63	YPC72	YPC81	YPC63	YPC72	YPC81
constant	-4,89	-8,51	-52,02	-10,53	-29,54	-44,77	-91,01	-92,48	-91,08
t	1,10	1,63	5,40	0,47	1,60	6,14	33,96	51,66	76,54
YPP	1,067	1,100	1,546				1,039	1,008	0,935
t	22,23	20,00	15,78				86,58	100,80	71,92
PROFE				1,011	1,233	1,431	0,877	0,921	0,984
t				4,57	6,74	19,87	35,08	54,18	82,00
R2	0,848	0,815	0,727	0,189	0,331	0,809	0,990	0,995	0,997
adjust.-R2	0,847	0,813	0,724	0,180	0,323	0,807	0,990	0,994	0,996
F	503,8	406,6	248,0	21,0	45,4	394,4	4414,3	8259,6	13138,6
degrees fr.	90	92	93	90	92	93	89	91	92
n.observ.	92	94	95	92	94	95	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
 estimate method: OLS enter
 significance levels: =5% *=10% **=15% ***=n.s.

dependent	YPCD63	YPCD72	YPCD81	YPCD63	YPCD72	YPCD81	YPCD63	YPCD72	YPCD81
constant	11,22	23,89	12,97	72,83	88,59	34,51	-108,47	-110,48	-99,94
t	2,75	4,90	2,13	2,48	4,01	2,05	63,21	50,95	124,10
YPPD	0,887	0,768	0,871				0,987	0,964	0,998
t	23,16	16,98	14,25				193,33	133,88	261,93
PROFED				0,325	0,175	0,650	1,098	1,140	1,001
t				1,10	0,79	3,87	73,25	65,54	158,01
R2	0,856	0,758	0,686	0,013	0,007	0,138	0,998	0,995	0,999
adjust.-R2	0,855	0,756	0,682	0,002	-0,004	0,129	0,998	0,995	0,999
F	536,6	288,4	202,9	1,2	0,6	14,9	18940	9023,7	39823
degrees fr.	90	92	93	90	92	93	89	91	92
n.observ.	92	94	95	92	94	95	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
 estimate method: OLS enter
 significance levels: =5% *=10% **=15% ***=n.s.

Table 5. Dualism and stages of growth (regressions)

dependent	YPCD60	YPCD70	YPCD80	YPPD60	YPPD70	YPPD80
constant	126,25	63,31	94,82	144,33	175,30	89,94
t	14,48	8,50	17,60	13,64	17,54	9,07
YPC	-0,362	-0,561	-0,054			
t	4,17	7,21	0,68			
YPP				-0,446	-0,630	0,000
t				5,38	7,81	0,00
AGRIC	-0,019	0,114	-0,006	-0,033	-0,034	0,013
t	0,67	6,27	0,48	0,91	1,47	0,95
PROIN	0,049	0,110	0,097	0,068	-0,060	0,088
t	0,64	1,56	1,69	0,92	0,78	1,62
PROMU	0,105	0,734	0,021			
t	1,29	10,66	0,30			
R2	0,326	0,638	0,085	0,440	0,683	0,029
adjust.-R2	0,295	0,622	0,044	0,421	0,672	-0,003
F	10,5	39,3	2,1	23,0	64,6	0,9
degrees fr.	87	89	90	88	90	91
n.observ.	92	94	95	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
estimate method: OLS enter
significance levels: =5% *=10% **=15% ***=n.s.

dependent	YPC63	YPC72	YPC81	YPP63	YPP72	YPP81
constant	-16,43	-0,73	-21,12	8,63	69,21	113,49
t	1,55	0,07	3,12	1,46	6,42	67,68
AGRIC	0,071	0,004	-0,043		-0,118	-0,127
t	2,09	0,15	2,60		4,28	11,31
PROIN	0,614	0,607	0,454	0,565	0,452	
t	9,11	8,59	7,60	8,89	5,11	
PROMU	0,485	0,423	0,727	0,352		
t	5,64	5,17	14,22	4,03		
R2	0,826	0,820	0,891	0,771	0,722	0,761
adjust.-R2	0,820	0,814	0,888	0,766	0,716	0,579
F	139,0	136,7	248,3	150,0	118,4	128,0
degrees fr.	88	90	91	89	91	93
n.observ.	92	94	95	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
estimate method: OLS enter for YPC, OLS stepwise (Pin<0,10 Pout>0,15) for YPP;
significance levels: =5% *=10% **=15% ***=n.s.

Table 6. Conditional beta convergence (regressions)

dependent	YPCD60	YPCD70	YPCD80	YPPD60	YPPD70	YPPD80	YPPD70	YPPD80	YPCD80
constant	111,78	60,90	96,45	124,90	164,32	113,15	174,66	118,30	95,60
t	17,59	5,44	35,90	22,51	40,64	16,01	22,10	13,84	35,09
YPC o YPP	-0,293	-0,455	-0,030	-0,360	-0,515	-0,078	-0,663	-0,173	-0,059
t	4,89	7,05	0,69	7,00	10,40	1,44	8,63	2,37	1,27
ISSAL		0,240					-0,108	-0,098	
t		3,36					1,46	2,19	
TECSC									
t									
ICONC							0,066		
t							1,56		
IORDI			0,069					0,090	0,057
t			2,17					2,59	1,77
IMDIR									
t									
INDUS		0,259							
t		10,02							
COMME	0,111	0,182					0,082		0,047
t	2,16	4,11					1,77		1,54
SERVI				0,071	-0,100		-0,090		
t				2,05	2,67		1,75		
TRASP									
t									
COSTR	0,092	0,097		0,066		-0,054			
t	2,29	2,40		2,16		2,35			
AGRIC		0,089							
t		5,50							
R2	0,354	0,667	0,078	0,483	0,699	0,057	0,719	0,084	0,101
adjust.-R2	0,332	0,644	0,057	0,465	0,692	0,036	0,703	0,054	0,071
F	16,1	29,0	3,9	27,4	105,6	2,8	45,1	2,8	3,4
degrees fr.	88	87	92	88	91	92	88	91	91
n.observ.	92	94	95	92	94	95	94	95	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
estimate method: OLS enter (YPC or YPP), then stepwise (Pin<0,10 Pout>0,15); last 3 columns (Pin<0,20 Pout>0,25);
significance levels: =5% *=10% **=15% ***=n.s.

Table 7. Production function approach (regressions)

dependent	YPC63	YPC72	YPC81	YPP63	YPP72	YPP81
constant	66,14	35,75	14,68	44,16	71,36	134,55
t	7,95	4,32	3,07	7,00	5,54	14,77
ISSAL	-0,309	-0,194		-0,178	-0,261	-0,329
t	3,70	2,18		2,43	3,07	5,97
TECSC	0,365	0,145	0,115	0,290	0,115	
t	8,29	3,87	2,87	6,08	2,55	
ICONC		0,235			0,153	
t		5,38			3,20	
IORDI	0,115		0,249	0,133		0,184
t	2,50		5,32	2,64		4,25
IMDIR			-0,104			-0,093
t			2,98			2,97
INDUS		0,109	0,323			
t		3,37	9,78			
COMME	0,279	0,241	0,236	0,182	0,108	
t	6,05	5,05	6,91	3,44	1,77	
SERVI					0,118	
t					1,94	
TRASP		0,129		0,128	0,135	
t		2,91		2,65	3,12	
COSTR	-0,108					
t	2,83					
AGRIC			0,043		-0,064	-0,093
t			2,85		2,20	5,71
R2	0,904	0,883	0,914	0,861	0,819	0,724
adjust.-R2	0,898	0,875	0,908	0,853	0,804	0,712
F	161,7	109,9	156,0	106,9	55,5	59,0
degrees fr.	86	87	88	86	86	90
n.observ.	92	94	95	92	94	95

Notes: independents refer to the year corresponding to the beginning of the reference period for Y
estimate method: OLS stepwise (Pin<0,10 Pout>0,15);
significance levels: =5% *=10% **=15% ***=n.s.