CONTRIBUTI DI RICERCA CRENOS

REGIONAL DEVELOPMENT AND CREATIVITY

Emanuela Marrocu
Raffaele Paci

WORKING PAPERS

2012/02

CUEC

CENTRO RICERCHE ECONOMICHE NORD SUD
(CRENOS)
UNIVERSITÀ DI CAGLIARI
UNIVERSITÀ DI SASSARI

CRENOS was set up in 1993 with the purpose of organising the joint research effort of economists from the two Sardinian universities (Cagliari and Sassari) investigating dualism at the international and regional level. CRENoS' primary aim is to improve knowledge on the economic gap between areas and to provide useful information for policy intervention. Particular attention is paid to the role of institutions, technological progress and diffusion of innovation in the process of convergence or divergence between economic areas. To carry out its research, CRENoS collaborates with research centres and universities at both national and international level. The centre is also active in the field of scientific dissemination, organizing conferences and workshops along with other activities such as seminars and summer schools.
CRENoS creates and manages several databases of various socio-economic variables on Italy and Sardinia. At the local level, CRENoS promotes and participates to projects impacting on the most relevant issues in the Sardinian economy, such as tourism, environment, transports and macroeconomic forecasts.

www.crenos.it
info@crenos.it

CRENOS – CAGLIARI
VIA SAN GIORGIO 12, I-09100 CAGLIARI, ITALIA
TEL. +39-070-6756406; FAX +39-070- 6756402

CRENOS - SASSARI
VIA TORRE TONDA 34, I-07100 SASSARI, ITALIA
TEL. +39-079-2017301; FAX +39-079-2017312

Title: REGIONAL DEVELOPMENT AND CREATIVITY

ISBN: 978 88 84 67 775 4

First Edition: January 2012
Second Edition: November 2012

Via Is Mirrionis, 1
09123 Cagliari
Tel./Fax 070 291201
www.cuec.it

Regional development and creativity

Emanuela Marrocu and Raffaele Paci
University of Cagliari, CRENoS

Abstract

The aim of this paper is to assess the role played by creativity and other components of human capital on the process of economic growth for 257 regions in the 27 member countries of the European Union. We first decompose the regional human capital endowment to distinguish between the educational component (the share of individuals with a university degree) and the creativity component, which considers the actual occupations of individuals in specific jobs like science, engineering, education, arts and entertainment. We define three non overlapping categories of human capital (creative graduates, bohemians and non creative graduates) which are simultaneously included in a spatial model as determinants of regional growth measured by labour productivity. After extending the analysis to control for other relevant factors which may affect regional development, such as physical, technological and social capital, cultural diversity, industrial and geographical characteristics, we provide robust evidence on the growth enhancing effects of graduates, in particular for those of the creative category.

Keywords: human capital, creativity, regional growth
Jel classification: C21, J24, O40, R11

Acknowledgments: The research leading to these results has received funding from the European Union's Seventh Framework Programme FP7-SSH-2010-2.2-1 (2011-2014), under grant agreement n° 266834 SEARCH project.

1. Introduction

The role of creative people as one of the main drivers of economic performance at the regional level has received a huge amount of interest since the publication of Florida's seminal book in 2002. The idea that the presence of individuals working in creative jobs like sciences, education, culture and arts enhances local development has been noticed especially among policy makers. It is now rare to see a metropolitan or a regional development plan which does not include among its strategic goals the attraction of creative individuals as the key determinant of local growth.

At the same time, academic researchers have promptly disputed Florida's definition of creative class for being too broad and vague to allow for an accurate application in empirical models of regional performance. More specifically, the focus of the debate has shifted to how to discriminate between the creative and the education components, both of which are essential in several occupations. Indeed if we look at the list of creative occupations proposed by Florida it clearly turns out that most of these jobs (medical doctors, engineers, lecturers and so on) require the achievement of a university degree. This strong overlapping between creativity and the traditional measures of human capital, like educational attainment, has been remarked by Glaeser (2005) who claims that creativity does not generate an independent effect on local performance.

As a matter of fact, while the empirical literature on economic growth has provided robust evidence on the role played by human capital even when the analysis is performed within quite different settings (datasets, geographic units, time periods, econometric methodologies and controls), the evidence of creativity in enhancing economic development is still debatable. The contrasting results provided are largely due to the lack of a clear-cut definition of what creativity is meant to entail from an economic perspective. Overall, the unclear identification of the creative and education components in the empirical analyses generates a measurement problem due to either multicollinearity or omitted variable bias. In both cases this leads to confusing evidence as the effects of creativity on local performance are inadequately estimated.

The aim of this paper is to assess the role played by creativity and other components of human capital on the process of economic growth for 257 regions of the 27 European Union member countries. In order to overcome the creativity-education overlapping issue, we first

decompose the regional human capital endowment on the basis of the share of individuals with a university degree – the education component – and of the actual occupations of individuals in specific jobs – the creativity component. In this way we are able to define three non-overlapping categories: creative graduates, bohemians and non creative graduates which are expected to provide more sound results when simultaneously included as determinants of regional growth.

As measure of regional development we use the growth rate of labour productivity. This measure is preferred with respect to employment growth, largely used in the literature, since the latter does not account for the process of production restructuring, which often implies a labour reduction to achieve a good performance of the local economy. However, to test for the robustness of our results we also consider two alternative indicators of regional development, the growth rate of employment and of total factor productivity.

In order to capture the possible interdependence among the geographical units we adopt a spatial error specification with the spatial weight matrix represented by the inverse of the distance between all possible pairs of regions. Finally, we extend the analysis to control for other relevant factors which may influence regional development, such as physical, technological and social capital, cultural diversity as well as industrial and geographical characteristics.

The paper is organised as follows. Section 2 discusses the literature on creativity and its role in regional development. Section 3 deals with the measurement of creativity and education and defines three non-overlapping categories. In section 4 the empirical model and some estimation issues are discussed, while the results for the basic model are presented in Section 5. Section 6 presents an extension of the basic model with the introduction of a set of control variables which characterise the local environment. Section 7 concludes.

2. Literature review

Since Florida's (2002) seminal contribution the concept of creativity has attracted the attention of scholars and policymakers in an attempt to refine its definition and measurement and to assess empirically its impact on the local economic performance. Florida's idea is that the local economy greatly benefits from the presence of "creative" individuals defined as people employed in occupations like sciences, engineering, education, culture, arts and entertainment. These people, often labelled as 'creative class', fulfil the role of identifying problems,

discovering original solutions, generating new ideas and new technology and all these functions are expected to favour regional development.

From the very beginning there has been a dispute over Florida's definition of creative class, which has been criticised on the ground of being too broad and vague to allow for an application in empirical models of regional performance. For instance, Markusen (2006) perceives the definition of creative class as a generic category which assembles several occupations with very little in common. On the same vein, McGranahan and Wojan (2007) criticise Florida's creative class for being excessively varied since it includes also several technical jobs. The need to reduce the number of different occupations included in the definition of creative class is also suggested by Comunian et al. (2010) since the high level of heterogeneity decreases the explanatory power of the empirical evaluation. In general, most empirical works start discussing the meaning of creative class and then propose their own classification of creativity which depends mainly on the specific aim of the study and on the data available.

Closely related with the definition issue is the debate on how to discriminate between the creative and the education components inherent in several occupations. Indeed if we look at the list of creative occupations proposed by Florida it is quite evident that most of these jobs require the attainment of a higher education degree. Just to give some examples, it is plain that to work as a medical doctor or an engineer or an architect one needs a university degree. This strong overlapping between creativity and the traditional measures of human capital like educational attainment has been firstly remarked by Glaeser (2005) which disputes that creativity may exert an independent effect on local performance.[1] This issue has been usually acknowledged in the literature although it is often neglected in the empirical evaluation.

In Table 1 we summarize the results of the empirical literature on the effects of creativity on regional performance, which has been formally tested in several contributions applied to different geographical contexts, like the US metropolitan areas and the regions of Northern European countries like the Netherlands (NL), Germany (DE), Sweden (SE), Finland (FI), Norway (NO) and Denmark (DK). These studies do not offer a unified and conclusive interpretation and it is not simple to

[1] In a recent contribution Storper and Scott (2009) discuss the relationship between the traditional measures of human capital and the notion of creativity and their role on urban growth.

compare them given the differences in the measurement of regional performance, in the definition of creative class, in the inclusion of education measures, in the control for local environment indicators and in the econometric methodology.

In what follows we provide a brief account of the relevant results reported in the contributions most directly related to the analysis presented in this paper.

Glaeser (2005), in a critical review of Florida's (2002) book, estimates a simple cross section model of population growth in the US metropolitan areas over the nineties where an indicator of schooling (population with a bachelor's degree) is included as an explanatory variable together with single measures of creativity. The results show that once we control for the traditional measure of human capital – education – then all the creative indicators become irrelevant proving that creativity *per se* does not exert a direct effect on local economic performance. Rausch and Negrey (2006) show that the creative class has an unexpected negative impact on the growth of the Gross Product for US metropolitan areas if an educational attainment measure is also included together with other control variables like diversity, tolerance, technology and territorial characteristics.

Similar results are found by McGranahan and Wojan (2007), who extend the analysis to the rural US counties and employ a restrictive definition of creative occupations. Controlling for a full set of local features, they show that creativity has a positive and significant effect on employment growth. Also in this case the presence of a high correlation among the creativity and education variables, although acknowledged, is not adequately considered in the econometric estimation, so that when the endowment of graduates is also included in the model it turns out to be not significant as a clear result of a multicollinearity problem.

A different approach in dealing with the overlapping between creativity and education is followed by Donegan et al. (2008) who assess the role played by creative core, bohemians and graduates by including them one at a time in a cross section model of employment and income growth for US metropolitan areas. None of the human capital variables show a statistically significant impact on employment growth; on the contrary, both creatives and graduates influence positively income dynamics while the bohemians component remains irrelevant.

Another contribution on the US metropolitan areas is given by Florida et al. (2008) who show that, within a path model of regional development system for the year 2000, the creative class influences only

the level of labour productivity (proxied by the average wage level), while the educational attainments positively affect the regional income level as well. The same methodological framework is used by Mellander and Florida (2011) to analyse per capita wage level for 81 labour market areas in Sweden. In this case bohemians turn out to be significantly associated with labour productivity while both creative class and graduates are irrelevant. In both contributions a great attention has been devoted to accounting for differences among the various groups of creative occupations, but the crucial issue of assessing to what extent the effects of creativity are overstated by the concurrent influence of graduates has remained unaddressed.

Continuing the review of the contributions dealing with the European context, Marlet and van Woerkens (2007) analyse the case of 50 cities in the Netherlands within a cross-section model of employment growth and controlling for various characteristics of the local environment like diversity, congestion and unemployment. They include the three human capital indicators in pairs and find that the creative class measures outperform the conventional education indicators; moreover, bohemians show a strong impact of regional performance which, however, cancels out if Amsterdam is excluded.

Contrasting results are found by Boschma and Fritsch (2009) within a spatial error model of employment growth applied to NUTS3 regions in the Netherlands and Germany. Considering the various proxies of human capital one at a time in order to avoid multicollinearity, they show that the education indicator outperforms the creative class measures in the case of German regions, while for the Dutch regions all variables significantly affect employment dynamics. The economic dynamics of the German regions is also analysed by Wedemeier (2010) with two different specifications of the dependent variable: employment and labour productivity growth. The author controls for diversity, population growth, and production specialisation while the educational component of human capital is not considered. It turns out that labour productivity growth is positively affected by the presence of the creative class, which however does not affect employment dynamics. Finally, Andersen et al. (2010), in a simple partial correlation framework applied to four Nordic countries (Denmark, Finland, Norway and Sweden), show that the creative class is positively correlated with employment growth only for the case of the large city regions, while it results not significant once all regions are considered; the opposite outcomes are found for the schooling measure.

In summary, a critical drawback emerges from the analysis of the empirical literature. The unclear identification of the creative and education components generates a measurement problem, which in the econometric analyses leads to either multicollinearity if the two measures are included together or to an omitted variable bias if they are included one at a time. In both cases this induces confusing evidence as the effects of creativity on local performance are inadequately estimated. Therefore, in order to attain a more accurate evaluation of their impacts, in the following section we propose a way to distinguish the education and the creativity components.

3. Creativity and education indicators

As we have seen in the previous section, one of the crucial issues in the debate on the influence of creativity on regional performance is the definition and measurement of creative population and its distinction with respect to the education measures. Indeed, there is a large overlapping between the two measures of human capital – education and creativity – which if not properly dealt with may cause estimators to be biased or to exhibit an incorrectly estimated variance.

To tackle this problem we introduced in a previous contribution (Marrocu and Paci, 2012) a classification of human capital measures which, combining the two different data sources on occupations and education attainments, defines the following three non overlapping categories (see Table 2).

Creative Graduates, which include scientific, life sciences, health, teaching and social sciences professional occupations (this group corresponds to the one usually referred to as "super creative core" or "creative core" in the existing literature).

Bohemians, consisting of artistic, entertainment and fashion professionals.

Non Creative Graduates, computed as the difference between the total number of employed people who has attained at least a university degree (ISCED 5-6) and the creative graduates; they mainly include legislators, government officials, managers, business and legal professionals, technicians and associate professionals.[2]

[2] Some of these occupations (senior officials, managers, business professional, legal professionals) are sometimes included in the category "creative professionals" (Florida et al., 2008; Boschma and Fritsch, 2009).

The occupations included in the *Creative Graduates* group require, in general, the tertiary level of education and therefore these individuals are simultaneously *graduates* working in *creative* occupations. The second category *Bohemians* includes several creative occupations like writers, painters, musicians, actors, designers, athletes and many others. We assume that in these occupations the creative component is essential and predominant with respect to the educational one and thus we maintain that all bohemians are creative and did not graduate. The third category *Non Creative Graduates* includes all employed individuals which hold a university degree and are not already considered in the Creative graduates component.

The identification of these three non-overlapping groups provides a working distinction between the formal education and the creativity components of human capital and it allows to overcome the multicollinearity or the omitted variable problems which very often affect the econometric analysis of previous contributions.[3]

Let us now briefly describe our human capital measures. The data sources and definition for all the variables are reported in Table 3 while the summary statistics are presented in Table 4. Starting from the occupation measures provided by the Labour Force Survey, in Table 4 we see that the creative people in the European territory represent 5.9% of population, the great majority of them is employed in occupations requiring a degree and therefore constitutes the creative graduate group (5.3%), while only 0.6% of population belongs to the bohemians' group. On the other hand, the share of employed population holding a degree counts for 12.5%; among them 5.3% of population are employed, as we have seen, in the creative occupations and thus the remaining 7.2% can be defined as non creative graduates.

Looking at the territorial distribution of our human capital measures, the creative graduates show a well defined spatial divide with the highest values displayed in Northern Europe while the Southern and Eastern countries show a lower presence of creative graduates. More specifically, the creative graduate group is larger, as expected, in the capital cities (Stockholm, Helsinki, Paris, Bucharest, Prague, Amsterdam)

[3] A similar attempt to overcome the overlapping problem between education and creativity components has been followed by Comunian et al. (2010), who focus on the category of "bohemian graduates" defined as individuals who obtained a degree in an artistic subject like arts, design, communications, music, architecture.

and in other regions, close to the capital city, which host well-known universities (Utrecht, Oxford, Louvain-la-Neuve). The bohemian group presents a spatial distribution more concentrated in few areas, as it is confirmed by the higher value of the variation coefficient (0.79) when compared to the other human capital indicators. The region with the highest presence of bohemian population is Inner London (4.4%), followed by other cities like Amsterdam, Stockholm, Outer London, Hamburg, Prague, Berlin. The third component, the active individuals with a degree not employed in creative jobs, shows a spatial distribution characterised by a strong national pattern. High values can be found for all regions in Spain, France, UK, Germany and the Netherlands and also in the Scandinavian and Baltic countries. On the other hand, low values appear almost uniformly distributed for the other Southern and Eastern countries.

4. Model specification and methodological issues

The role played by human capital – considering both its education and creativity components – in determining growth performance is analyzed within a regression framework which accounts for possible spatial dependence among the European regions included in our sample. The empirical model is specified as follows:

$$\hat{y}_{2002-07,i} = \alpha + \beta\, human\ capital_i + \delta\, y_{2002,i} + \varepsilon_i \qquad (1)$$

where the dependent variable is the annual average growth rate of labour productivity computed over the period 2002-2007 for each region *i*. In order to consider both the education and creativity components of human capital, the corresponding variables' vector in (1) includes the three non-overlapping categories of creative graduates, non creative graduates and bohemians, which are log-transformed and expressed in per capita terms with respect to the resident population aged 25 and over. The level of labour productivity with reference to the initial year 2002 is included in order to account for possible convergence dynamics, as predicted by the conditional convergence or catching up models.

Moreover, the human capital variables of creative graduates in the econometric analysis presented in section 5 are also considered further decomposed on the basis of the jobs' creativity content, in order to get some possible insights on the growth enhancing feature of some specific occupations, which are generally believed to foster positive economic outcomes, such as those related to science professionals.

In the literature review we have seen that the most common measure of regional development is employment growth. However, this measure is not fully satisfactory since it does not account for the process of production restructuring which often requires, in the short run, a reduction in the labour input to achieve a good performance of the local economy. Therefore, our preferred measure of regional dynamics is labour productivity. However, to allow comparisons with previous contributions and to test for the robustness of our results, we also consider two alternative indicators of regional development, the growth rate of employment and of total factor productivity.

In section 6 we then extend the basic model to check whether the effects associated with human capital are robust to the inclusion of an array of control variables, the new specification is reported in (2):

$$\dot{y}_{2002-07,i} = \alpha + \beta\, human\ capital_i + \gamma\ set\ of\ controls_i + \delta\, y_{2002,i} + \varepsilon_i \quad (2)$$

The set of controls comprises, besides the initial period level of the physical capital, a set of variables which are expected to account for the regional endowments of technological capital and social capital in relation with the degree of diversity, openness and tolerance of the social environment. Additional variables are also included to control for different specialization patterns across the European regions and to account for some geographical characteristics. The rationale for including such controls is explained in detail in section 6, where the main statistical features of the data are also reported and discussed. In our empirical models the geographical determinants of the growth process are captured by including a dummy variable for the convergence regions, defined as those regions whose per capita GDP is below the 75% EU average threshold, and two dummy variables for Bulgarian and Romanian regions since their countries formally joined the European Union at the end of the period considered in our growth analysis.

Moreover, the geographical interconnectivity among the regions is taken into account by adopting for both model (1) and (2) a spatial error specification, which entails that the error term follows a spatial autoregressive process with each regional shock given by the spatial weighted average of all other regions' shocks plus a pure random component. Throughout the paper, in order to capture the possible interdependence among the geographical units we make use of a spatial weight matrix represented by the inverse of the distance between all possible pairs of regions. Following the suggestion advanced in a recent paper by Kelejian and Prucha (2010), the matrix is maximum-eigenvalue

normalized; with respect to the commonly used row-standardization, this kind of normalization has the advantage of not imposing overly strong restrictions on the weight structure and of preserving the importance of absolute – rather than relative – distance.

Finally, note that both human capital categories and control variables are considered at their 2002 values in order to obtain an accurate measure of their proper impact on economic dynamics in the subsequent five year period.

5. Results for the basic model

The results for the basic specification, which includes the human capital variables and the geographical controls, are reported in Table 5; the OLS regression is presented in the first column along with the robust LM tests designed to detect spatial correlation of the error component or the omission of a spatially lagged dependent term. Both tests are highly significant but the higher value of the first one suggests the spatial error specification as the most adequate for the labour productivity growth model.

Once we control for the initial conditions, which exhibit the expected negative sign, the results reported in the second column point out the relevant role played by the education component of human capital in driving productivity growth. Both creative and non creative graduates categories turn out to be highly significant with the first one outperforming the second with an effect four times as large. The talent component of human capital does not seem to contribute in any way when it is considered *per se* and not complemented by the formal education support.[4] This result is in line with previous findings, as discussed in Glaeser (2005) for the US metropolitan areas (growth models) and in Marrocu and Paci (2012) for the European regions (productivity level models).[5] More generally, our results confirm the positive role of human capital measured by education on regional performance, which has been found by a vast literature in different

[4] The absence of a direct effect of Bohemians on regional development is also observed by Wojan et al. (2007), who remark however that their presence might still represent an important signal for the presence of a creative milieu.

[5] Note that in the studies presenting a significant positive effect for the Bohemians group of workers (Florida et al., 2008, Boshma and Fritsch, 2009 or Mellander and Florida, 2011), this category is the only variable included for human capital, education indicators are excluded in order to avoid multicollinearity.

settings; just to mention, among many others, some recent contributions: Moretti (2004) at the firms level, Dettori et al (2011) for the European regions, Yamarik (2011) for states of the United States, Cohen and Soto (2007) for the OECD countries.

In order to single out the role played by specific groups of occupations in driving economic growth, in regression (3) of Table 5 we report the results of the empirical analysis based on a finer decomposition of the graduates' categories. For the creative graduates the occupations related to the Physical, mathematical and engineering science professionals (ISCO code 21) and Life science and health professionals (code 22) are considered as a separate subgroup.[6] Although such professions are those with the highest level of education and creativity content and therefore could be expected to be the most growth enhancing, their effect is much lower (0.38) than the one reported in column (2) for the overall creative graduates group, a similar magnitude is also found for the effect of the remaining creative graduates occupations. Moreover, both effects are barely significant. This unexpected result could be due to the reduced variability of the new subgroups variables, which exhibit a much higher within-group homogeneity with respect to the non creative graduates subgroups. Moreover, a companion explanation may be related to the possible presence of strong complementarities among the occupations included in the creative graduates groups, which are lost as a result of the decomposition. More encouraging evidence is found for the subcategories of the non creative graduates; in this case we try to isolate the contribution to labour productivity of the top managerial occupations (codes 12 and 13); their effect turns out to be significantly sizeable (0.60), while the one associated with the remaining occupations is very low (0.04), although still statistically significant. It may be the case that the organizational skills and abilities of the managerial occupations are quite effective when it comes to labour productivity as their specific aim is to ensure increasing levels of profitability for the firms by improving their degree of efficiency.

In Table 6 we contrast the results previously discussed for labour productivity growth with those obtained when the dependent variable is the annual growth rate of employment or of total factor

[6] The specific role of scientists and engineers on the employment growth process of 242 US metropolitan areas has been examined by Beckstead et al. (2008).

productivity. Employment is measured in terms of units of labour while total factor productivity is estimated by adopting a growth accounting approach after having estimated inputs' elasticities from a Cobb-Douglas production function model using a panel data sample for the 257 European regions over the period 1990-2007.[7]

Column (1) and (3) of Table 6 report the OLS regression for the basic specification, which includes the three categories of human capital and the initial year dependent variable in levels. For both alternative economic performance indicators the LM tests detect the significant presence of spatial dependence in the form of spatially autocorrelated error processes. Therefore, in column (2) and (4) we report the results of the estimation based on the spatial error specification.

Focusing on labour growth, only the group of creative graduates turns out to contribute significantly to employment increases, with an estimated effect which is less than half of that obtained for the same regressor in the case of labour productivity growth. On the contrary, the estimates for the TFP growth are very much in line with those reported for the basic model (2) of Table 5. It is worth remarking that the TFP indicator already accounts for the contribution of labour and physical capital so that, differently from labour growth, it is much more robust to the structural change that has been occurring in Europe in the last decade as a result of the enlargement and integration processes on one hand and of the world globalization trends on the other.

For employment growth, comparisons with previous empirical literature are not directly viable as most studies are affected by the measurement problem of the education and creativity components of human capital. Referring to the European context, graduates are found to enhance employment growth in the German and Dutch regions (Boshma and Fritsch, 2009) and in the Nordic countries regions (Andersen et al., 2010); evidence in favour of creativity as a driver of labour growth is provided by Marlet and Van Woerkens (2007) and Boshma and Fritsch (2009) for the Netherlands. In some studies (Marlet and Van Woerkens, 2007; Mellander and Florida, 2011) a relevant role is also found for the Bohemians; their presence can act as an attractor for highly educated people who tend to prefer working in more open, diverse and tolerant environments. However, this cannot be considered as a proper causal effect as further analysis would be necessary to rule

[7] The estimation details can be found in Marrocu and Paci (2012).

out double causality problems among the different human capital groups.

On the basis of the results presented in Table 5 and 6 we think that labour productivity growth is an adequate measure to analyse the dynamics of the economic performance of the European regions; the extension of the basic model is therefore based on such an indicator.

6. Extending the basic model

6.1 Control variables for regional characteristics

The European Union is characterised by a high degree of regional heterogeneity and therefore in evaluating the role of creativity and education on regional development it is important to control in the econometric estimation for other institutional and economic factors (Asheim and Hansen, 2009; Rodriguez-Pose and Crescenzi, 2008). In particular, in our empirical model we consider the endowments of tangible and intangible assets like physical capital, technological capital, social capital, cultural diversity and we also control for production specialisation.

The performance of the local economy can be influenced by the stock of physical capital, which is computed by applying the perpetual inventory method on investment series over the period 1980-2001, and it is then divided by units of labour. From Table 4 it is possible to notice the strong differences among regions in the level of the capital labour ratio for 2002, it ranges from 2.8 to 1860, indeed the coefficient of variation turns out to be very high (CV=1.4).

Technology is, at least partially, a public good so that firms and regions benefit from the availability of technological capital, as originally suggested by Griliches (1979) in the so-called knowledge-capital model. In this paper, as an indicator for technological capital, we use R&D expenditure per thousands inhabitants. Also for this variable there is a high degree of disparity in the regional endowment of technological capital (CV = 1.2). In general, the cluster of high innovative regions embraces the Scandinavian countries, most German regions plus some regions in the UK, France and Northern Italy; while all Southern and Eastern European regions are characterised by very low levels of technological capital. In the econometric analysis, as a robustness check,

we also employ the stock of patents per thousands inhabitants in the years 2000-2002.[8]

Regional productivity growth may also be influenced by social capital, which represents an intangible asset often neglected in economic analyses (Temple and Johnson, 1998). Social capital is a complex feature of social organization – represented by strong ties, shared norms and trust – which improves the efficiency and the economic performance of the local society by decreasing the transaction costs and by facilitating the coordination among actors (Knack and Keefer, 1997). It is not an easy task to measure a phenomenon as complex, and often informal, as social capital (Glaeser et al., 2002) especially when we need to appraise it at the regional level for the whole of Europe.[9] In this paper as a proxy for regional social capital we use, following La Porta et al. (1997), the level of "trust" measured by the share of population who state their belief in people's helpfulness, as reported by the European Social Survey.[10] The share of population declaring high level of trust is unevenly distributed in the EU ranging from a minimum value of 26% in Calabria (IT) to a maximum value of 96% in Itä-Suomi (FI). In general there is a clear geographical pattern with the Northern and Western countries showing higher level of trust with respect to the Southern and Eastern countries. As a robustness check, we have also considered, as a proxy for social capital, the level of safety feeling computed as the share of population who reports feeling very safe when walking alone in their own local area after dark.

According to Florida (2002) diversity and heterogeneity are the key ingredients for economic growth and the traditional social capital might have adverse effects on growth as it induces conformism and attitudes less inclined to innovativeness. Diversity among individuals is expected to favour approaches which are more open-minded,

[8] European Patent Office (EPO) data have been regionalised on the basis of the inventors' residence; in the case of patents with multiple inventors, proportional quotas have been attributed to each region.

[9] In the empirical works several indicators for social capital have been used: newspaper reading and referenda turnout (Helliwell and Putnam, 1995), blood donations (Guiso et al., 2004), voluntary organisation density (Paldam and Svendsen, 2000), associational activity (Beugelsdijk and van Schaik, 2005; Dettori et al, 2011).

[10] Individuals were asked to answer using a scale from 0 (no trust) to 10 (high trust); here we consider the share of population who chose the three highest scores, 8-10.

meritocratic and tolerant. Dissimilarity is what makes a socio-economic environment more stimulating as it fuels self-expression, creativity, innovation and eventually economic growth. Although the role of diversity is not at all new to economic analysis, since it dates back at least to Jacobs (1961) who discussed the importance of both firms' and individuals' diversity, there is still limited empirical evidence on its growth enhancing effects, in particular for the case of European regions. Thus, as an additional control variable we include the degree of cultural diversity of each region proxied by the share of foreign population from the 2001 Census data. A similar measure has been already used by Ottaviano and Peri (2006) for the US cities and by Bellini et al. (2011) for the European regions. The idea is that foreign people, who are usually younger and more dynamic, bring diversified backgrounds in the new country of residence and this facilitates the diffusion of new ideas and an increase in productivity for the whole economy. The average share of foreign born population in Europe is 6.7% and this value exhibits a high variability going from the minimum level of 0.24% in the Romanian region of Sud-Vest Oltenia to the highest value of 38% in Brussels. High values are displayed by capital cities like London, Luxembourg, Wien, Paris and Stockholm, while in most of the Eastern country regions the share of foreign born population is very low. To appraise openness to cultural diversity we have also used an indicator of tolerance measured by the share of population who, in the European Values Study (EVS), has not answered to dislike immigrants or foreign workers as their own neighbours.

In our empirical models we consider both social sources of economic growth, the one stemming for similarity – trust – and the one coming from dissimilarity – foreign population – as additional complementary drivers of economic growth rather than opposite forces.

Finally, we have controlled for the regional production structure with the inclusion of two alternative indicators of the relative specialisation in the knowledge intensive services (KIS) and in the manufacturing sectors which is expected to affect the regional productivity (Marrocu et al., 2010). More specifically, since the KIS sectors are more efficient and dynamic, we expect that regions specialised in these sectors exhibit a higher productivity growth; while the opposite relationship should result for the manufacturing specialisation. It should be remarked that currently in Europe the knowledge intensive regions are largely located in the advanced Western countries while Eastern regions are mainly specialised in manufacture.

For instance, the top ten regions in knowledge intensive sectors are in the UK, Luxembourg, Netherlands and France; while the top five regions in manufacture are in the Czech Republic, Hungary and Romania and among the top ten there is only one German and one Italian region.

6.2 Estimation results

In Table 7 we report the results of the empirical analysis carried out on the extended version of the model, which allows us to test the robustness of the creativity and education effects previously discussed when a wide set of covariates is also included. The alternative specifications considered comprise, in addition to the three categories of human capital and the initial year level of labour productivity, the level of physical capital, technological capital, social capital, diversity and production specialization. All variables refer to the year 2002 in order to avoid possible endogeneity and to allow for a time span long enough for their potential effects on labour productivity to unfold. All the models presented are estimated allowing for a spatial autocorrelated error term; the spatial autoregressive coefficient is always highly significant with an average estimate of 0.90.

The most salient result is that the creative graduates group is highly significant and quite effective – the coefficient ranges from 0.76 to 0.99 – across all the specifications considered; the relevance of the non creative graduates is also broadly confirmed, although it depends somehow on the specific set of controls included in the estimation. No evidence was found of positive effects of bohemians on economic dynamics.

Focusing on the estimated effects of regression 1, the creative graduate group is highly significant with an elasticity value of 0.85, while the non creative graduate coefficient is not significant at conventional levels (p-value=0.16); this result is mainly due to a certain degree of collinearity associated with the inclusion of both trust and diversity in specification (1); when they are included one at a time (regressions 2 and 3 of Table 7) the non creative graduates group is again statistically significant. Note also that, due to the presence of the control variables, the estimated effects of creative and non creative graduate groups are lower than the ones reported for the basic specification (regression 2 of Table 5).

The capital/labour ratio exhibits a significant negative coefficient, indicating that the growth process is stationary, as is the case also with the initial level of labour productivity, so that regions with high

endowments of physical capital with respect to their labour force tend to have slower dynamics. R&D expenditure does not seem to provide a significant contribution to the growth of labour productivity over and above the human capital's one. This apparently unexpected result may be due to the fact that even high amounts of R&D expenditure might be ineffective without a highly skilled and educated labour force, so that it might be the case that the R&D effect is an indirect one which works through the human capital channel and in particular through the creative educated one.

Turning to the social factors, our results point out that both trust and diversity contribute positively towards accelerating the growth process, with the latter having twice the effect of the former one. It seems reasonable to argue that the foreign population plays an important role in creating a more challenging productive environment and in signalling to graduate, creative and innovative people the most open, tolerant and inclusive places. At the same time this is associated with reasonable degrees of trust as the positive effects are not offset by increasing transaction costs. This favourable result may be due to the particular European context, where it still possible to benefit from the positive effects of both diversity and similarity, however threshold limits could be easily reached and adverse effects might result if the social capital-demographic diversity combination is upset. Specific social policies are indeed required at local level to maintain such a delicate balance.

Keeping constant the human, technological and social capital endowment, having a regional productive structure specialized in knowledge intensive services turns out to foster markedly the labour productivity growth. It is expected that the specialization pattern favours more strikingly the Western regions with respect to the new accession Eastern ones, which are relatively more specialized in the manufacturing sectors as a result of the production delocalization triggered by the European integration and enlargement process.

In column (4)-(7) of Table 7 we report the results of the extended model obtained by including alternative proxies for the main control variables. The evidence previously discussed is confirmed. Technological capital has no significant effects even when an indicator based on patents stock is included (regression 4) in place of R&D investments; this may be due to technological capital having a pure level effect on productivity, as documented by the empirical literature on intangible assets augmented production function (Dettori et al. 2011),

and no additional growth effects. The social capital effectiveness proves to be robust to the use of the alternative proxy represented by safety (regression 5), while the tolerance proxy (regression 6) is outperformed by the foreign population one in accounting for the degree of diversity in society. Finally, as expected, specializing in manufacturing (regression 7) does not seem to contribute in accelerating growth performance steadily.

In general, the analysis carried out so far provides further evidence on the prominent role played by well educated labour forces employed in creative occupations in driving and sustaining economic growth, which is also enhanced by a productive environment featuring high levels of social capital and diversity.

7. Conclusions

In recent years creativity has attracted a great deal of attention from both scholars and policymakers alike. In advanced economies, increasingly specializing in knowledge intensive sectors, talent applied to improve the level of innovativeness is seen as the key ingredient in most policy prescriptions, as it is the most important factor in enhancing competitiveness and ultimately economic growth. Traditionally, economists have theorized that the degree of innovation is directly linked to high endowments of human capital, beside sizeable R&D expenditure, so that what really matters for long run economic growth is investment in education (Mankiw et al., 1992; Benhabib et al., 1994). Recently, Florida (2002) has questioned this view by claiming that the real fuel of growth is the creativity content of occupations and not the formal education attainments of employed individuals. Policymakers should be more concerned with realizing the most favourable working conditions in order to attract such high valued people. This, in turn, would entail that local policies should aim at promoting an open, diverse and tolerant social and productive environment where creative individuals are relatively more keen to work in.

While the empirical evidence on the relevant role of human capital, mainly in the form of high levels of education, on economic outcomes is very settled and it has been proved to be robust to a vast set of varying conditions (countries, regions, time period, methodology, set of covariates), the debate on the economic effectiveness of creativity is still open, with an increasing number of contributions providing contrasting or quite ad hoc results. This is basically due to the fact that the very concept of "creativity" is not straightforward to define, so that in most empirical studies the first step is to provide a workable definition

of it, which inevitably ends up to be too dependent on the specific aim of the paper. As a consequence, the results of the analysis can hardly be generalized to different contexts and settings. Moreover, an additional difficulty is represented by the fact that whatever the adopted definition, creativity tends to overlap with education when high skilled innovative occupations are considered. Therefore a non trivial issue is how to disentangle the individual effects of the education and creativity component of human capital.

In this paper, building on the identification strategy proposed in a previous analysis (Marrocu and Paci, 2012), we use the three non-overlapping categories of creative graduates, non creative graduates and bohemians to assess their role on the economic growth of 257 European regions over the period 2002-2007. Following previous literature and in order to evaluate the robustness of our results we consider three alternative measures of growth performance: labour productivity dynamics is compared with growth in employment and in total factor productivity.

The most relevant result is that the crucial growth determinant turns out to be the endowment of creative graduates, which comprises both the education and creativity traits of human capital. Non creative graduates also exhibit a growth effect, although it was found to be somehow dependent on the particular empirical specification adopted. The most talent endowed category, the bohemians, does not show any significant direct impact on regional development.

The relevance of the creative graduates in determining economic growth, specifically in terms of increasing labour productivity, is robust to the inclusion of a wide set of additional variables, which control for some geographical aspects, the endowment of technological and social and capital, the productive specialization pattern and, finally, for cultural diversity. The latter feature has been shaping the European local environment along several dimensions, demographic, social and productive and is expected to become increasingly relevant in complementing the effects of human capital.

From a policy perspective, our analysis confirms the importance of the traditional growth models' recommendation of investing in education in order to ensure long run steady increases in the level of production. Our findings also allow us to emphasize the diversified effects of different kinds of education when they are used in actual occupations; education associated with creativity – talent, originality and innovativeness – is more productivity enhancing. Therefore for lagging

regions it is of crucial importance to increase the general level of education of the resident population but also to ensure the access of young generations to the most economically effective kinds of graduate specializations. Note also that the corresponding professions are also the ones which are expected to provide viable answers to the challenging issues at stake in the current European scenario, a balanced environment-friendly growth, higher and sharp competition from emerging countries, ageing population and increasingly costly healthcare system, inclusive social policies for ensuring continued integration of foreign people, starting – not by chance – just from the education system.

References

Andersen K.V., H.K. Hansen, A. Isaksen and M. Raunio (2010) Nordic City Regions in the Creative Class Debate: Putting the Creative Class Thesis to a Test, *Industry and Innovation*, 17, 215-240.

Asheim B. and H.K. Hansen (2009) Knowledge bases, talents, and contexts: On the usefulness of the creative class approach in Sweden, *Economic Geography*, 85, 425–442.

Beckstead D., Brown WM. and Gellatly G. (2008) The Left Brain of North American Cities: Scientists and Engineers and Urban Growth, *International Regional Science Review*, 31, 304-338.

Bellini E., G.I. Ottaviano, D. Pinelli and G. Prarolo (2011) Cultural Diversity and Economic Performance: Evidence from European Regions, in Crescenzi R. and M. Percoco (eds) *Geography, Institutions and Regional Economic Performance*. Springer.

Benhabib J. and M. Spiegel (1994) The role of Human Capital in Economic Development: evidence from aggregate cross-country data, *Journal of Monetary Economics*, 34, 143-174.

Beugelsdijk S. and T. van Schaik (2005) Social capital and growth in European regions: an empirical test, *European Journal of Political Economy,* 39, 301–324.

Boschma R.A. and M. Fritsch (2009) Creative class and regional growth. Empirical evidence from seven European countries, *Economic Geography*, 85, 391-423.

Cohen D. and Soto M. (2007) Growth and human capital: good data, good results, *Journal of Economic Growth*, 12, 51–76.

Comunian R., A. Faggian and Q.C. Li (2010) Unrewarded careers in the creative class: The strange case of bohemian graduates, *Papers in Regional Science*, 89, 389-411.

Dettori B., E. Marrocu and R. Paci (2011) Total Factor Productivity, intangibile assets and spatial dependence in the European regions, *Regional Studies*, forthcoming, DOI: 10.1080/00343404.2010.529288.

Donegan M., Drucker J., Goldstein H., Lowe N. and Malizia E. (2008) Which indicators explain metropolitan economic performance best? Traditional or creative class, *Journal of the American Planning Association*, 74, 180–195.

Florida R. (2002) *The rise of the creative class and how it's transforming work, leisure, community, and everyday life*. New York: Basic Books.

Florida R., C. Mellander and K. Stolarick (2008) Inside the black box of regional development: Human capital, the creative class and tolerance, *Journal of Economic Geography*, 8, 615–49.

Glaeser E. (2005) Review of Richard Florida's the rise of the creative class, *Regional Science and Urban Economics*, 35, 593-596.

Glaeser E., D. Laibson and B. Sacerdote (2002) An Economic Approach to Social Capital, *Economic Journal*, 112, 437-458.

Griliches Z. (1979) Issues in Assessing the Contribution of Research and Development to Productivity Growth, *The Bell Journal of Economics*, 10, 92-116.

Guiso L., P. Sapienza and L. Zingales (2004) The Role of Social Capital in Financial Development, *American Economic Review*, 94, 526-556.

Helliwell J. and R. Putnam (1995) Economic growth and social capital in Italy, *Eastern Economic Journal*, 21, 295-307.

Jacobs J. (1969) *The Economies of Cities*. New York: Random House.

Kelejian H.H. and I.R. Prucha (2010) Specification and estimation of spatial autoregressive models with autoregressive and heteroskedastic disturbances, *Journal of Econometrics*, 157, 53-67.

Knack S. and P. Keefer (1997) Does social capital have an economic payoff ? A cross-country investigation, *Quarterly Journal of Economics*, 112, 1251-1288.

La Porta R., F. Lopez-de-Silanes, A. Shleifer and R.W. Vishny (1997) Trust in Large Organizations, *American Economic Review Papers and Proceedings*, 87, 333-338.

Mankiw N.G., D. Romer and D. Weil (1992) A contribution to the empirics of economic growth, *Quarterly Journal of Economics*, 107, 407-437.

Markusen A. (2006) Urban development and the politics of a creative class: Evidence from the study of artists, *Environment and Planning A*, 38, 1921–1940.

Marlet G. and C. van Woerkens (2007) The Dutch Creative Class and How It Fosters Urban Employment Growth, *Urban Studies*, 44, 2605-2626.

Marrocu E. and Paci R. (2012) Education or Creativity: what matters most for economic performance?, *Economic Geography*, forthcoming.

Marrocu E., R. Paci and S. Usai (2010) Productivity growth in the Old and New Europe: the role of agglomeration externalities, *CRENoS WP* 2010/24.

McGranahan D. and T. Wojan (2007) Recasting the creative class to examine growth: Processes in rural and urban counties, *Regional Studies*, 41, 197–216.

Mellander C. and R. Florida (2011) Creativity, talent, and regional wages in Sweden, *Annals of Regional Science*, 46, 637–660.

Moretti E. (2004), Workers' Education, Spillovers, and Productivity: Evidence from Plant-Level Production Functions, *American Economic Review*, 94, 656-690.

Ottaviano G. and G. Peri (2006) The Economic Value of Cultural Diversity: Evidence from US Cities, *Journal of Economic Geography*, 6, 9-44.

Paldam M. and G.T. Svendsen (2000) An essay on social capital: looking for the fire behind the smoke, *European Journal of Political Economy*, 16, 339–366.

Rausch S. and Negrey C. (2006) Does the creative engine run? A consideration of the effect of the creative class on economic strength and growth, *Journal of Urban Affairs*, 28, 473–489.

Rodriguez-Pose A. and R. Crescenzi (2008) Research and Development, Spillovers, Innovation Systems, and the Genesis of Regional Growth in Europe, *Regional Studies*, 42, 51-67.

Storper M. and Scott A.J.(2009) Rethinking human capital, creativity and urban growth, *Journal of Economic Geography,* 9, 147–67.

Temple J. and P.A. Johnson (1998) Social Capability and Economic Growth, *Quarterly Journal of Economics*, 113, 965-990.

Wedemeier J. (2010) The Impact of Creativity on Growth in German Regions, *European Planning Studies*, 18, 505-520.

Wojan T., Lambert D. and McGranahan D. (2007) Emoting with their feet: Bohemian attraction to creative milieu, *Journal of Economic Geography*, 7, 711–736.

Yamarik S. (2011) Human capital and state-level economic growth: What is the contribution of schooling?, *Annals of Regional Science*, 47, 195-211.

Table 1. Econometric studies on the relationship between creativity and regional development

Paper	Country	Territory	Period	Method	Dependent variable	Creative core	Bohemians	Graduates	Other controls	Note
Andersen et al (2010) table 7	DK, FI, NO, SE	(a) all regions (b) large regions	1996-2002	partial correlation	employment growth	(a) ns (b) 0.37 *		(a) 0.12 * (b) ns		they are simple correlations
Boschma, Fritsch (2009) tab 7, 8	(a) DE (b) NL	NUTS3 regions	1996-2002	spatial error	employment growth	(a) ns (b) 19.9 *	(a) 2.2 * (b) 7.4 *	(a) 4.0 * (b) 28.5 *	density	the human capital measures are included one at a time, elasticities
Donegan et al. (2008) table 6, 7	US	263 MA	1994-2003	cross section	(a) empl. growth (b) income growth	(a) ns (b) 19.1 *	(a) ns (b) ns	(a) ns (b) 27.9 *	demography, geo dummy, manuf share, diversity, technology	the traditional and creative variables are included one at a time
Florida et al (2008) fig 5, 6, 9	US	331 MA	2000	structural equations	(a) wage pc (b) income pc	(a) 0.49 * (b) ns	0.58 *	(a) 0.45 * (b) 0.44 *	tolerance, university, technology, service	the human capital measures are included one at a time
Glaeser (2005)	US	242 MA	1990-2000	cross section	population growth	ns	ns	0.74 *		variables included together
Marlet, van Woerkens (2007) tab 5	NL	50 cities	1994–2003	cross section	employment growth	0.73 *	28.6 *	ns	diversity, population, congestion, manuf. share, unempl.	Human capital measures are included in couples. If Amsterdam is excluded, bohemians are not significant
Marrocu, Paci (2012) tab 4 eq 4	EU	257 regions	2002-2007	spatial error model	TFP level	0.161 * (i)	ns	0.043 * (ii)	technology, diversity, manuf spec, settlement,	3 non overlapping categories: (i) creative graduates, boheminas, (ii) non creative graduates
McGranahan, Wojan (2007) tab 7	US	(a) non metro (b) metro county	1990-2000	cross section	employment growth	(a) 1.03 * (b) 1.75 *		(a) ns (b) -0.03 *	density, landscape, demographic, labour mkt, industry shares	all variables are included together even if highly correlated
Mellander, Florida (2011) tab 4, 7, 13	SE	81 labor market areas	2003	structural equations	wages pc	ns	19.4 *	ns	tolerance, university, technology, service	the human capital measures are included one at a time
Rausch, Negrey (2006) table 4.4	US	269 MA	2000-2004	cross section	gross product growth	-0.27 *	ns	ns	geo dummy, diversity, technology, tolerance	all variables are included together
Wedemeier (2010) tab 4 eq 3, 4	DE	97 planning regions	1995-2004	cross section	(a) empl growth (b) GDP/L growth	(a) ns (b) 1.45 *	(a) -2.53 * (b) ns		diversity, pop growth, service share, territorial dummies	creative are called technological employees, no education measure considered

*: statistically significant ns: not significant

Table 2. Creatives and Graduates

Code (a)	Occupation
Creative graduates (core creative class)	
21	Physical, mathematical and engineering science professionals
22	Life science and health professionals (except nursing)
23	Teaching professionals
243	Archivists, librarians and related information professionals
244	Social science and related professionals
Bohemians	
245	Writers and creative or performing artists
347	Artistic, entertainment and sports associate professionals
521	Fashion and other models
Non creative graduates *(non exhaustive list)*	
11	Legislators, Senior government officials
12	Directors and chief executives
13	General managers
223	Nursing and midwifery professionals
241	Business professionals
242	Legal professionals

(a) International Standard Classification of Occupations (ISCO 88)

Table 3. Data sources and definition

Variable	Description	Primary Source
Measures of economic performance (dependent variables)		
Labour productivity	GDP over units of labour, prices 2000, annual average growth rate, 2002-2007	Cambridge Econometrics
Employment growth	Units of labour, annual average growth rate, 2002-2007	Cambridge Econometrics
Total factor productivity	Total factor productivity, annual average growth rate, 2002-2007	Own estimation
Measures of human capital		
Creatives	Creative graduates plus Bohemians, % over population 25 and over; 2002	Labour Force Survey
Creative graduates	Creative core employment, % over population 25 and over; 2002	Labour Force Survey
Bohemians	Bohemians employment, % over population 25 and over; 2002	Labour Force Survey
Graduates	Employment with qualification level ISCED 5-6, % over population 25 and over; 2002	Eurostat
Non creative graduates	Differences between Graduates and Creative graduates empl., % over population 25 over; 2002	Own calculation
Control variables		
Physical capital	Capital stock per unit of labour, thousands euro; 2002	Own calculation
Technological capital	Research & Development expenditure, per capita, euro 2002	Eurostat
alternative measure	Patents stock over population, years 2000-2002	Crenos on EPO
Social capital	Trust, population that feel people helpful (highest 3 scores), %	European Social Survey
alternative measure	Safety, population that feel very safe of walking alone in local area after dark, %	European Social Survey
Cultural diversity	Foreign population over resident population, Census 2001	Eurostat
alternative measure	Tolerance, population that do not dislike immigrants or foreigners as neighbours, %	European Values Study
Production specialisation	Knowledge service, specialisation index in knowledge intensive service, employment, 2002	Eurostat
alternative measure	Manufacture, specialisation index in manufacturing industries, employment, 2002	Eurostat
Dummy convergence regions	Dummy for the "convergence regions" (<75% EU GDP average)	Eurostat
Dummy late accession	Dummies for Bulgarian and Romenian regions that join EU in 2007	

Table 4. Descriptive statistics

Variable	Measure	Min	Max	Mean	St. dev.	Var coeff.
Measures of economic performance (dependent variables)						
Labour productivity	annual average growth rate %, 2002-2007	-1.39	8.09	1.80	1.75	0.97
Employment growth	annual average growth rate %, 2002-2007	-3.23	6.94	0.95	1.20	1.26
Total factor productivity	annual average growth rate %, 2002-2007	-2.66	9.70	1.61	1.84	1.14
Measures of human capital						
Creatives	% of population aged 25 and over	1.25	12.76	5.90	2.05	0.35
Creative graduates	% of population aged 25 and over	1.17	10.93	5.26	1.70	0.32
Bohemians	% of population aged 25 and over	0.03	4.46	0.63	0.50	0.79
Graduates	% of population aged 25 and over	4.53	59.20	12.52	5.73	0.46
Non creative graduates	% of population aged 25 and over	0.00	51.41	7.25	4.64	0.64
Control variables						
Labour productivity	thousands euro	3.20	81.81	41.72	18.56	0.44
Total factor productivity	level	2.44	26.59	10.31	3.74	0.36
Physical capital	over unit of labour, thousands euro	2.78	1869.74	88.33	126.21	1.43
R&D	over thousands population, thousands euro	0.00	2.88	0.34	0.40	1.19
Patents	over thousands population, stock 2000-2002	0.00	2.59	0.28	0.36	1.31
Trust	% of population	26.52	95.74	77.91	13.11	0.17
Safety	% of population	2.43	86.39	24.15	13.31	0.55
Foreign population	% of population, 2001	0.24	38.05	6.69	5.38	0.80
Tolerance	% of population	45.29	100.00	86.69	10.06	0.12
Knowledge services	normalised specialisation index [-1 , +1]	-0.57	0.38	-0.07	0.18	2.73
Manufacture	normalised specialisation index [-1 , +1]	-0.59	0.35	-0.04	0.19	4.75

If not otherwise specified all explanatory variables refer to 2002

Table 5. Labour productivity growth and creativity

Dependent variable: labour productivity growth rate, 2002-2007

	1	2	3
Model	Linear	Spatial error	Spatial error
Estimation method	OLS	ML	ML
Human capital determinants			
Creative graduates	1.125 ***	1.020 ***	
	(0.281)	*(0.281)*	
Creative graduates - 21 and 22 codes[a]			0.381 *
			(0.202)
Creative graduates - others			0.377
			(0.289)
Non creative graduates	0.311 ***	0.261 ***	
	(0.090)	*(0.088)*	
Non creative graduates - 12 and 13 codes[b]			0.605 ***
			(0.157)
Non creative graduates - others			0.040 ***
			(0.015)
Bohemians	0.145	0.110	0.052
	(0.135)	*(0.133)*	*(0.132)*
Control variables			
Labour productivity, initial level	-2.158 ***	-2.069 ***	-1.958 ***
	(0.222)	*(0.224)*	*(0.222)*
Spatial error correlation coefficient		0.907 ***	0.899 ***
		(0.065)	*(0.071)*
Robust LM error test	33.954		
p-value	*0.000*		
Robust LM lag test	13.464		
pvalue	*0.000*		
Square correlation, actual and fitted values	0.629	0.659	0.670

a ISCO codes 21 and 22: Science professionals, Life science and health professionals (excluding nursing)

b ISCO codes 12 and 13: Directors and chief executives and General managers

Observations: 257 regions. All regressors refer to the 2002 year.

All regressions include a constant and three dummy variables for convergence regions, Bulgarian regions and Romanian regions

Human capital variables are log-transformed and in per capita values.

The spatial weight matrix is the inverse distance matrix, max-eigenvalue normalized.

Robust standard errors in parenthesis; level of significance: *** 1%, ** 5%, * 10%

Table 6. Alternative growth performance indicators

	1	2	3	4
Dependent variable	Employment growth		TFP growth	
Model	Linear	Spatial error	Linear	Spatial error
Estimation method	OLS	ML	OLS	ML
Human capital determinants				
Creative graduates	0.098	0.488 *	1.323 ***	0.948 **
	(0.280)	*(0.272)*	*(0.406)*	*(0.385)*
Non creative graduates	0.082	0.098	0.269 **	0.206 *
	(0.090)	*(0.085)*	*(0.131)*	*(0.120)*
Bohemians	0.223 *	0.183	0.159	0.120
	(0.135)	*(0.128)*	*(0.195)*	*(0.181)*
Control variables				
Employment, initial level	-0.104	-0.066		
	(0.086)	*(0.080)*		
TFP, initial level			-1.836 ***	-1.769 ***
			(0.458)	*(0.428)*
Spatial error correlation coefficient		0.948 ***		0.961 ***
		(0.037)		*(0.028)*
Robust LM error test	40.509		89.701	
p-value	*0.000*		*0.000*	
Robust LM lag test	2.508		87.431	
pvalue	*0.113*		*0.000*	
Square correlation, actual and fitted values	0.210	0.325	0.306	0.434

Observations: 257 regions. All regressors refer to the 2002 year.

All regressions include a constant and three dummy variables for convergence regions, Bulgarian regions and Romanian regions

Human capital variables are log-transformed and in per capita values.

The spatial weight matrix is the inverse distance matrix, max-eigenvalue normalized.

Robust standard errors in parenthesis; level of significance: *** 1%, ** 5%, * 10%

Table 7. Labour productivity growth models - robustness analysis

Dependent variable: labour productivity growth rate, 2002-2007
Spatial error models

	1	2	3	4	5	6	7
Human capital determinants							
Creative graduates	0.852 ***	0.797 ***	0.806 ***	0.804 ***	0.798 ***	0.832 ***	0.986 ***
	(0.289)	*(0.291)*	*(0.290)*	*(0.285)*	*(0.286)*	*(0.293)*	*(0.283)*
Non creative graduates	0.127	0.144 *	0.176 **	0.122	0.162 *	0.161 *	0.135
	(0.091)	*(0.092)*	*(0.088)*	*(0.091)*	*(0.087)*	*(0.094)*	*(0.093)*
Bohemians	-0.053	-0.007	-0.040	-0.064	-0.038	-0.013	-0.003
	(0.137)	*(0.136)*	*(0.137)*	*(0.136)*	*(0.135)*	*(0.136)*	*(0.135)*
Control variables							
Labour productivity, initial level	-2.020 ***	-1.981 ***	-2.111 ***	-2.073 ***	-2.372 ***	-1.923 ***	-1.999 ***
	(0.284)	*(0.286)*	*(0.281)*	*(0.244)*	*(0.292)*	*(0.292)*	*(0.294)*
Physical capital	-0.305 ***	-0.315 ***	-0.296 ***	-0.295 **	-0.335 ***	-0.322 ***	-0.309 ***
	(0.117)	*(0.118)*	*(0.118)*	*(0.117)*	*(0.117)*	*(0.118)*	*(0.118)*
Technological capital: R&D	-0.006	-0.004	0.030		0.052	-0.015	0.019
	(0.096)	*(0.097)*	*(0.095)*		*(0.094)*	*(0.098)*	*(0.101)*
Technological capital: patents stock				0.166			
				(0.235)			
Social capital: trust	0.014 **	0.013 *		0.013 *		0.013 *	0.018 **
	(0.007)	*(0.092)*		*(0.007)*		*(0.007)*	*(0.008)*
Social capital: safety					0.018 ***		
					(0.006)		
Cultural diversity: foreign population	0.031 ***		0.028 **	0.029 **	0.025 *		0.033 **
	(0.014)		*(0.014)*	*(0.014)*	*(0.014)*		*(0.014)*
Cultural diversity: tolerance						-0.007	
						(0.007)	
Production specialisation: knowledge services	1.464 **	1.735 ***	1.661 **	1.564 **	2.382 ***	1.624 **	
	(0.681)	*(0.674)*	*(0.676)*	*(0.695)*	*(0.712)*	*(0.683)*	
Production specialisation: manufacture							-0.446
							(0.409)
Spatial error correlation coefficient	0.910 ***	0.902 ***	0.899 ***	0.914 ***	0.875 ***	0.900 ***	0.908 ***
	(0.063)	*(0.069)*	*(0.071)*	*(0.060)*	*(0.087)*	*(0.070)*	*(0.065)*
Square correlation, actual and fitted values	0.687	0.681	0.683	0.688	0.691	0.683	0.683

Observations: 257 regions. All regressors refer to the 2002 year.
All regressions include a constant and three dummy variables for convergence regions, Bulgarian regions and Romanian regions
Human capital variables and R&D are log-transformed and in per capita values; physical capital is log-transformed and per units of labour; patents stock is in patents per 1000 inabitants
The spatial weight matrix is the inverse distance matrix, max-eigenvalue normalized.
Robust standard errors in parenthesis; level of significance: *** 1%, ** 5%, * 10%

Ultimi Contributi di Ricerca CRENoS

I Paper sono disponibili in: http://www.crenos.it

12/01 *Bianca Biagi, Maria Giovanna Brandano, Claudio Detotto,* "The effect of tourism on crime in Italy: a dynamic panel approach"

11/23 *Rinaldo Brau, Anna Maria Pinna,* Movements of People for Movements of Goods?"

11/22 *Giorgio Garau, Giovanni Mandras, Lucia Schirru,* "A Statistical Information System supporting Environmental Policies"

11/21 *Emanuela Marrocu, Raffaele Paci, Stefano Usai,* "The complementary effects of proximity dimensions on knowledge spillovers"

11/20 *Giuseppe Pulina,* "Tax Evasion and Presumptive Taxation Methods. A Case Study in Italy: Sector Studies"

11/19 *Juan Gabriel Brida, Giacomo Del Chiappa, Marta Meleddu, Manuela Pulina,* "The perceptions of an island community towards cruise tourism: A factor analysis"

11/18 *Fabio Cerina, Francesco Mureddu,* "Structural Change and Growth in a NEG model"

11/17 *Juan Gabriel Brida, Manuela Deidda, Nicolàs Garrido, Manuela Pulina* "Exploring the dynamics of the efficiency in the Italian hospitality sector. A regional case study"

11/16 *Juan Gabriel Brida, Nicolàs Garrido, Francesco Mureddu,* "Italian economic dualism and convergence clubs at regional level"

11/15 *Adriana Di Liberto, Marco Sideri,* "Past dominations, current institutions and Italian regional economic performance"

11/14 *Juan Gabriel Brida, Marta Meleddu, Manuela Pulina*, "Museum visitors can be regarded as specific cultural tourists? A length of stay analysis"

11/13 *Edoardo Otranto,* "Classification of Volatility in Presence of Changes in Model Parameters"

11/12 *Alessandro Fiori Maccioni,* "The risk neutral valuation paradox"

11/11 *Leonardo Becchetti, Vittorio Pelligra,* "Don't Be Ashamed to Say You Didn't Get Much: Redistributive Effects of Information Disclosure in Donations and Inequity-Aversion in Charitable Giving"

11/10 *Alessandra Colombelli, Marta Foddi, Raffaele Paci,* "The knowledge regions in the enlarged Europe"

11/09 *Emanuela Marrocu, Raffaele Paci, Stefano Usai,* "Proximity, Networks and Knowledge Production in Europe"

11/08 *Vittorio Pelligra,* "Empathy, Guilt-Aversion and Patterns of Reciprocity"

11/07 *Claudio Detotto, Edoardo Otranto,* "Cycles in Crime and Economy Revised"

11/06 *Juan Gabriel Brida, Marta Meleddu, Manuela Pulina,* "The attractiveness of a modern and contemporary art museum"

11/05 *Juan Gabriel Brida, Marta Meleddu, Manuela Pulina,* "An urban icon? The case of the Iceman Ötzi "

11/04 *Silvia Balia, Rinaldo Brau,* "A Country for Old Men? An Analysis of the Determinants of Long-Term Home Care in Europe"

Finito di stampare nel mese di Dicembre 2012
Presso **Copy…Right! studio grafico & stampa digitale**
Via Turritana 3/B – Tel. 079.200395 – Fax 079.4360444
07100 Sassari

www.crenos.it

ISBN 978-88-84-67-775-4