Creative industries and the productivity of the European regions

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Resumen: *This paper investigates the effect of creative service industries (CSI) on labour productivity in the European regions. CSI offer services that increase the capacity of generation and combination of ideas for the whole economy of the region, resulting in increased production of innovations through the generation of new products or varieties, which in turn raises productivity. The article proposes an analytical framework that is contrasted for a sample of 250 regions in the European Union in 2008. We find that a doubling of the percentage of jobs in CSI increases average labour productivity by around 16 per cent. Evidence that CSI have a significant impact on productivity differentials in European regions imply than a faster way to grow is through increased specialization in creative industries. This evidence would place the policy based on CI in a similar level of importance than scientific policy or human capital policy, offering in some regions a better alternative than other policies.*

Palabras Clave: *creative industries; creative service industries; regional productivity*
Clasificación JEL: R11, R12, R58

1. INTRODUCCIÓN

In a simple economic identity, the output of a region depends on the number of workers (workforce) and the output per worker (productivity). The differences of productivity across the regions of the European Union (EU) are remarkable: whereas Inner London's productivity is more than 300 per cent above the average, most regions in Romania and Bulgaria are more than 70 per cent below the average. The debate about the causes of the differences in productivity across regions has remarked the role of capital and the elements of the total factor productivity such as the agglomeration economies, human capital, institutions, social capital, infrastructures, scientific production, and the composition of the structure of activities (GARDINER *et al.* 2004; MAROTO and CUADRADO-ROURA 2011). Last decades economic debate has witnessed the emergence of a new set of concerns that have turned the attention of scholars and policy-makers towards business and industries that so far have been neglected. With the relocation of a part of the mass production in low cost countries, and with technological advancement having transformed many industries and invented others, the focus has now shifted to those economic activities and business that are producing value in developed countries, particularly through the use of intangibles.

In this debate, *creative industries* (CI) have received increasing attention of scholars and policy-makers as a driver of growth (DCMS 1998 and 2001; HAWKINS 2007; EUROPEAN COMMISSION 2010; UNCTAD 2010). Creative industries can be defined as a set of knowledge-based activities focused on the generation of meaning, content and aesthetic attributes by means of creativity, skill and talent, and with the potential to create wealth from trade and intellectual property rights (DCMS 2001; UNCTAD 2010). They include industries such as publishing, fashion, audiovisual, radio and TV, software, architecture and engineering, research and development, advertising, design, photography, and arts and entertainment, are generally considered to be “creative”.

This paper investigates the effect of *creative service industries* (CSI) on labour productivity in the European regions. The question is whether creative industries impacts on the levels of labour productivity of the regions where they are placed. Our hypothesis is that higher shares of workforce in creative services industries results in higher levels of productivity of the region. This is due to the fact that CSI offer services that increase the capacity of generation and combination of ideas for the whole economy of the region, resulting in increased production of innovations through the generation of new products or varieties, which in turn raises productivity. Our objective is to propose an analytical framework relating CSI and productivity and to test whether higher shares of CSI on the economy of the region results in higher levels of productivity.

Despite the emphasis in recent years on the role of CI to the development of countries, regions and cities, contributions focused on explaining and measuring the impact of creative industries on labour productivity are scarce. This article contributes to the debate with an analytical framework that is contrasted for a sample of 250 regions in the European Union. The research findings are relevant to both the scientific debate as to policy: evidence that CSI have a significant impact on productivity differentials in European regions imply than a faster way to grow is through increased specialization in creative industries. This evidence would place the policy based on CI in a similar level of importance than scientific policy or human capital policy, offering in some regions a better alternative than other policies.

The article is divided into five parts. After Section 1's introduction, Section 2 reviews the literature relating CI and productivity. Section 3 then develops the analytical model. Section 4 introduces the data, variables and estimation procedures. Section 5 presents the results of the econometric estimates and the main findings. Finally, Section 6 is devoted to a discussion of the results and their implications.

2. CREATIVE INDUSTRIES AND PRODUCTIVITY

The term "creative industries" seems to originate in Australia (DCA, 1994), and then its use expanded thanks to the actions of Tony Blair's British Labour government which needed to find new bases for growth for the UK's post-industrial economy (O'CONNOR, 2007; DCMS, 1998). One of the raisons because the DCMS (2001) focused on creative industries was because they show high growth rates in Great Britain during the 1990s. In addition, the discourse had an attraction of changing the perception of certain activities such as arts and culture from being subsidized sectors (BAUMOL AND BOWEN, 1965) to being generators of wealth (DCMS, 1998; UNCTAD, 2010) and as contributors to the so called new economy. The contemporary success of Richard FLORIDA's (2002) book The Rise of the Creative Class helped with the dissemination of the idea. However, whereas Florida's creative class perspective is human capital-based, the creative industries approach is industry-based.

The research agenda on creative industries has hitherto focused on four basic aspects: epistemological and taxonomical issues (DCMS, 2001; O'CONNOR, 2007; HESMONDHALGH, 2008¸ FLEW AND CUNNINGHAM, 2010); geographies (COOKE AND LAZZERETTI, 2008; LAZZERETTI *et al*., 2008; CAPONE, 2008; DE PROPRIS *et al*., 2009; LAZZERETTI, 2012); policy-making (MOMMAAS, 2004;

GARNHAM, 2005; RAUNIG, 2007; HESMONDHALGH, 2008); and economic and social impacts (UNCTAD, 2010; FLEW AND CUNNINGHAM, 2010; POTTS AND CUNNINGHAM, 2008; RAUSELL *et al*., 2011; DEMIGUEL *et al*., 2012; BOIX *et al*., 2013).

The relationship between creative industries and productivity is inserted into the last line, although it has still received little attention. This relationship is intrinsically linked to the debate on the impact of creative industries on economic growth and wealth differentials. A good point of departure to contextualize the problem is POTTS AND CUNNINGHAM (2008) and POTTS (2009), who propose four models of the relationship between the creative industries and the whole economy: welfare model, competitive model, growth model, and innovation model.

In the *welfare model*, creative industries are affected by the *Baumol's disease* (BAUMOL AND BOWEN, 1965) and their rate of productivity grow less than in the rest of the economy so that they have a direct negative impact on growth, even if they are subsidized because they welfare enhancing. However, this approach usually neglects that an increase of welfare has effects on, for example, health and psychological well-being (SACCO 2011), which can reduce the expenditures in health of a region or derive in healthier and psychologically more motivated workers, which in turns can translate to productivity growth.

In the *competitive model*, creative industries are just another industry and don't have more effect than the rest of activities on the technological change, innovation or productivity growth.

In the *growth model*, creative industries are a growth driver and their impact on the economy is more than proportional. From a supply-side, creative industries have been growing more than the rest of industries because they were in their phase of expansion. Growth of CI is explained in terms of increased investment in input factors, qualitative improvement in input factors through increases in human capital and embodied technology, the growth of the demand, and institutional change affecting organizational forms, business models and market strategies. From a demand-side, the raison could be that a growth in income causes a proportionate increase in demand for creative industries services.

(d) The *innovation model* reconceptualises the creative industries as a higher-order system that operates on the economic system, and their main effects are not the direct effects on the production or wealth but rather its contribution to the technical change. From the point of view of the *innovation model*, the contribution of creative industries to the economic growth derives not only from their direct value, but particularly from their contribution to the growth of the entire economic system. Creative industries are part of a process of economic evolution in which their role is to provide *evolutionary services* to the innovation system, facilitating change (POTTS 2009).

If fact, according to the theory of the differentiated knowledge bases, creative industries provide a particular type of services where the use of *symbolic knowledge* is dominant (JENSEN *et al*. 2007; ASHEIM and PARRILLI 2012). Conceptual distinctions between *knowledge bases* take into account the rationale for knowledge creation, its development and use, and the way the knowledge is transmitted and absorbed. JENSEN *et al*. (2007) and ASHEIM and PARRILLI (2012) differentiate three basic types of knowledge used as input in knowledge creation and innovation processes, analytical, synthetic and symbolic:

a) An *analytical knowledge base* refers to the development of new knowledge through the use of the deductive scientific method and scientific laws (*know why*). The workforce requires analytical skills and capacity for abstraction and testing, and needs research experience or university training. Knowledge inputs and outputs are more codified than in other knowledge bases. This base is linked to the *Science, Technology and Innovation* model of the knowledge economy, where knowledge creation usually takes the form of scientific discoveries and technological inventions (e.g. the pharmaceutical industry).

b) A *synthetic knowledge base* refers to the application or novel combinations of existing knowledge (*know how*). Knowledge is not addressed to scientific discovery but to solving specific problems. The synthetic base is linked to the *Doing, Using, and Interacting* innovation model, where knowledge is created in a more inductive process of testing, experimentation, and practical work (e.g. as found in mechanical engineering).

c) A *symbolic knowledge base* is related to the "creation of meaning and desire as well as aesthetic attributes of products, producing designs, images and symbols, and to the economic use of such forms of cultural artefacts" (ASHEIM *et al*. 2011, p.897). The knowledge input is aesthetic more than cognitive and new knowledge is usually developed through a *creative process* more than analytical processes or problem solving. This is typical of cultural and creative industries, where skills are more linked to practice in the several stages of the creative process in place than to formal education and embodied in communities of practice, and as a consequence knowledge is highly tacit and contextual. Linking this discussion with POTTS (2009) argument, one interesting quality of aesthetic attributes is that they impact on the regional economic processes is direct when they are an output of creative industries for the final consumer, and in addition they provide services to the rest of the productive system in two ways: as an input demanded for other industries, and through a horizontal spillover effect since they affect the perceptions of the communities (people, business and institutions) as a whole.

Most of the contributions of other authors justifying the impact of creative industries on economic growth have also focused on POTTS and CUNNINGHAM (2008) third and fourth scenarios. Thus, RAUSELL *et al*. (2011) propose a theoretical model with circular causal effects: an increase in the GDP per capita increases the share of people with high levels of education and income, the percentage of public and private expenditure oriented to creative goods and services, and the stock of cultural capital. The result is an increase in the demand of creative goods and services that makes grow the share of workers in creative industries. This has two effects: first, an increase in the number of innovations; second, and increase in the levels of productivity of the economy, under the assumption that productivity in creative industries is higher than the average of the economy. Increases in innovation and productivity results in an increase in the GDP per capita, and the process starts over.

SACCO AND SEGRE (2006) propose a virtuous circle based on the acquisition of *competences*, where the notion of competence refers to the effect of the stimulus of cultural, symbolic and identitarian capital. The basic assumption is that the level of competence and capability of consumers is large enough to guarantee that they will be willing to pay for the creative component of a given quality commodity, where a part of these consumers is made of creative workers. Firms invest in creative assets to take advantage of the skills of creative workers in order to increase the creative component in the production of goods and services and attend the qualified demand. The result is an increase in the stock of creative capital, which enlarges the quality and dimension of local cultural supply. Changes in the supply and social awareness improve the competences of non-core creative workers and foster the demand of creative commodities. At this point, a part of the value added generated by the process is devoted to financing creative activities by firms and the investment of public sector in creative industries, creating a virtuous cycle.

We can conclude that creative industries can affect the productivity of regions because of two reasons:

a) Creative industries have higher productivity than the rest of industries, which in practice means that their relative investment in capital and/or their rate of technical change is higher than in the rest of the economy. The evidence on this respect is still poor and unclear, although some works provide positive evidence. Thus, DOLFMAN *et al*. (2007) find that in the United States the average wage in creative industries was 34.9 per cent higher than the comparable national private sector wage, even if the evolution in both cases was similar since 1990. POTTS *et al*. (2008) provide evidence that the average income of creative industries in Australia is 31 per cent higher than the national average and their aggregate growth rate is higher than that of the aggregate economy.

b) Creative industries impact on the total factor productivity of the whole regional economic system by providing innovation services. In this scenario we could even found that the rest of activities do not remunerate part of these services, so that creative industries provide external economies to the rest of the system. Evidence on this respect is also limited although positive, for example, FLORIDA *et al*. (2008) find that occupational groups related to arts and entertainment, architecture and engineering, and research, have important impacts on the differentials of income, productivity and wages in 331 metropolitan regions of US.

If we accept POTTS (2009) argument, the contribution of creative industries in the second scenario is quite more important as they affect the performance of the entire regional economy. In order to reinforce evidence on this scenario, in the next section we will propose an analytical framework to analyse the contribution of creative industries to the productivity of the regions.

3. CREATIVE INDUSTRIES AND PRODUCTIVITY: AN ENDOGENOUS GROWTH APPROACH

In this section we propose a supply-based view of the contribution of creative industries to the productivity of the regions, based on the endogenous growth theory. It has been chosen because it allows to analyse the relationship between CI and wealth of the regions through the generation of innovations. The use of this approach is mainly instrumental in this article, being aware of its limitations.

Endogenous growth theory explains the occurrence of long-run growth as something which emanates from economic activities internal to an economic system creating new knowledge. It proposes channels through which the rate of technological progress, and hence the long-run rate of economic growth, can be influenced by economic factors. A second wave of endogenous growth theory, generally known as *innovation-based growth theory*, recognizes that intellectual capital, the source of technological progress, is distinct from physical and human capital. The key point is that whereas physical and human capital are accumulated through saving and schooling, intellectual capital grows through creativity, and this drives innovation.

Innovation-based growth is generally thought to develop in accordance with either of two main conceptual frameworks, namely *Schumpeterian theory* (GROSSMAN and HELPMAN 1991; AGHION and HOWITT 1992), which accommodates very well the notions of analytic and synthetic knowledge; or *endogenous technological change models* proposed by ROMER (1990a,b), which accord perfectly with the idea of symbolic knowledge. Romer-type models assume that aggregate productivity is an increasing function of the degree of product variety: innovation causes productivity growth by creating new, but not necessarily improved, varieties of products. Intuitively, an increase in product variety raises productivity by allowing society to spread its intermediate production more thinly across a larger number of activities, each of which is subject to diminishing returns and hence exhibits a higher average product when operated at a lower intensity. The implication is that the way to grow rapidly is not by saving, but by dedicating a large fraction of output to creative activities.

Our model is based on the Romer-Jones framework, reproducing the solution of JONES (1995, 2001). The model departs from a multiplicative equation $Y = K^{\propto}(AL_Y)^{1-\propto}$ (1). The key of the model is that working people (L), the source of creativity, can be dedicated to producing ideas (L_A) in the creative sector or, alternatively, producing goods and services in other sectors (L_Y): $L = L_A + L_y$ (2), where we can express that $s_R = L_A/L$ (3) so that $L_A = s_R L$, (4) and $s_Y = 1 - s_R$ (5).

Following JONES (1995, 2001), the general production function for ideas is $\dot{A} = A_t - A_0 = \bar{\delta} L_A^{\lambda}$ (6), where $\bar{\delta} = \delta A^{\phi}$ (7). So that: $\dot{A} = \delta L_A^{\lambda} A^{\phi}$ (8). In the formula, δ is the rate of creation of ideas and λ, defined between 0 and 1, measures the existence of scale economies. The parameter ϕ measures the productivity (returns) in the production of the ideas: $\phi < 0$ involves that every time is more difficult to create new ideas, $\phi = 0$ means that the creation of new ideas is independent from previous knowledge, and $\phi > 0$ means that creation increases more than proportionally due to the existence of previous ideas. The growth rate of generation of ideas can be expressed as $g_A = \frac{\dot{A}}{A} = \delta L_A^{\lambda} \frac{A^{\phi}}{A}$ (9), from which $A = \left[\frac{\delta (s_R L)^{\lambda}}{g_A}\right]^{\frac{1}{1-\phi}}$ (10).

The long term growth rate of the model is constant, which means that the ratio *y/A* is constant, and along a balanced growth path is determined by the equation:

$$\left(\frac{y}{A}\right)^{*} = \left(\frac{s_K}{n+g_A+d}\right)^{\propto/(1-\propto)} (1 - s_R) \quad (11)$$

where y^{*} is the output per worker (*Y/L*), s_K is the investment rate in capital, *n* the growth rate of the population, *d* is the depreciation rate of capital. By substitution, a general solution of the simplest version of the model for a path of balanced growth and a moment of time *t* can be written as:

$$y^{*} = \left(\frac{s_K}{n+g_A+d}\right)^{\propto/(1-\propto)} (1 - s_R) \left[\frac{\delta(s_R L)^{\lambda}}{g_A}\right]^{\frac{1}{1-\phi}} \quad (12)$$

The equation can be linearized taking logarithms, taking the form[1]:

$$\ln y = b\ ln\delta + b\lambda\ lns_R + lns_y + a \ln s_k - a \ln(n + g_A + d) + b\lambda\ lnL - b\ lng_A \quad (13)$$

, where $a = \frac{\propto}{1-\propto}$ and $b = \frac{1}{1-\phi}$.

This equation is spatially static, although in a regional context they should incorporate spillover effects coming from other regions. KOCH (2008) or FISCHER (2008) show analytical justification to arrive to the spatially augmented specification. The spatially augmented in spatial growth model can take several forms (LeSage and Pace 2009), although Fingleton & López-Bazo (2006) provide convicing arguments that

[1] Jones provides solutions for particular values, i.e. $\lambda=1$ and $\phi=0$, which assures the stability of the model. The final equation to be estimated is similar. The only difference is the interpretation of the parameters.

the spatial dependence should be more of the substantive type than due to stochastic shocks. In the next section, the convenience of estimating the spatially augmented regression and the concrete form of the spatial model can be decided after analysing the residuals of the spatial model.

4. DATA AND ESTIMATION

4.1. Data

The sample comprises data for 250 NUTS 2 regions in 24 countries of the European Union: Austria, Belgium, Bulgaria, Check Republic, Cyprus, Denmark, France, Estonia, Finland, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Nederland, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Sweden, and the United Kingdom. The countries for which data was not available, such as for Greece, Luxembourg and Malta, were not included. Data were drawn from Eurostat's Structural Business Statistics (SBS), Science and Technology Statistics (STS) and Regional Economic Accounts (ESA) databases for the year 2008. SBS, in combination with the new NACE, provides a good source of data for this research, since the information is disaggregated from two to four digits. The new NACE is particularly designed to deal with the requirements of the knowledge economy, with the consequence that CI are properly captured at the two digits level in most cases. Data for multimodal accessibility come from ESPON Accessibility update.

4.2. Variables

Dependent variable and structural explanatory variables

The dependent variable is regional GDP per worker. Explanatory variables include the structural variables directly derived from the model and the modelling of the growth rate of ideas. Thus, the variable s_Y refers to the share of the rest of manufacturing and services industries, and agriculture and construction are not included to avoid perfect collinearity. The most comprehensive taxonomy of CI, particularly appropriate to cross-country comparisons, has been proposed by UNCTAD (2010). This classification has the advantage of being not only firmly founded but also of being less restrictive as it encompasses both cultural and technological dimensions of CI, whereas other taxonomies (e.g. DCMS, WIPO or KEA) are biased towards one of the two dimensions. It includes both manufacturing and service industries, although the majority of creative industries are in fact services, especially knowledge-intensive services (such as audiovisual, broadcasting, computer programming, R&D, publishing, architecture and engineering, advertising, design, and arts and entertainment services) (Table 1). In their research on the differentials of wealth in the European regions, BOIX *et al.* (2013) suggest there should be an exclusive focus on creative services because in many countries it is not clear whether creative manufacturing are really creative and services are the only CI that seems to have a positive impact on wealth differentials. Focus on services is also more consistent with POTTS (2009) proposal we introduced in the Section two, in which creative industries provide evolutionary services to the rest of the activities.

Again, in order to make for greater coherency with the theoretical section, activities are aggregated by knowledge base. Symbolic knowledge is represented by CSI. Analytic knowledge includes high-tech manufacturing and service sectors (except those already classified as creative services). Synthetic knowledge groups the rest of manufacturing and service activities classified as non-creative[2]. In order to avoid perfect collinearity, in the estimates only symbolic, analytic and synthetic activities are included, excluding the residual group of non-classified activities.

Table 1- Classification of activities by knowledge base

Knowledge base	NACE Rev.2 codes
Symbolic (creative services)	4779 Retail sale of second-hand goods in stores 58 Publishing 59 Audiovisual 60 Programming and broadcasting 62 Computer programming 71 Architecture and engineering 72 R&D 73 Advertising 74 Design, photography 90 to 93 Arts, entertainment and recreation (section R)
Analytic	21, 23 High tech manufacturing 61, 63 High tech knowledge intensive services (excluding creative services)
Synthetic	20, 27, 28, 29, 30 Medium-high tech manufacturing 19, 22, 23, 24, 25, 33 Medium-low tech manufacturing 10, 11, 12, 13, 14, 15, 16, 17, 18, 31, 32 Low tech manufacturing 50, 51, 64, 65, 66, 69, 70, 75, 78, 80, 84, 85, 86, 87, 88 Rest of knowledge intensive services (excluding creative services) 45, 46, 47 (excluding 4779), 49, 52, 53, 55, 56, 68, 77, 79, 81, 82, 94, 95, 96, 97, 98, 99 Less-knowledge-intensive services
Non classified	Rest of NACE codes

Source: Elaborated from UNCTAD (2010) and Eurostat (2009

The capital investment rate s_K is measured using gross fixed capital formation per worker; n is the annual growth rate of the working age population (15 to 64 years) between 1992 and 2008 (the largest series without significant problems of missing data); $g+d$ is considered to be 0.05 for every region as in the Mankiw-Romer-Weil estimates, which is usual in this type of model due to the lack of regional data about depreciation rates; and L is the number of jobs in the region.

[2] This elaboration is imperfect, although it provides a first proxy for exploring the idea of separating the three types of knowledge bases. The fact that analytic and synthetic knowledge bases do not create ideas could seem counterintuitive. A more realistic view is that the creative sector produces basically ideas and the rest produces basically goods and services. In any case, this does not affect the structure of the model.

Variables for the growth rate of ideas

GLAESER *et al.* (1992) and HENDERSON *et al.* (1995) assume that the growth rate of ideas g_A is a function of knowledge spillovers generated by dynamic externalities. Whereas static external economies (e.g. traditional localization and urbanization economies) produce transitory shocks, dynamic external economies are related to the generation and exchange of knowledge spillovers and have the ability to produce irreversible changes in the production function. Dynamic external economies focus on three theories: Marshall, Arrow and Romer (MAR) focus on knowledge spillovers between firms in the same industry; Porter focus on the same idea although remarking that local competition in specialized industries is necessary to foster rapid adoption of innovation; by contrast, Jacobs emphasises variety and diversity of geographically proximate industries as the key determinant of innovation. TRULLÉN *et al*. (2013) introduce the notion of dynamic network economies between places articulated in network of cities, with the idea that they facilitate spillovers or network information and knowledge flows among actors located in different cities.

The indicators for dynamic agglomeration economies are quite similar to those used by GLAESER *et al.* (1992) and HENDERSON *et al.* (1995), being the most usual in agglomeration studies.

MAR specialization economies are measured using the location quotient of each industry. However, our models include the share of jobs by type of knowledge base, which is the numerator of the location quotient. The simple indicator and the location quotient are highly collinear so that only the simple coefficient is introduced because is requested by the model. Following DE MIGUEL *et al.* (2012), we use as a proxy for

MAR economies the number of clusters in the region. To elaborate the variable, we first calculated the location quotient of each sector at two digits in the region using as base the sample of 250 regions. Then, we sum the number of sectors for which the location quotient is higher than one, this is, in which the region is specialized.

Jacobs's variety of activities is measured using diversity and density indexes. For the former, since our data are not panelled as in GLAESER *et al.* (1992), we follow HENDERSON *et al.* (1995) and use the more usual Hirschman-Herfindahl index, calculated for the jobs in 60 sub-sectors in the economy, and expressed as the inverse of the index to facilitate the interpretation. The higher the IHHI ratio, the more diverse is the region, and this should affect positively its wealth: $IHHI_s = 1/\left(\sum_i (Jobs_{i,s}/Jobs_i)^2\right)$. HENDERSON *et al.* (1995) include a second indicator of Jacobs's economies: the density of jobs per square kilometre, to take into account the fact that density fosters technological spillovers within regions (CICCONE and HALL 1996).

Porter competition economies were measured by Glaeser using the location quotient of number of firms per worker in city industry. We use the simple version of the competition indicator: the number of firms per worker.

To measure TRULLÉN *et al*. (2013) dynamic network external economies, we use the ESPON (2009) multimodal accessibility index, which is weighting the potential of each region to exchange information through transportation infrastructures.

Descriptive statistics and the correlation table are in the annex 1.

4.3. Estimation

In the equation 13, creative service industries (S_R in the equation) is an endogenous covariate. In addition, the estimates suffer from non-normality and heteroskedasticity. To deal with these issues, the estimates are performed using the Generalized Method of Moments (GMM). GMM requires the use of instruments for the endogenous covariates. The instruments used are the regionalized cultural expenditures per capita[3] and the number of UNESCO heritage places in the region.

Spatial tests were performed on the residuals of the OLS and IV-GMM estimates. Three matrices were used for the test: geographical contiguity (binary), distance, and squared distance, where interaction is conceived as being based on a mix of cognitive, organizational, social, institutional and geographical proximities. The matrices were row-normalized, and as a consequence each region *i* is influenced by neighbouring regions *j*, each neighbour exerts the same influence regardless of its size, and the total number of neighbours of each region is not relevant. The contiguity matrix produced the strongest evidence of spatial correlation and was used for the final estimates. Tests in table 2 suggest the existence of spatial autocorrelation in the form of a spatial lag model. Subsequent comparisons with other alternatives suggest the preference for the spatial lag model.

The spatial lag of the endogenous model contains two endogenous covariates: CSI and the spatial lag of the dependent variable. To deal with these issues, the estimates are performed using the Generalized Method of Moments (GMM) (see KELEJIAN AND PRUCHA 2010) with the spatial "best instruments" approach (LEE 2003). GMM - Lee method allows the simultaneous estimation of spatial and non-spatial endogenous variables, producing consistent and efficient estimates that can be made robust against heteroskedasticity, solving at the same time most of the problems

[3] The data on cultural expenditures is only available at a country level. The regionalization is made by dividing the 2001 data by the share of people working in culture and heritage in 2001.

associated with instruments in the spatial estimates (number of lags, weakness, etc.). Initial instruments for the first step of Lee's procedure includes the first and second order lags of: cultural expenditures per capita and the number of UNESCO heritage places in the region, the capital investment rate, and multimodal accessibility. Identification and overidentification tests (Anderson LR and Hansen J) suggest that the instruments are exogenous and have good explanatory capability in all the estimates.

4. RESULTS

In table 2 we present results for equation 13 pertaining to the effect of CSI on the productivity of the regions of the European Union. The column (1) presents the estimates including all the variables. The column (2) presents the estimates after removing step by step the collinear variables (parsimonious estimates). The column (3) introduces the effect of productivity in neighbouring regions through the estimation of a spatial lag model. The coefficient in (3) cannot be directly compared with the coefficient of the other estimates, and comparison is performed using the *total effect* (see LESAGE AND PACE 2009). The *total effect* can be divided in *direct* (originated in the region) and *indirect* (coming from neighbouring regions). Since both parts of the equation are in logarithms, the results can be interpreted as elasticities. In terms of model comparison (Akaike and Schwartz) the estimates of the spatial lag model are preferred to the other two.

As predicted by the analytical model, the percentage of jobs in creative industries impacts positively on the productivity of the region, and their effect is higher those of the rest of activities. In the spatial model (3), we find that a doubling of the percentage of jobs in CSI increases average labour productivity by around 16 percent.

Two thirds of the impact on productivity come from CSI in the own region (direct effect), and the rest are generated by CSI in neighbouring regions (indirect effect).

Regarding the rest of structural variables, the coefficient of the capital investment rate on the productivity is about 0.31 (quite standard in this type of models) and is statistically significant; the total employment and $n+g+d$ are close to zero and are statistically non-significant.

Regarding dynamic external economies, in the estimates of the complete model (column 1): higher levels of competition (firms per worker), Jacobs dynamic external economies (population density and diversity), and dynamic network economies (multimodal accessibility) impacts positively on the differences of productivity across the EU regions. However, density, diversity and accessibility are collinear among them, particularly density and accessibility. Accessibility is statistically significant in all the step by step regressions, and has a better performance than density. This is due to the fact that, by construction, multimodal accessibility is summarizing transaction costs, spillovers and variety (CICCONE AND HALL 1996 explain the linkages among these elements) and not only within regions but also across regions.

There is a final impact on the productivity of the regions coming from increases of productivity in neighbouring regions, with a coefficient of around 0.35[4].

[4] As an ulterior measure of control, we assumed that the only endogenous covariate is the spatial lag of the dependent variable (according to the results of the endogeneity tests in table 2, this is not completely mistaken), and estimated the spatial lag model using a Bayesian SAR (LESAGE AND PACE 2009) with a heteroskedastic prior (r=4), using LeSage's toolbox for Matlab. The results for CSI were similar to GMM estimates. The coefficient of the spatial lag of productivity is about 0.30 and the total impact for CSI is about 0.15.

Table 2. Estimates

	(1)	(2)	(3)			
	GMM Robust	GMM Robust	Spatial lag GMM Robust			
	Coefficient	Coefficient	Coefficient	Total effect	Direct effect	Indirect effect
Constant	7.2672	7.1598	4.1768			
	(0.000)	(0.000)	(0.000)			
Percentage of jobs in creative services	0.1702	0.2078	0.1033	0.1592	0.1070	0.0521
	(0.071)	(0.000)	(0.001)	(0.001)	(0.000)	(0.084)
Percentage of jobs in analytic knowledge	-0.0022					
	(0.846)					
Percentage of jobs in synthetic knowledge	0.0050					
	(0.948)					
Capital investment rate	0.2746	0.2681	0.2019	0.3110	0.2091	0.1019
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)
Total employment	-0.0319					
	(0.131)					
n+g+d	0.0159					
	(0.571)					
Number of clusters (MAR)	0.1016					
	(0.058)					
Diversity (Jacobs)	-0.0250					
	(0.792)					
Population density (population/Km^2) (Jacobs)	0.0509					
	(0.002)					
Competition (Firms per worker) (Porter)	0.0455					
	(0.000)					
Accessibility (Network)	0.1335	0.1839	0.1792	0.2761	0.1856	0.0904
	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.022)
Spatial lag of the dependent variable			0.3508			
			(0.003)			
R2	0.7166	0.6731	0.7525			
Akaike	-826.77	-807.11	-997.59			
BIC	-784.51	-793.02	-983.50			
Shapiro-Wilk p-value	0.0000	0.0000	0.0000			
Pagan-Hall General p-value	0.0000	0.0000	0.0000			
VIF	4.48	1.31				
Anderson LR p-value	0.0000	0.0000	0.0000			
Hansen J p-value	0.1302	0.2008	0.1193			
Endogeneity C(χ^2) p-value	0.2540	0.0564				
LM-Error	75.12	47.54				
	(0.000)	(0.000)				
LM-Error Robust	12.40	1.87				
	(0.000)	(0.171)				
LM-Lag	74.59	66.53				
	(0.000)	(0.000)				
LM-Lag Robust	11.87	20.87				
	(0.000)	(0.000)				
Observations	250	250	250			

Notes: Variables in logarithms. GMM estimates robust to heteroskedasticity. Instruments for the spatial lag estimates are based on LEE (2003) best instruments. Initial instruments for the percentage of jobs in creative services are the logarithm of the regionalized cultural expenditures per capita and the number of UNESCO heritage places in the region. Total, direct and indirect impacts and their measures of dispersion (simulation with 10,000 replications) for GMM and Bayesian estimates have been calculated following LESAGE and PACE (2009).

5. CONCLUSIONS

This paper investigates the effect of creative service industries (CSI) on labour productivity in the European regions. The approach that we explored is that CSI offer evolutionary services that increase the capacity of generation and combination of ideas for the whole economy of the region, resulting in increased production of innovations through the generation of new products or varieties, which in turn raises productivity. The article proposes an instrumental analytical framework based on an endogenous growth model that is contrasted for a sample of 250 regions in the European Union in 2008.

The main conclusion is that a doubling of the percentage of jobs in CSI increases average labour productivity by around 16 percent in the regions of the European Union. This conclusion has two direct implications:

First, evidence that CSI have a significant impact on productivity differentials in European regions imply than a faster way to grow is through increased specialization in creative industries. Indeed, this result is in the line of recent evidence such as FLORIDA *et al*. (2008), DE MIGUEL *et al*. (2012), BOIX (2013) or LOBO *et al.* (2014) which suggest that, at this moment, differences in creativity explain better the differences in productivity, wealth or growth than other approaches such as science of formally educated human capital. These works have been highly criticized and, as this one we present, have limitations, although in essence this evidence is suggesting changing the focus from policies based on the analytical and synthetic bases to policies based on the symbolic knowledge base, or at least paying more attention to the latter one.

Second, this evidence would place the policy based on CSI in a similar level of importance than scientific policy or human capital policy, offering in some regions a better alternative than other policies. Here is probably the main interest and novelty of an industrial policy based on creative industries: in contrast to other policies, CSI does not propose a *hard* path of development based on the radical implementation or development of new activities, but a *soft*, *natural* or *evolutionary* path of development providing services and symbolic spillovers to the development, reinvention or evolution of other activities already present in each region. From this point of view, notice that policies based on CSI to increase the productivity of regions are structural (long term) policies.

Other relevant point question is how easy is to increase the regional specialization in CSI in order to increase productivity, and through which mechanisms; or to what regions this alterative is feasible or more efficient than develop other kind of industries. At this respect, a conclusion of the little quantitative research on this respect (LAZZERETTI *et al.* 2012; BOIX *et al.* 2014) is that higher shares of CI and CSI in regions are related to higher size (population) and profundity (GDP per capita) of the regional consumption market, as well as a highly diversified economic structure that increases the demand for CSI and produces Jacob's dynamic external economies. DE MIGUEL *et al.* (2012) also provides evidence of co-location of CSI with high-tech and medium-tech manufacturing as well as other knowledge services. This evidence is in the line that the circular mechanism between CI and growth explained by RAUSELL *et al.* (2011) produces cumulative dynamics, and policy could be necessary to accelerate this dynamic in less creative regions.

The convenience of increase the share of symbolic base of regions in order to increase their productivity needs to be contextualized in a wider research programme providing evidence about how CSI affects and are affected by other economic parameters such as wealth (See DE MIGUEL *et al.* 2012 and BOIX *et al*. 2013), employment and unemployment, ecological sustainability, as well as other non-directly economical parameters (See SACCO 2011).

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Annex I. Descriptive statistics and correlation matrix

A) Descriptive statistics. Variables in logarithms

	Mean	Standard deviation	Min	Max
Productivity	10.8350	0.3433	9.6595	12.0529
Percentage of jobs in creative services	1.7565	0.6807	-2.3000	3.4923
Percentage of jobs in analytic knowledge	-0.0695	1.3244	-2.3000	2.0729
Percentage of jobs in synthetic knowledge	7.0815	0.1825	6.0044	7.4097
Capital investment rate	9.2505	0.5315	7.5331	10.4300
Total employment	13.4096	0.7627	9.6107	15.4832
n+g+d	5.3236	0.5795	3.7221	8.3066
Number of clusters (MAR)	3.1318	0.3794	2.3979	3.9120
Diversity (Jacobs)	2.7435	0.4180	1.2312	3.2670
Population density (population/Km^2) (Jacobs)	5.0487	1.1548	1.1939	9.1491
Competition (Firms per worker) (Porter)	0.4699	0.3266	-0.4348	1.0925
Accessibility (Network)	4.5350	0.4916	3.2921	6.1792

B) Correlation matrix. Variables in logarithms

	Productivity	% jobs CSI	% jobs analytical	% jobs synthetic	Capital	Employment	n+g+d	Clusters	Diversity	Density	Competition	Accessibility
Productivity	1											
% jobs CSI	0.6526	1										
% jobs analytical	0.0806	0.178	1									
% jobs synthetic	0.3185	0.2854	0.0611	1								
Capital	0.6529	0.4350	-0.0223	0.2793	1							
Employment	0.0365	0.1167	0.3949	0.0959	-0.1541	1						
n+g+d	0.1805	0.1439	0.1863	-0.1056	0.1075	-0.0046	1					
Clusters	0.3348	0.4713	-0.0638	0.1056	0.0052	0.1890	-0.1023	1				
Diversity	0.4427	0.6876	0.2261	0.2818	0.2827	-0.1764	0.1328	0.1173	1			
Density	0.4079	0.4037	0.1661	0.0770	0.0318	0.3947	0.0903	0.3400	0.1119	1		
Competition	-0.1142	0.1661	0.0568	-0.2094	-0.0198	-0.2164	0.0381	-0.1166	0.0990	-0.0288	1.0000	
Accessibility	0.5849	0.4366	0.0530	0.3182	0.2725	0.1891	0.0291	0.4999	0.1730	0.5401	0.1884	1