TÍTULO DE LA COMUNICACIÓN: Inter-regional spillovers of creative industries and the wealth of regions: Do spillovers of creative services industries go beyond the regional boundaries?

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RESUMEN: Previous research has evidenced that creative services have an important impact on the wealth of regions. The translation of this evidence to efficient policy strategies is hampered because some relevant aspects of the relationship between creative services and regional wealth are still unknown. One of the most relevant is if the effect of creative industries on wealth takes place strictly within the regions or spill over to close regions. This article investigates if there are spillovers from creative services industries that affect the wealth of neighbour regions. The literature provides three basic hypotheses on the mechanisms through spillovers of creative services can take place. The hypotheses are incorporated by means of spatial variables to a model that is estimated for a sample of 250 European regions. The main finding is that most of the effect of creative services takes place within-regions and the only way creative industries in a region impacts on the wealth of other regions is by means of their previous impact on the wealth of the region where they are located. The results have implications on future research on creative industries and policy design.

PALABRAS CLAVE: creative industries; creative services; regional wealth; regional growth; spatial econometrics

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1. INTRODUCTION

When Gutenberg invented the modern printing press roughly 1440 in the German city of Mainz, probably had no idea that in a few years his invention would spread throughout Europe giving birth to the publishing industry. In 1460 civil unrest broke out in Mainz and most printers moved to other German cities or abroad following the transalpine route that takes them to prosperous Italy and subsequently to France, Spain, England and the Nederland. In 1500, the printing press had spread to more than 200 European cities across 12 European countries. Printing and publishing developed especially in richest cities such as Venice, Rome or Paris, attracted by the potential of the local demand and their insertion in commercial routes, becoming a propulsive and wealthy industry with an accumulated production of more than 20 million of volumes in Europe. This example illustrates the ability of cultural and creative industries to diffuse across the space and to create wealth.

Today, creative industries such as publishing, fashion, audiovisual, radio and TV, software, architecture and engineering, research and development, advertising, design, photography, and arts and entertainment, represents 6.1% of the world GDP (Howkins 2007; UNCTAD 2010). Taken together, they can be defined as a set of knowledge-based activities focused on the generation of meaning, contents and aesthetic attributes by means of creativity, skill and talent, and which have the potential to create wealth from trade and intellectual property rights (DCMS 2001; UNCTAD 2010).

Although, as in our example, some of these industries date back centuries, the idea of studying them as a set of activities linked by the relevance of creative processes is new. Until this moment the literature has focused on two basic aspects of the

paradigm, being the first the epistemological and taxonomical issues of creative industries (DCMS 1998; DCMS 2001; UNCTAD 2010; O'Connor 2007) and the second their implications for growth and development (UNCTAD 2010; Flew & Cunningham 2010; Potts & Cunningham 2008). Focusing on this second aspect, it is now known that creative industries have a strong causal impact on the wealth of regions and that this impact is generated by creative services industries more than by creative manufacturing (Florida et al. 2008; Rausell et al. 2011; De Miguel et al. 2012a,b). This aspect is crucial in pots-industrial societies, which have a real need for new models of development.

However, our knowledge of how the creative industries affect regional growth is still poor because they lack important elements to incorporate in the analysis. In concrete, whereas the example of the printing press illustrates the capacity of creative industries to diffuse between regions and affecting their development path, the few existing theoretical models relating creative industries and growth (Potts & Cunningham 2008; Sacco & Segre 2006; Rausell et al. 2011) are a-spatial. Similarly, applied research (DCMS 2001; Florida et al. 2008; De Miguel et al. 2012a,b) has also focused on regions as independent (non-interdependent) units, neglecting whether the effect of creative industries on wealth takes place strictly within regions or spill over to other regions. However, the existence of these spillovers is not a minor issue, since it conditions the elaboration of theoretical models and, in particular, the design of policy strategies. Intuitively, the existence of spillovers between regions implies a difficult aspect to control for regional policy, although their effects accelerating or slowing down the regional policy must be taken into account.

The goal of the study is to investigate whether there are spillovers from creative services industries that affect the wealth of neighbour regions. To do this, we depart from a theoretical framework that combines the literature about creative industries with literatures about spillovers and endogenous regional growth. The review of the literature arrives to three hypotheses: two of them suggest that creative services do not generate inter-regional spillovers on the wealth neither from direct wealth-spillovers of creative services nor indirectly through knowledge-spillovers from creative services in a region to creative services in other regions. On the contrary, a third hypothesis suggest that creative services increases the wealth of the regions where they are located and the effect of this increase of wealth spill over to neighbour regions. The hypotheses are

incorporated into a model where differences in regional wealth are due to creativity, the production structure, agglomeration economies, and spatial spillovers. The resulting model is estimated for a sample of 250 European regions in the year 2008, using spatial econometric techniques.

By doing this, the study challenges the implicit assumption that the impact of creative industries is intra-regional and proposes two contributions:

i. An analytical framework to understand how and why the effects of creative industries spill over affecting the wealth of other regions.

ii. Empirical evidence about the existence or not of these spillovers and the mechanisms through they transmit.

Filling this particular gap is important not only because we enhance understanding of the creative industries and their impacts on regional wealth, but because:

i. It has strong implications on the theoretical models. If there are spillovers from creative industries, then they must be incorporated in regional modelling.

ii. It has implications of the creative industries' policy, conditioning the effectiveness of intra-regional policy of creative industries.

The article is organized as follows. After the introduction, section 2 provides an introduction to the creative industries and their impacts on the wealth of regions. Section three revises the literature to understand what are the mechanisms through which the effects of creative services spill over to other regions, and proposes the hypothesis. Section four introduces the empirical model, data and variables. The fifth section explains the main findings. The paper ends with the conclusions leaded by the results and their implications for regional policy.

2. CREATIVE INDUSTRIES AND THE WEALTH OF REGIONS

The term *creative industries* originated in Australia with the report *Creative Nation: Commonwealth Cultural Policy* (DCA 1994). The expansion of the concept can be traced to the British Labour government of Tony Blair and the necessity of find new

bases of growth for the UK's postindustrial economy (O'Connor 2007; DCMS 1998). Creative industries proved to be a relevant share of the economy and to have fast growth rates (DCMS 2001). In addition, the discourse had the attractive of changing the view of some activities such as arts and culture from a subsidized sector to a generator of wealth. The contemporary success of Richard Florida (2002) book *The rise of the creative class* has helped to the penetration of the concept. However, whereas Florida's creative class focus on a human capital-based approach, creative industries focus on an industry-based approach, which in practice means that both notions are different but complementary.

Until the moment, the research agenda on creative industries has focused on two main issues:

i. The first, which has occupied most of the literature, is the notion and measurement of creative industries, and includes topics such as the definitions and taxonomies, the nature and drivers of the creative industries, and their dimensions (economic, social, cultural, ecological, and spatial)[1].

DCMS (2001, p.4) defines creative industries, as "those industries that are based on individual creativity, skill and talent, and which have the potential to create wealth and jobs through developing intellectual property". UNCTAD (2010, p.8) defines them as "cycles of creation, production and distribution of goods and services that use creativity and intellectual capital as primary inputs; constitute a set of knowledge-based activities, focused on but not limited to arts, potentially generating revenues from trade and intellectual property rights; comprise tangible products and intangible intellectual or artistic services with creative content, economic value and market objectives; are at the cross-road among the artisan, services and industrial sectors; and constitute a new dynamic sector in the world trade".

The most comprehensive taxonomy of creative industries, 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 the less restrictive as encompasses both cultural and technological dimensions of creative industries, whereas other taxonomies (e.g. DCMS, WIPO or KEA) are biased towards one of the two dimensions. It includes both manufacturing and service industries,

[1] We focus on the definitions and taxonomies, and cross-refer for the rest of aspects to wider synthesis of the literature in UNCTAD (2010), O'Connor (2007) and Flew & Cunningham (2010).

although the majority of the sectors included in creative industries are services, especially knowledge-intensive services (audiovisual, broadcasting, computer programming, R&D, publishing, architecture and engineering, advertising, design, and arts and entertainment) whereas only a small number of sectors are low-tech manufacturing (fashion and printing) (Table 1).

Table 1- Classification of Services in terms of creativity and knowledge intensity, based on NACE Rev. 2

NACE Rev.2 code	Description
	Manufactures
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
18	Printing and reproduction of recorded media
	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)

Source: Elaborated from UNCTAD (2010).

ii. The second dimension of the creative industries research agenda is related to their economic impact, in concrete interested the linkages between creative industries and wealth or added value. Theoretical frameworks have been proposed by Potts & Cunningham (2008), Sacco & Segre (2006) and Rausell et al. (2011).

Potts & Cunningham (2008), propose four models of the relationship between the creative industries and the whole economy: (a) in the *welfare model*, creative industries are affected by the "Baumol's disease" (Baumol & Bowen 1965) and their rate of productivity grow less than in the rest of the economy so that they have a negative impact on growth, even if they are subsidized because they welfare enhancing. (b) 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. (c) In the *growth model,* creative industries are a growth driver and their impact on the economy is more than proportional. From a supply-side, the cause could be that their productivity is higher than in the rest of industries, that they introduce new ideas that transfers to other sectors of the economy, or that they facilitate

the adoption and retention of new ideas in the rest of sectors. 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.

Sacco & 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.

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 (the assumption is 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.

The empirical evidence about the effects of creative industries on growth and wealth is still poor. A first group of articles reports simple evidence. DCMS find that during the second part of the 1990s creative industries grew in UK at 5% annual

average whereas the whole economy grew at 3%. Dolfman et al. (2007) find that in the United States the average wage in creative industries was 34.9% 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% higher than the national average and their aggregate growth rate is higher than that of the aggregate economy. In Europe, Power & Nielsén (2010) and Power (2011) find that the correlation between the GDP per capita of the regions and the share of creative workers in the regional economy is about 60% and that creative industries has exhibited strong long-term growth for the EU as a whole, although with important regional differences and cyclical or negative behaviour in some regions. All this evidence is weak and there is not any control for the effect of other variables affecting growth or wealth.

A second group of studies has specifically focused on simultaneity and causality (Florida et al. 2008; Rausell et al. 2011; De Miguel et al. 2012a; De Miguel et al. 2012b). Florida et al. (2008) introduces in a structural equations model the effects of tolerance, university, consumer services, talent and technology on the regional development. They findings show 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.

Rausell et al. (2011) contrast the two hypothesis of their circular model using a dynamic panel and the Granjer causality test for 19 Spanish regions between the years 2000 and 2008. Their results suggest that there is positive circular causality between the growth of the percentage of workers in creative industries and the growth of the GDP per capita, and that these effects take two years to produce a significant impact.

De Miguel et al. (2012a) assume that differences in regional wealth are due to creativity (symbolic knowledge), other forms of knowledge (analytic and synthetic), the production structure, and localization economies. The results of their empirical model for 250 European regions in the year 2008 provide evidence that an increase of 1% in the contribution of creative industries to the regional structure of the employment produces an increase of 0.45% (about 1,400 euros) in the GDP per capita. They address the possible endogeneity of creative industries on the GDP by means of instrumental variables regressions, arriving to the conclusion that the estimated effect was causal and none biased by simultaneity. De Miguel et al. (2012b) argue that creative manufacturing

and creative services should be separated because creative services are positively correlated with wealth, whereas the correlation is negative for creative manufacturing.

3. HYPOTHESES

Inter-regional spillovers are here defined as the impacts of a region on the economic performance of other regions. Despite the evidence of a positive causal effect of creative industries on the wealth/growth of regions, no attention has been paid until the date to the existence of spillovers of creative industries between regions, and in particular of spillovers affecting the wealth of other regions. Do spillovers of creative services industries on the wealth go beyond the regional boundaries? To arrive to some testable hypothesis for this question we framework spillovers of CI in related literature focusing on the type of spillovers have been identified, the spatial mechanisms of transmission of spillovers, the spatial range at with spillovers have been found operative, the barriers to spillovers, and the expected behaviour for spillovers in industries of symbolic knowledge base such as the CI:

i. *Types of spillovers*. The first relevant dimension is whether spillovers are direct or transmit through indirect channels. This is similar to the notion of direct and indirect external effects in Viner (1931) and Scitovsky (1954). Adapting these ideas to regions (e.g. Antonelli et al. 2011), we can say that direct spillovers (or also technological external economies or pure externalities) exists when the output of a region depend not only from the production factors in the region but rather from the output and production factors in other regions (for example, when the percentage of jobs in CI in a region depends on the percentage of jobs in CI in other regions). Indirect spillovers (pecuniary external economies) arises when the returns or income or a region are in part dependent from input and output factors located in other regions and this effect is transmitted through indirect channels (for example, CI in the region *j* affects CI in region *i* and then the wealth of region *i*).

A different way to classify spillovers is attending the nature of their content. Capello (2009) differentiates between knowledge spillovers, industry spillovers and growth spillovers. *Knowledge spillovers* are based on knowledge transfer, *industry spillovers* on input-output or competition linkages in related industries, and *growth*

spillovers on the creation of growth potentialities through trade linkages and market relationships. The conception of the space has a relevant role here to determine under which spatial spillovers have a spatially bounded nature. In a *geographical space*, spillovers are based on the physical distance so that proximity is their main determinant acting through transportation costs and epidemiological and gravity mechanisms. In a *functional space*, spillovers are explained due to the presence of territorially-embedded functions and mediated by a territorial filter linked to the specialized productive structure and the labour market. The *cognitive approach* to the space focuses on a relational space where knowledge is generated through cooperative learning processes in proximity (*atmosphere* effects) network relations, interaction, creativity, and recombination capability.

ii. *Mechanisms.* Creative industries in a region can affect creative industries in neighbour regions through a direct mechanism of within-industry synergy. This is characteristic of epidemic processes such as those described by Hägerstrand (1967) and Griliches (1957) for the spatial diffusion of innovations. In Hägerstrand, spatial spillovers take place in three stages: adoption through the urban hierarchy (hierarchical diffusion), diffusion to neighbour places (horizontal diffusion), and saturation in which spillovers are random. Griliches stress that spillovers are influenced by socio-economic factors so that the capacity of emission and adoption of innovation across actors or regions is determined by the levels of productive activity, income, consumption, structure of costs, and educational levels.

Capello (2009) remarks that epidemiological mechanisms are characteristic of geographical and functional approaches, as well as input-output linkages, inter-industry linkages, labour market pooling, trade linkages, demand linkages and interregional mobility of production factors. Cognitive approach remarks other transmission channels such as stable customers and suppliers, spin-offs from firms and universities, high mobility in internal labour market, actor's capacity to identify and imitate good practices, attitudes towards novelties and local cooperation, and governance support for cooperation.

The recent literature on knowledge spillovers proposes several theoretical models and provides empirical evidence about the spatial range of spillovers and their mechanisms. Basic mechanisms involves (Döring & Schnellenbach 2006) the mobility of individuals and the trade or transfer of goods, direct transfer of production

technologies, sharing mechanisms (patent licensing, collaborative research projects, scientific exchange, etc.), and social networks. This literature uses in most of the cases knowledge production functions reporting the direct effect of the variable of interest on an explained variable as a measure of the spillover and tries to delimit the spatial distance in which spillovers happen.

iii. *Spatial range.* Maruseth & Verspagen (2002), Fischer et al. (2006) and Greunz (2005) find evidence of direct industry-specific interregional knowledge flows. Spillovers are more intense between regions located close in the technological space limited by country boundaries and are significant until the 3rd-order geographical neighbourhoods. Bottazzi & Peri (2000) study on European regions find that significant knowledge spillovers are geographically localized in an area of 200 Km even if they extend within a circle of 300 Km (although at this distance the impact is very small). The scope of spillovers is generally lower for the studies carried out in the US. Varga (2000) find evidence of knowledge spillovers between metropolitan areas up to a distance of 75 miles (120 Km) in US. Adams & Jaffe (1996) found that R&D spillovers on firms total factor productivity decreases with the distance to be very small outside the state of reference or more than 100 miles away (60 Km). Anselin et al. (2000) find a significantly positive impact of university research on innovative activity within a range of 50 miles (80 Km). Jaffe et al. (1993) find that spillovers of patent citations tend to be localized in the same US state and particularly in the same metropolitan area. Audrestch & Feldman (1996) find that in those industries where new knowledge plays a more important role, the innovative firms tend to be more geographically concentrated, meaning that spillovers are highly local in US. Funke & Niebuhr (2005) find evidence for Germany that regional growth is positively correlated with R&D of neighbour regions but occurs at an average distance of only 23 Km and decrease quickly with the distance. Autant-bernard (2001) finds that in France spillovers occur only inside regional boundaries (NUTS 3). Wallsten (2001) reports that spillovers are particularly strong in a very small radius such as a fraction of a mile in US.

iv. *Barriers.* One explanation for these differences is that spillovers are bounded due to the existence of barriers such as the geographical distance, the learning capability, the institutional frameworks, the sectoral differences and the firm size (Caniëls & Verspagen 2001; Döring & Schnellenbach 2006) or due to the nature of the transmission channel (Capello 2009). In a *geographical* approach, spillovers are

bounded because information flows easier in a limited geographical area, lower transport costs, larger pools of skilled workers, facility of imitation and easier possibilities of commuting. In the *functional* approach, spillovers are locally bounded due to the absorptive capacity of the locally specialized productive structure and the receptivity of the labour market. In the *cognitive* approach, spillovers are bounded because the channels of diffusion are highly embedded in the socio-cultural structure of the local system, the cooperative nature of traded dependencies, existence of untraded interdependencies and of local non-replicable assets (Capello 2009).

The industrial and urban *atmosphere* associated with the cognitive mechanisms is highly relevant here. Co-location of people and firms in a geographical space (e.g. industrial districts or clusters) facilitates to share and internalize the local context. The local embeddedness with the local knowledge facilitates the absorption and the dissemination of tacit knowledge through networks of practice based on specific activities and individuals through face-to-face communication, the suppliers' chain, inter-firm mobility of workers, entrepreneurship mechanisms, and shared institutional infrastructures (Marshall 1920; Malecki 1997; Almeida & Kogut 1997; Audretsch & Feldman 2004; Jacobs 1961). This explains why in most of the studies the spatial scope of the spillovers is highly local, even if some of these spillovers could also work at inter-regional scale.

A different perspective for the same argument is that differences can be explained because spillovers are highly dependent on the nature and type of knowledge. Higher levels of codification and lower contextual embeddedness are associated with larger spillover distances. On the contrary, higher levels of tacitness and contextual embeddedness are related to shorter spillover distances (Almeida & Kogut 1997; Autant-Bernard 2001). To understand the nature of creative spillovers it is crucial to determine the type of knowledge base in creative industries. The distinction between knowledge bases takes account of the rationale of knowledge creation, development and use and the way the knowledge is transmitted and absorbed. Asheim et al. (2011) stress that the dominance of one mode (analytical, synthetic or symbolic) has different spatial implications and different sensitivity to geographical distance. Analytical knowledge is highly codified and usually non-dependent on the context. Synthetic knowledge is partially codified and embodied in technical solutions, although tacit knowledge is also relevant due to the importance of the experience at the workplace, learning by doing,

and using and interacting processes. Symbolic knowledge associated with creative industries - where a crucial share of work is dedicated to the creation of new ideas and images - is related to a deep understanding of the habits and norms of specific social groups so that it is highly embedded, tacit and context-specific. Consequently, analytical knowledge is less sensitive to distance-decay so that spatial spillovers can be local, intra-regional and inter-regional. Synthetic knowledge is much more sensitive to proximity effects, so that spillovers will be more frequent in local and inter-regional ambits. Symbolic knowledge tends to be extremely local and in consequence spillovers should be also highly local.

This can be expressed in two hypotheses:

> Hypothesis 1: Direct spillovers from creative services located in neighbour regions $j \neq i$ on the wealth of a region i are not significant.

> Hypothesis 2: Indirect spillovers from creative services located in neighbour regions $j \neq i$ on the creative services of a region i are not significant.

The literature on regional endogenous growth suggests that spillovers between regions occur through an income-to-income mechanism, similar to Capello's (2009) *growth spillovers*. We refer to Abreu et al. (2005) and Arbia (2006) for a review of the literature on this topic. The basic conclusion is that the economic performance of a region (wealth, productivity) has a major impact on the production, productivity and wealth of the neighbour regions. This is due to the fact that: (a) an increase in the local income results in an increase in the local demand which is in part supplied by imports of commodities and factors coming from neighbour regions with which trade flows are more intense, and/or (b) the existence of processes of technological catch up (Arora & Vamvakidis 2005; Döring & Schnellenbach 2006). The coefficient for the spatial spillover differs among studies due to differences in the dependent variables (GDP per capita, GDP per worker), time periods, sample of regions, type of effect (spatial lag or

spatial error), and estimation procedure, although in all the cases ranges between 0.4 and 0.9. Consequently, another hypothesis can be formulated:

> Hypothesis 3: Changes in the share of creative services in neighbour regions $j \neq i$ increase the GDP per capita of these regions $j \neq i$, and this translates to an increase of wealth of the region i.

Note that some articles focusing on the innovation literature, such as Adams & Jaffe (1996) or Audretsch & Keilbach (2002), suggest that the final part of the process is not income-to-income but rather that there are additional mediating mechanisms (e.g. productive structure, human capital, etc.) intermediating the process. This three steps mechanism can be introduced as a nested hypothesis:

> Hypothesis 3b: Changes in the share of creative services in neighbour regions $j \neq i$ increase the GDP per capita of these regions $j \neq i$, this affects variables in region i that are highly correlated with wealth and this translates to an increase of wealth of the region i.

4. EMPIRICAL MODEL WITH SPATIAL EFFECTS

4.1. Direct effects

To contrast the existence of spillovers of CI between regions we depart from the model proposed by De Miguel et al. (2012a,b). The choice is based on the fact that to capture CI with precision in European regions it is necessary the use of NACE Rev.2, only available for 2008 (now partially for 2009). That does not allow for the use of dynamic models except by losing most of the activities in the CI classification. De Miguel et al. (2012a,b) translate Potts and Cunningham's *growth model* notion to a linear equation close to Romer-type endogenous growth models, where differences in regional wealth (GDP per capita) are due in these case to four forces: creativity (symbolic knowledge),

other forms of knowledge (analytic and synthetic), productive structure, and agglomeration economies (internal scale economies, localization economies and urbanization economies):

$$\frac{GDP_i}{Pop_i} = \beta_0 + \beta_1 \begin{matrix} Creative \\ Services \end{matrix}_i + \beta_2 \begin{matrix} Knowledge \\ Structure \end{matrix}_i + \beta_3 Agglomeration_i + \varepsilon_i \quad (1)$$

In this model, the direct effect of the percentage of creative industries in neighbour regions (Hypothesis 1) can be incorporated in the form of an additional variable *WX*, where *W* is the matrix of spatial weights incorporating the neighbours of each region *i* and *X* is the percentage of jobs in creative industries in the neighbour regions *j≠i*. This form is known as *spatial cross-regressive model* (Anselin 1988), where the coefficient γ of the spatial variable measures the existence of direct inter-regional spatial spillovers from creative industries to wealth:

$$\frac{GDP_i}{Pop_i} = \beta_0 + \beta_1 \begin{matrix} Creative \\ Services \end{matrix}_i + \beta_2 \begin{matrix} Knowledge \\ Structure \end{matrix}_i + \beta_3 Agglomeration_i + \gamma WX + \varepsilon_i \quad (2)$$

3.2. Indirect effects

The wealth of a region can be also affected by indirect effects coming from creative industries in neighbour regions.

First, creative industries in neighbour regions *j≠i* affect the share of creative industries of a region *i*, and through these to the GDP per capita of *i* (Hypothesis 2). We can assume, for simplicity, that creative industries in a region are a function of the knowledge structure, agglomeration economies and creative industries in neighbour regions[2]:

[2] The GDP per capita in the region can be also included in the left hand side of the equation, although since it is highly correlated with the rest of variables it produces collinearity problems. Lazzeretti et al. (2012) provide a different equation to explain the concentration of creative industries in local labour markets that also includes cultural assets and the creative class but not the knowledge structure.

$$\underset{Services}{Creative}_i = \beta_0 + \beta_1 \underset{Structure}{Knowledge}_i + \beta_2 Agglomeration_i + \rho W \underset{Services}{Creative}_{j \neq i} + \varepsilon_i \quad (3)$$

A second indirect effect comes through the wealth of neighbour regions (Hypothesis 3). The literature on growth has remarked the effects on the wealth of the region coming from inter-regional spillovers due to the levels of wealth or the growth of wealth in neighbour regions. If creative industries in neighbour regions $j \neq i$ affect the wealth of those regions $j \neq i$ and that impact on the wealth of a region i, then an indirect effect is produced. This effect is usually introduced in the equation as a spatial lag of the dependent variable (spatial lag model, Anselin 1988):

$$\frac{GDP_i}{Pop_i} = \beta_0 + \beta_1 \underset{Services}{Creative}_i + \beta_2 \underset{Structure}{Knowledge}_i + \beta_3 Agglom_i + \rho W \frac{GDP_i}{Pop_i} + \varepsilon_i \quad (4)$$

, where $\rho W \frac{GDP_i}{Pop_i}$ reproduces the same equation for neighbour regions, including the second-order spatial lag ($\rho W2$)

$$\rho W \frac{GDP_i}{Pop_i} = \beta_0 + \beta_1 \underset{Services}{\rho W Creative}_i + \beta_2 \underset{Structure}{\rho W Knowledge}_i + \beta_3 \rho W Agglom_i + \rho W2 \frac{GDP_i}{Pop_i} + \varepsilon_i \quad (5)$$

The impact can be also induced through an stochastic shock transmitted by means of a spatial component in the error term (spatial error model, Anselin 1988)[3].

$$\frac{GDP_i}{Pop_i} = \beta_0 + \beta_1 \underset{Services}{Creative}_i + \beta_2 \underset{Structure}{Knowledge}_i + \beta_3 Agglom_i + \varepsilon_i \quad (6)$$
$$\forall\ \varepsilon_i = \lambda W \varepsilon_i + u$$

[3] Other combinations are possible, for example a combination of the spatial lag and error models (Anselin 1988) or the Durbin model (spatial lag plus spatial cross-regressive model) (Fischer 2009)

4. DATA AND VARIABLES

The sample comprises 250 European regions at NUT2 from Eurostat's Structural Business Statistics (SBS), Science and Technology Statistics (STS) and Economic Accounts (ESA) databases for the year 2008. The countries where data was not available, such as Greece, Luxembourg and Malta, were not included. SBS, in combination with the new NACE, provides a good source of data for this research, as the information is disaggregated from two to four digits. The new NACE is particularly designed to deal with the requirements of the knowledge economy, so that creative industries are properly captured at two digits in most of the cases (Table 1).

Following De Miguel et al. (2012a,b) the dependent variable is the GDP per capita. It is a mix between the productive efficiency and the income per capita, and the indicator traditionally used as a proxy of the regional wealth in cross-country and cross-region studies.

Explanatory variables include the percentage of creative industries in the region, the rest of the employment structure by technological intensity, and agglomeration economies. To calculate the regional structure we group the activities in (De Miguel et al. 2012b) manufacturing, creative service industries (Table 1), and rest of services grouped by knowledge intensity: non-creative high-tech services, rest of non-creative knowledge-intensive services, and non-creative less-knowledge-intensive services (Eurostat 2009). For each group, the indicator is calculated as the share of regional jobs in the group with respect to total regional employment.

Agglomeration economies are divided in three families: external localization economies, external urbanization economies, and internal economies. As in De Miguel et al. (2012a,b), the proxy for localization economies is the sum of regional clustered activities at two digits. It is considered that an activity is clustered when its location quotient (LQ) for firms in the industry is above 1:

$$LQ_{ij} = \frac{Firms\ in\ the\ NACE\ code\ j\ in\ region\ i / Firms\ in\ the\ NACE\ code\ j\ in\ the\ EU27}{Firms\ in\ the\ region\ i / Firms\ in\ the\ EU27} \quad (7)$$

, where

$$LQ'_{ij} = 1 \ \forall \ LQ_{ij} > 0$$
$$LQ'_{ij} = 0 \ \forall \ LQ_{ij} \leq 0$$

, so that the indicator is

$$Localization\ economies_i = \sum_{j=1} LQ'_{ij} \qquad (8)$$

Although there is some correlation between the indicators used for the regional structure and those used for localization economies, both indicators refer to different concepts and are elaborated using different data (number of jobs in the first case and number of firms in the second one).

Following De Miguel et al. (2012b) and Lazzeretti et al. (2012), proxies for urbanization economies include the total population in the area (market potential), population density (population per Km2) which favours within-regions knowledge spillovers, and diversity of the productive structure at two digits which fosters cross-fertilization across sectors (inverse of the Hirschman-Herfindahl index calculated for the employment in 60 sub-sectors in the economy in 2001):

$$IHHI_j = 1/\left(\sum_i L_{i,j}/L_{i,j}\right)^2) \qquad (9)$$

The proxy for internal economies is the average firm size in the region (average number of employees by firm in the region) which captures scale economies and organization of the production.

3.3. Spatial weight matrix

The literature on regional spillovers and regional endogenous growth usually consider three forms for the spatial weight matrix (Abreu et al. 2005; Greunz 2005; Varga 2000; Anselin et al. 2000; Funke & Niebuhr 2005; Arbia 2006). The first is based on the

contiguity between regions. This form assumes that spillovers only occur between neighbour regions as the interaction is based on a mix of cognitive, organizational, social, institutional and geographical proximity. The second matrix is based on the *geographical distance* between regions. In this case we consider that spillovers not only occur between neighbour regions and their probability linearly decays with the geographical distance (Anselin 1988). We could also consider that the spillovers decay more than proportionally with the distance so that a third matrix is introduced considering in this case the inverse of the squared distance.

These matrices are the most usual choices in spatial econometrics and reflect the objective of the article in connexion with the scales of design and application of policy strategies for creative services industries. As Döring & Schnellenbach (2006) remarks, the use of proximity or contiguity and distance-decay means that we are considering that the diffusion between regions takes place horizontally, such as in the second stage of Hägerstrand epidemic model.

As is also usual in this case, matrices are row standardized so that the final impact of spillovers does not depend on the differences in the number of neighbours across regions.

Descriptive statistics for the variables are provided in Table 2.

Table 2. Descriptive statistics.

Variable	Mean	Std. Dev.	Min	Max
GDP per capita in PPS	24,465	9,005	7,100	85,800
% jobs in creative services	6.88	3.83	0.01	32.86
% jobs in high-tech services (1)	0.88	0.78	0.01	4.43
% jobs in other knowledge-intensive services (2)	28.25	6.45	13.98	42.71
% jobs in less-knowledge-intensive services (3)	27.77	4.17	14.55	45.42
% jobs in manufacturing	16.40	7.40	0.01	35.99
Number of clusters of creative services	2.70	2.23	0.00	8.00
Number of clusters of high-tech services (1)	0.85	0.64	0.00	2.80
Number of clusters of other knowledge-intensive services (2)	2.85	1.88	0.00	7.00
Number of clusters of less-knowledge-intensive services (3)	5.27	2.10	1.00	9.00
Number of clusters of manufacturing activities	9.39	2.96	3.00	16.00
Population	1,934,258	1,531,182	27,153	11,700,000
Population density (population/Km2)	363.14	890.89	3.30	9,405.70
Productive diversity	16.73	5.62	3.43	26.23
Average firm size in the region	8.21	7.02	1.00	44.22
Spatial lag % jobs in creative services (4)	2.64	2.46	0.18	15.72

Spatial lag GDP per capita in PPS [4]	23,723	6,278	8,166	30,533

Notes: [1] Includes only telecommunications and information service activities as the rest (motion picture, video and television, sound recording and music, broadcasting, computer programming, and scientific research and development) are included in "creative services".
[2] Excluding publishing, architectural and engineering activities, advertising, and arts, entertainment and recreation, included in "creative services".
[3] Excluding retail sale of other goods in specialized stores, included in "creative services".
[4] The spatial weights matrix is a contiguity matrix (queen matrix) row standardized

5. FINDINGS

5.1. Exploratory analysis of spatial data

An exploratory analysis of spatial data (ESDA) is conducted in order to obtain preliminary information about the form of the spatial processes. ESDA is performed using graphic information through the mapping of the variables, global Moran's I autocorrelation statistic, and multivariate local Moran's I. The main findings from ESDA are:

i. The percentage of jobs in creative services in the regions doesn't show any clear pattern of spatial correlation (Figure 1). In addition, the evidence of spatial spillovers of creative services on the GDP per capita of neighbour regions is inconclusive and follows different patterns in different areas of Europe.

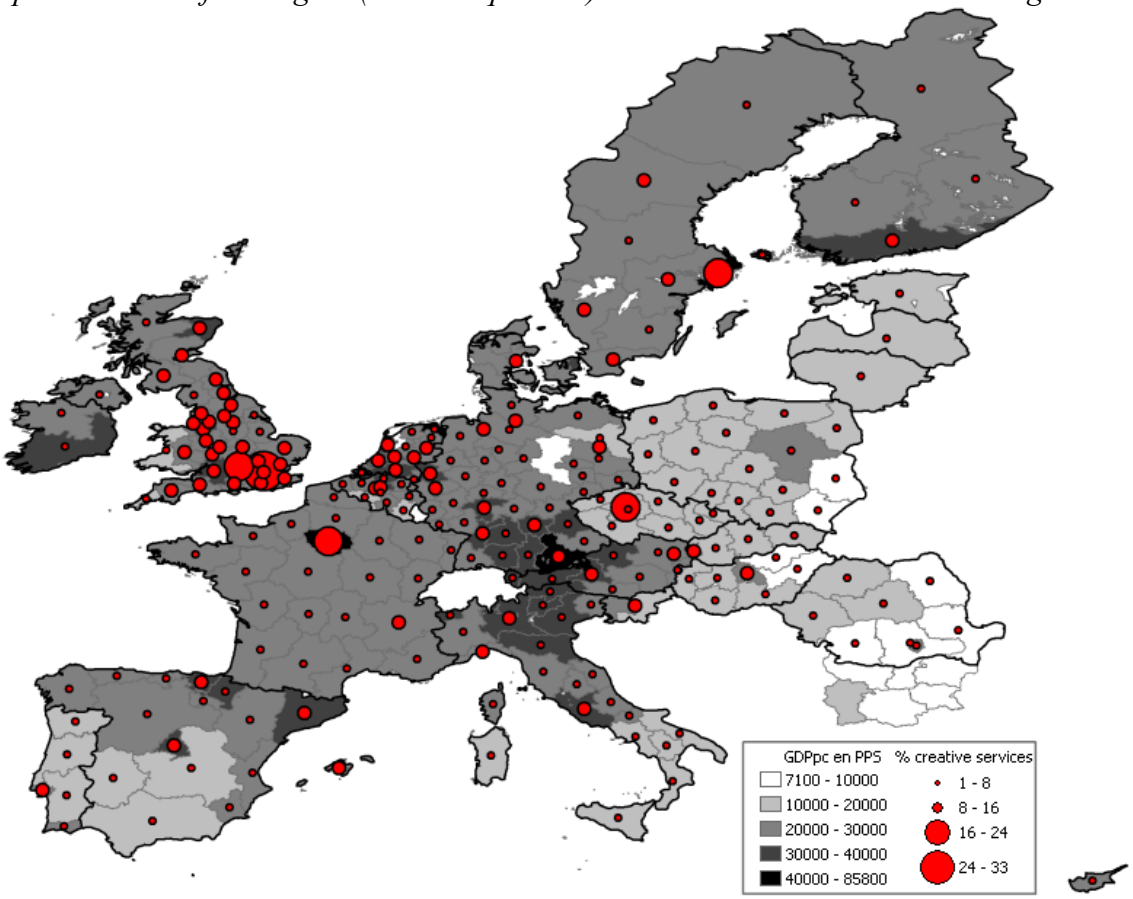
ii. Regions with higher levels of GDP per capita are not usually surrounded by regions with high specialization in creative services (Figure1). However, the values of the Moran I are positive and statistically significant suggesting that both variables are spatially correlated (Table 3).

iii. The multivariate local Moran index shows more concrete evidence (Figure 2) indicating that the correlation between wealth and creative industries in neighbour regions is significant in 25% of the regions. However, only in 6% of the cases high values of wealth are correlated with high shares of creative industries in neighbour regions (south-east of the United Kingdom and the centre of Nederland) whereas in another 15% the correlation is low-low (country-specific patterns concentrated in Poland, Romania, Bulgaria and the centre-west part of France). Mixed patterns high-low (Île de France and Rône-Alpes) and low-high (centre of England and north of Scotland) only involves 2% of the cases each one. However, even in the cases for which

this correlation is clear (high-high and low-low) we don't know if spillovers impacts directly on the wealth or indirectly through other variables. These points will be clarified by the causal analysis.

ESDA provides fundamental evidence about other two facts. First, regions with the same levels of GDP per capita tend to be located close in the space showing evidence that the wealth of regions is affected by the wealth of neighbour regions such as in the spatial lag and spatial error models (Table 2). Second, the more robust evidence of spatial correlation is provided in all the cases by the matrix of contiguities, suggesting that neighbourhood is more relevant than distance (Table 3).

Figure 1. Share of creative services on the regional employment and relative specialisation of the region (location quotient) in creative services in 250 EU regions

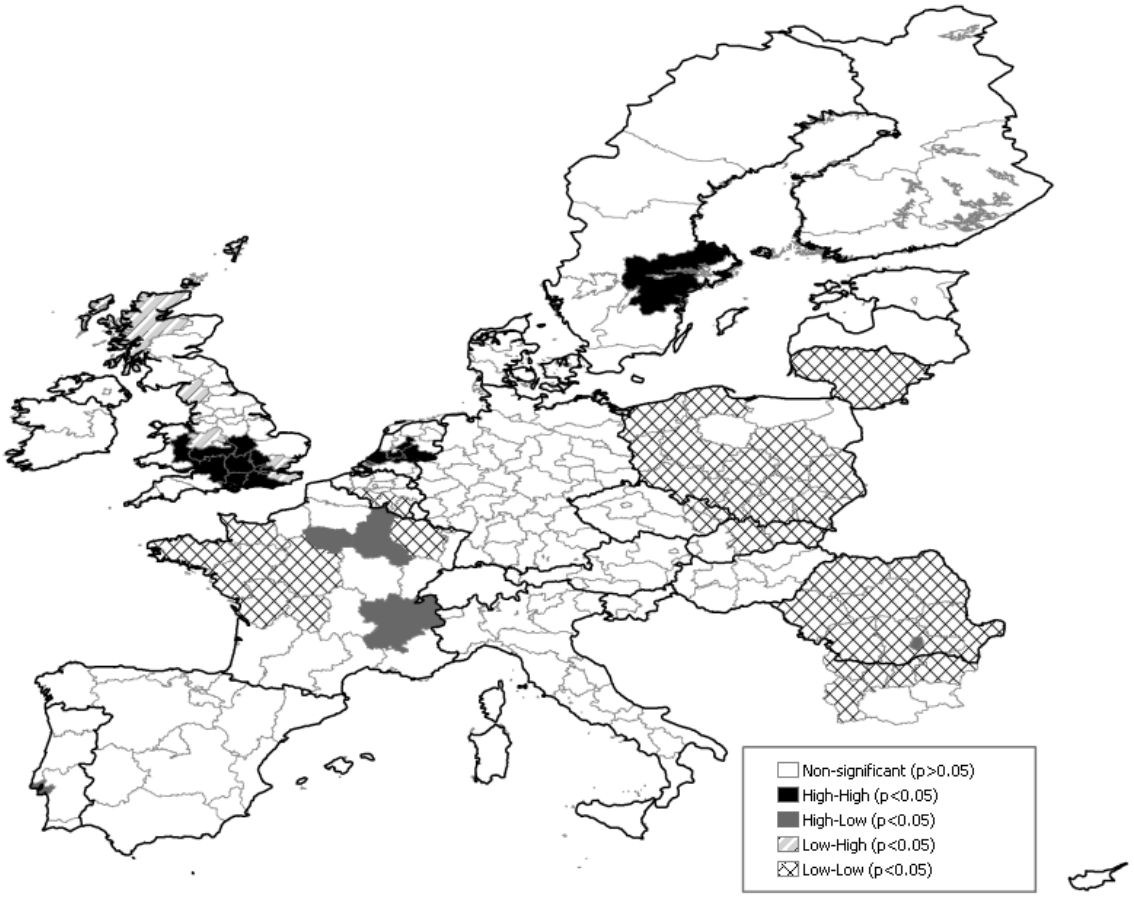


Source: Elaboration from Eurostat.

Table 3. Exploratory analysis of spatial data. Univariate and multivariate Moran I statistics for the GDP per capita, percentage of jobs in creative services, and the GDP per capita confronted with the spatial lag of the percentage of jobs in creative services

Variable	Matrix	Moran I	Probability (random)
GDP per capita in PPC versus spatial lag of the percentage of jobs in creative services	Contiguity	0.2589	0.001
	Inverse distance	0.0902	0.001
	Squared inverse distance	0.0902	0.001
GDP per capita in PPC	Contiguity	0.2790	0.000
	Inverse distance	0.1476	0.000
	Squared inverse distance	0.2297	0.000
Percentage of jobs in creative services	Contiguity	0.4427	0.000
	Inverse distance	0.2039	0.000
	Squared inverse distance	0.3057	0.000

Figure 2. Multivariate LISA map. GDP per capita in PPS correlated with the spatial lag of the percentage of jobs in creative services. Queen spatial weights matrix



High-High: Gelderland; Flevoland; Utrecht; Zuid; Östra Mellansverige; Leicestershire, Rutland and Northamptonshire; Herefordshire, Worcestershire and Warwickshire; Bedfordshire and Hertfordshire; Inner London; Outer London; Berkshire, Buckinghamshire and Oxfordshire; Surrey, East and West Sussex; Hampshire and Isle of Wight; Gloucestershire, Wiltshire and Bristol/Bath area; East Wales.
High-Low: Île de France; Champagne; Rhône; Lisboa; Bucuresti.
Low-High: Cumbria; Shropshire and Staffordshire; Essex; Kent; Highlands and Islands.
Low-Low: Prov. Hainaut; Prov. Luxembourg (BE); Prov. Namur; Severozapaden; Severen tsentralen; Severoiztochen; Yugozapaden; Střední Morava; Moravskoslezsko; Centre (FR); Basse; Lorraine; Pays de la Loire; Bretagne; Poitou; Limousin; Lietuva; Lódzkie; Mazowieckie; Malopolskie; Slaskie; Lubelskie; Podkarpackie; Swietokrzyskie; Wielkopolskie; Zachodniopomorskie; Lubuskie; Dolnoslaskie; Opolskie; Pomorskie; Nord-Est; Sud-Est; Sud-Muntenia; Sud-Vest Oltenia; Vest; Nord-Vest; Centru; Stredné Slovensko; Východné Slovensko.

5.2. Regression analysis

The estimation by Ordinary Least Squares (OLS) of the equation 1 produces a parsimonious specification in which the explanatory variables are the percentage of jobs in creative services, the percentage of jobs in other knowledge-intensive services, the number of clusters of less-knowledge-intensive services and the population density (Table 4, column 1). This is similar to those obtained by De Miguel et al. (2012b).

The exogeneity of creative services is tested (Durbin-Wu-Hausman test) and it cannot be rejected. This means that creative services don't have any negative effect on the consistency of the model, than the estimated effect of creative industries on the wealth is causal, and that OLS is more efficient than instrumental variables (IV).

As also *WX* is *a priori* exogenous, the equation 2 can be estimated using OLS (Anselin 1988 and 2001). The spatial lag and error in equations 4 to 6 are endogenous by definition, and in some cases suffer from non-normality and heteroskedasticity so that they are estimated using robust Instrumental Variables (IV) and Generalized Method of Moments (GMM) (Anselin 1988).

Tables 4 to 6 present the detailed results, and a synthesis concerning the relevant hypothesis is presented in Figure 3.

Hypothesis 1 suggest that direct spillovers from creative services located in neighbour regions $j \neq i$ don't have significant impacts on the wealth of a region i. We find that the coefficient of the spatial lag of the creative services *WX* is very small (162.85 euro) and statistically non-significant (p=0.43) (Table 4, column 2). Thus, Hypothesis 1 is supported.

Hypothesis 2 suggests that spillovers from creative services located in neighbour regions $j \neq i$ on the creative services of a region i are not significant so that that cannot cause an indirect spillover on the wealth of region i. This is tested twice. First, Lagrange Multiplier (LM) tests (Table 5, column 1) are not statistically significant neither for the lag model (0.00004, p=0.99) nor for the error model (0.0187, p=0.89), which means that we cannot reject the null hypothesis of spatial independence. Second, the estimation of a spatial lag model including the spatial lag of the creative industries (Table 5, column 2) provides the same conclusion as the spatial lag of the dependent

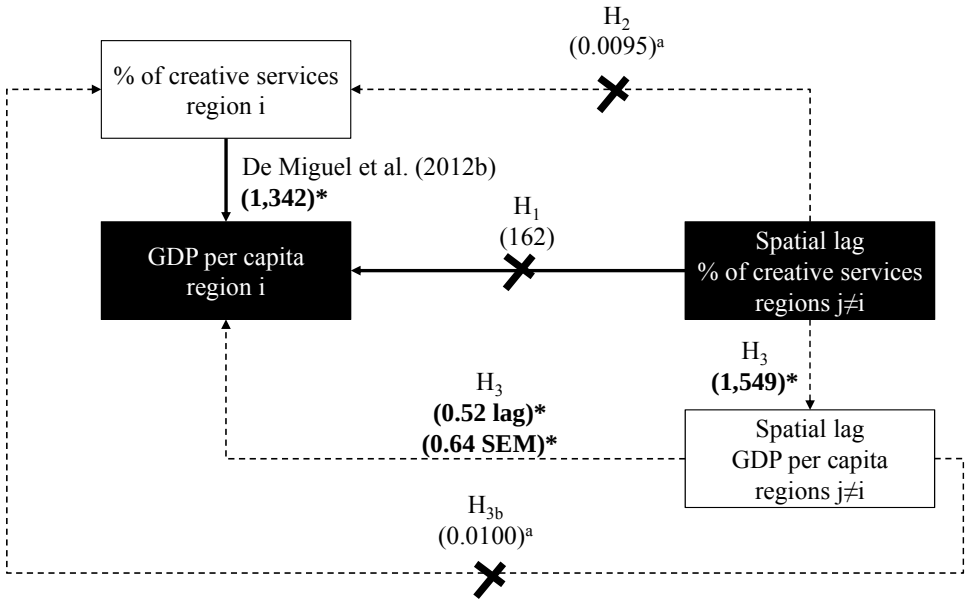
variable (-0.0066, p=0.95) is not statistically or economically significant. Thus, Hypothesis 2 is supported.

Hypothesis 3 suggest that changes in the share of creative services in neighbour regions $j \neq i$ increase the GDP per capita of these regions $j \neq i$, and this translates to an increase of wealth of the region i. We found (Table 6) that creative industries in neighbour regions affect positively the GDP per capita of neighbour regions (1,549 euros, p=0.000) and then the wealth of neighbour regions $j \neq i$ affects positively the wealth of region i (lag model 0.5266, p=0.000; SEM model 0.6436, p=0.000) (Table 4 columns 4 and 5). Thus, Hypothesis 3 is supported. Looking at the three hypotheses, the only significant spillover effect of creative industries in neighbour regions is transmitted though the wealth. Looking at the coefficients and their relative variations, the indirect impact, when amplified by the wealth, ranges between the 10 and 30% of the wealth of regions (depending on the model).

Hypothesis 3b suggest that the wealth-to-wealth effect from Hypothesis 3 transmits through other variables in the structure of the employment or the external economies in the region. The only variable within the region capable to affect the wealth in such a measure are creative services (Table 4, column 1). However, the share of creative services of a region is not affected by the wealth of neighbour regions (0.0000, p=0.29) (Table 5 column 3). Thus, Hypothesis 3b isn't supported and Hypothesis 3 reports a pure wealth-to-wealth effect.

In addition, we notice that, after the introduction of the spatial effects, the impact of creative industries on the wealth of the region where they are located is still strong, ranging from 970 to 1479 euro. However, from an econometric point of view, the incorporation of the spatial effects is necessary otherwise the econometric estimates are biased and inconsistent.

Figure 3. Direct (hypothesis 1 (H_1) and indirect (hypothesis 2 (H_2); hypothesis 3 (H_3); hypotheis 3b (H_{3b})) spillovers of creative services industries on the GDP per capita of the regions. Summary of results of tables 4 to 6.



* Statistically significant at 5%

[a] Coefficient of the logistic transformation recovered from Table 1as exp(βX)/(1+exp(βX))

Table 4. Estimates of the effects on wealth. Contiguity matrix (row standardized.

Dependent variable: GDP per capita in PPS	(1) OLS Robust[4]	(2) OLS Robust[4]	(3) OLS Robust[4]	(4) Spatial Lag (IV Robust) [4] [5]	(5) Spatial Error (GMM iterated)
		Coefficient	Coefficient	Coefficient	Coefficient
Constant	6178.05	6388.27	-29020.2	1210.62	11723.4
	(0.000)	(0.000)	(0.000)	(0.385)	(0.000)
% jobs in creative services	**1479.48**	**1388.62**	**1393.31**	**970.73**	**1342.38**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% jobs in other knowledge-intensive services [2]	**166.61**	**159.61**	47.59	63.35	34.26
	(0.005)	(0.011)	(0.687)	(0.247)	(0.598)
Number of clusters of less-knowledge-intensive services [3]	**526.26**	**432.84**	48.14	239.94	**397.73**
	(0.003)	(0.018)	(0.819)	(0.090)	(0.025)
Population density (population/Km2)	**1.62**	**1.8331**	**2.0900**	**3.5374**	**2.2998**
	(0.039)	(0.036)	(0.006)	(0.000)	(0.000)
Spatial lag % jobs in creative services		162.85	356.023		
		(0.439)	(0.316)		
Spatial lag % jobs in high-tech services [1]			**2747.00**		
			(0.000)		
Spatial lag % jobs in other knowledge-intensive services [2]			**577.08**		
			(0.000)		
Spatial lag % jobs in less-knowledge-intensive services [3]			**471.15**		
			(0.011)		
Spatial lag % jobs in manufacturing			**473.83**		
			(0.000)		
Spatial lag Population			0.0009		
			(0.082)		
Spatial lag Population density			-2.5363		
			0.136		
Spatial lag Productive diversity			-201.43		
			(0.244)		
Spatial lag Average firm size in the region			165.94		
			(0.139)		
Spatial lag (ρ) or spatial error (λ) of the dependent variable				**0.5266**	**0.6436**
				(0.000)	(0.000)
R2	0.6179	0.6105	0.6855	0.7789	0.5545
R2-adj	0.6116	0.6025	0.6682		
Akaike	5036.46	5037.56	5000.08	4947.87	4918.18
Schwartz	5054.07	5058.69	5049.38	4968.00	4935.79
Mean VIF	1.36	1.60	2.85		
LM-error	-	120.55*	77.14*		
Robust LM-error	-	1.82	0.13		
LM-lag		120.061*	88.14		
Robust LM-lag		1.32	11.13*		
Probability LR error				0.000*	0.000*
Probability LR lag				0.483	0.000*
Observations	250	250	250	250	250

Notes: [1] Includes only telecommunications and information service activities as the rest (motion picture, video and television, sound recording and music, broadcasting, computer programming, and scientific research and development) are included in "creative services".

[2] Excluding publishing, architectural and engineering activities, advertising, and arts, entertainment and recreation, included in "creative services".

[3] Excluding retail sale of other goods in specialized stores, included in "creative services".

[4] Huber-White robust estimators used to prevent the problems of normality and heteroskedasticity.

[5] Instruments: spatial lags of the explanatory variables.

Table 5. Effects of the structure, agglomeration and spatial effects (lag) on the percentage of jobs in creative industries in the region. Contiguity matrix row standardized.

Dependent variable: % jobs in creative services	(1) OLS Robust[4]	(2) Spatial Lag (IV Robust). Logistic transformation [4] [5] [6]	(3) OLS Robust[4]. Logistic transformation [4] [5] [6]
Constant	2.2860	-0.0121	0.0491
	(0.218)	(0.688)	(0.227)
% jobs in high-tech services [1]	0.3066	**0.0056**	0.0031
	(0.126)	(0.017)	(0.315)
% jobs in other knowledge-intensive services [2]	**-0.0979**	-0.0008	**-0.0015**
	(0.002)	(0.054)	(0.009)
% jobs in less-knowledge-intensive services [3]	-0.0181	0.0005	-0.0008
	(0.646)	(0.375)	(0.316)
% jobs in manufacturing	**-0.1117**	**-0.0011**	**-0.0016**
	(0.000)	(0.003)	(0.000)
Number of clusters of high-tech services [1]	**0.6772**	**0.0084**	**0.0082**
	(0.007)	(0.001)	(0.006)
Number of clusters of other knowledge-intensive services [2]	**0.3057**	0.0026	**0.0035**
	(0.014)	(0.064)	(0.031)
Number of clusters of less-knowledge-intensive services [3]	-0.0583	-0.0010	-0.0006
	(0.514)	(0.209)	(0.601)
Number of clusters of manufacturing activities	0.0856	0.0011	0.0008
	(0.1764)	(0.126)	(0.338)
Population	**0.0000**	**0.0000**	**0.0000**
	(0.000)	(0.000)	(0.000)
Population density (population/Km2)	**0.0017**	**0.0000**	**0.0000**
	(0.000)	(0.000)	(0.003)
Productive diversity	**0.3345**	**0.0039**	**0.0037**
	(0.000)	(0.000)	(0.000)
Average firm size in the region	0.0365	0.0007	0.0002
	(0.272)	(0.128)	(0.644)
Spatial lag (ρ) of the dependent variable		-0.0066	
		(0.952)	
Spatial lag (γ) of the GDP per capita			0.0000
			(0.291)
R2	0.6983	0.6058	0.6996
R2-adj	0.6830		0.6831
LM-error	**0.0295 / p = 0.8636**		
Robust LM-error	**0.00004 / p = 99.47**		
LM-lag	**0.0481 / p = 0.8262**		
Robust LM-lag	**0.0187 / p = 0.8912**		
LM SARMA	**0.0482 / p = 0.9761**		
Observations	250	250	250

Notes: [1] Includes only telecommunications and information service activities as the rest (motion picture, video and television, sound recording and music, broadcasting, computer programming, and scientific research and development) are included in "creative services".

[2] Excluding publishing, architectural and engineering activities, advertising, and arts, entertainment and recreation, included in "creative services".

[3] Excluding retail sale of other goods in specialized stores, included in "creative services".

[4] Huber-White robust estimators used to prevent the problems of normality and heteroskedasticity.

[5] Instruments: spatial lags of the explanatory variables.

[6] Logistic transformation of the dependent variable ln(1/(1-p)) is performed since it is bounded between 0 and 1.

Table 6. Effects of the creative industries of neighbour regions on the wealth of neighbour regions. Contiguity matrix row standardized. Parsimonious estimation.

Dependent variable: spatial lag (GDP per capita in PPS)	OLS Robust[4]
Constant	-4995.75
	(0.023)
Spatial lag (% jobs in high-tech services) [1]	**1549.75**
	(0.000)
% jobs in other knowledge-intensive services [2]	**313.78**
	(0.000)
% jobs in manufacturing	**263.34**
	(0.000)
Number of clusters of high-tech services [1]	**-1837.77**
	(0.000)
Number of clusters of less-knowledge-intensive services [3]	**685.66**
	(0.000)
Spatial lag (ρ) of the dependent variable	**0.1342**
	(0.005)
R2	0.6614
Observations	250

Notes: [1] Includes only telecommunications and information service activities as the rest (motion picture, video and television, sound recording and music, broadcasting, computer programming, and scientific research and development) are included in "creative services".
[2] Excluding publishing, architectural and engineering activities, advertising, and arts, entertainment and recreation, included in "creative services".
[3] Excluding retail sale of other goods in specialized stores, included in "creative services".
[4] Huber-White robust estimators used to prevent the problems of normality and heteroskedasticity.
[5] Instruments: spatial lags (order 1 and 2) of the explanatory variables.

5. CONCLUSIONS

One relevant unknown aspect of creative services industries is whether they generate spillovers that impact on the wealth of other regions. These spillovers can be produced and transmitted through three mechanisms: direct spillovers from creative services on the wealth of other regions, indirect spillovers where creative services in a region affect first creative services in other regions and then the wealth, and indirect spillovers where creative services affect first the wealth of their own region and then the wealth of neighbour regions (directly or through other intermediate variables). The existence of these spillovers has been contrasted for a sample of 250 European regions in the year 2008, using exploratory analysis of data and spatial econometric confirmatory models.

The conclusion is that there is evidence of inter-regional spillovers of creative services on the wealth, but only in a way: in a first step creative industries increase the wealth of the region where they are located, and in a second step the wealth of this

region has a direct positive impact on the wealth of neighbour regions. This finding is coherent if we take into account that the literature on creative industries has found evidence separately on the first part of the mechanism (Florida et al. 2008; Rausell et al. 2011; De Miguel et al. 2012a,b) and the literature on regional growth (Abreu et al. 2005; Arbia 2006) has found evidence on the second part of the mechanism. The conclusion is that between 10 and 30% of the wealth of regions could be indirectly induced by creative services industries located in neighbour regions.

However, creative services don't spill over through the other two mechanisms:

i. there are not direct effects on the wealth of a region caused directly from creative services in neighbour regions. Some rare local exceptions have been found in concrete places such as the south of England and the centre of Nederland indicating that these places deserve a differentiated focus.

ii. The share of creative services industries in a region does not affect the proportion of creative industries in neighbour regions and therefore the impact on the wealth. From a theoretical point of view, this is caused because the dominant type of knowledge in creative industries is symbolic, which means that it is highly tacit and contextual and, as a consequence, highly local (Asheim et al. 2011). The physical distance between regions limits the range of emission of spillovers at the same time that social and cognitive distance between regions unable the mechanisms of absorption.

So far, the literature on creative industries had implicitly considered that the effects of the creative industries are strictly macro or strictly local (a-spatial), neglecting the effects of any spatial interaction such as inter-regional spillovers. The study challenges understanding of extant knowledge about creative industries confronting the implicit assumption that their impacts on wealth are strictly intra-regional with a more realistic assumption which is that creative industries also have effects on the wealth of neighbour regions.

Our findings suggest that a part of the effects of creative services on wealth are not strictly intra-regional but spill over to other regions. This is, the wealth of a region not only depends on internal processes and factors but also from creative services located in neighbour regions. In abstract, the results tell us that underlying theoretical constraints, principles, and their relationships in creative industries are not a-spatial. Spillovers of creative industries emerge when confront several aspects and effects of

creative industries. In concrete, when we consider that creative industries increase the wealth of the region where they are located (creative effect, or knowledge spillover in Capello's nomenclature) and that wealth increases the wealth of neighbour regions (wealth effect, or growth effect in Capello's nomenclature). The spatial dimension must be introduced in theoretical models and considered in practice. This refines appreciation of the underlying theory and empirics of creative industries. The raison is that neglecting the role of spatial spillovers produces an incomplete picture of the mechanisms through creative industries impacts on the regional wealth as well as biased estimations of the impacts. Together, this could lead not only improper analysis, which is not the main problem, but economic policy measures that are inefficient or even self-defeating. For example, in the concrete case of the European regions, we can observe how the within-region effect of creative services measured by De Miguel et al. (2012b) reduces because it was hiding part of the spillover effect, which in practice means that until 30% of the effect could be due to factors that are not under the direct control of the region but depend on the performance of neighbour regions. On the other hand, this evidence is not exactly competing with previous evidence but refining it, as policy makers could be interested in the fact that, in any case, most of the effect of creative services concentrates in the own region where they are located.

The findings also have consequences on the policy addressed to creative services. The effect of policies takes place basically within regions but a part spill over to other regions. In general, less creative regions don't take advantage of their proximity to more creative regions but rather to wealthier regions to develop their creative services. The results don't support direct evidence favourable to national or regional-driven policies. However, as the spillovers are not direct but mediated by an income mechanism, justification for non-compensated advantages (social optimum) to the generator regions are unclear. In addition, since the internal composition of creative services is heterogeneous across regions and the effects highly focused, policy should be differentiated and tailored for each region, which indirectly reinforce the role of regional policy.

The study has several limitations. First, a criticism to the conclusions arises if spillovers are different for each type of creative service. Second, we were interested on the mechanism of spillovers by proximity and neighbourhood. This means that we focused on horizontal spillover mechanisms. However, it has also sense to consider that

creative services are in an earlier stage of the diffusion process so that spillovers can be vertical through the urban hierarchy. In practice, this requires the introduction of different types of matrices of flows able to take this into account.

Future research must focus on these two limitations. It should differentiate within creative services in order to corroborate the existence or absence of exceptions for some creative services or combinations of creative services. Similarly, it must complete the range of mechanisms and ways of diffusion by considering other type of inter-regional flows such as, for example, flights, headquarters and subsidiaries of companies or internet flows.

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REFERENCES

Abreu, M., Groot, H.L.F.D. & Florax, R.J.G.M., 2005. Space and growth: a survey of empirical evidence and methods. *Région et Développement*, 21, pp.13-40.

Adams, J.D. & Jaffe, A.B., 1996. Bounding the effects of R & D : an investigation using matched establishment-firm data. *Rand Journal of Economics*, 27(4), pp.700-721.

Almeida, P. & Kogut, B., 1997. The Exploration of Technological Diversity and the Geographic Localization of Innovation. *Small*, pp.21-31.

Anselin, L., 1988. *Spatial econometrics: Methods and moments*, Dordrecht: Kluwer.

Anselin, L., Varga, A. & Acs, Z.J., 2000. Geographic and sectoral characteristics of academic knowledge externalities. *Business*, 443, pp.435-443.

Antonelli, C., Patrucco, P.P. & Quatraro, F., 2011. Knowledge externalities : An empirical analysis of agglomeration economies i European regions. *Economic Geography*, 87(1), pp.23-50.

Arbia, G., 2006. *Spatial econometrics: statistical foundations and applications to regional convergence*, Berlin: Springer.

Arora, V. & Vamvakidis, A., 2005. Economic Spillovers Exploring the impact trading partners have on each other's growth. *Finance and Development*, 42(3), pp.48-50.

Asheim, B.T., Boschma, R. & Cooke, P., 2011. Constructing Regional Advantage: Platform Policies Based on Related Variety and Differentiated Knowledge Bases. *Regional Studies*, 45(7), pp.893-904.

Audrestch, D.B. & Feldman, M.P., 1996. R&D spillovers and the geography of innovation and production. *The Americal Economic Review*, 86(3), pp.630-640.

Audretsch, D.B. & Keilbach, M., 2002. The Role of Labour Mobility and Informal Networks for Knowledge Transfer,. *Knowledge Creation Diffusion Utilization*, (November), pp.5-7.

Autant-bernard, C., 2001. Economics of Innovation and New Technology The Geography Of Knowledge Spillovers And Technological Proximity. *Economics of Innovation and New Technology*, 10(4), pp.237-254.

Baumol, W.J. & Bowen, W., 1965. On the performing arts: The anathomy of their economic problems. *American Economic Review*, 55((1/2)).

Bottazzi, L. & Peri, G., 2000. Innovation and spillovers: Evidence from European regions. *October*.

Caniëls, M.C.J. & Verspagen, Bart, 2001. Barriers to knowledge spillovers and regional convergence in an evolutionary model. *Journal of Evolutionary Economics*, 11(3), pp.307-329.

Capello, R., 2009. Spatial Spillovers and Regional Growth: A Cognitive Approach. *European Planning Studies*, 17(5), pp.639-658.

DCA, 1994. *Creative Nation: Commonwealth Cultural Policy*, Camberra.

DCMS, 2001. *Creative industries mapping document 2001*, London.

DCMS, 1998. *The Creative Industries Mapping Document*, London.

DeMiguel, B., Hervás, J.L., Boix, R., et al., 2012. The importance of creative industry agglomerations in explaining the wealth of the European regions. *European Planning Studies*, 20(8).

DeMiguel, B., Hervás, J.L. & Boix, R., 2012. The role of Creative Services promoting wealth in the European regions. *Business Services*, Forthcomin.

Dolfman, M.L., Holden, R.J. & Fortier Wasser, S., 2007. The economic impact of the creative arts industries: New York and Los Angeles. *Monthly Labor Review*, (October), pp.21-34.

Döring, T. & Schnellenbach, J., 2006. What do we know about geographical knowledge spillovers and regional growth?: A survey of the literature. *Regional Studies*, 40(3), pp.375-395.

Eurostat, 2009. High-technology' and "knowledge based services" aggregations based on NACE Rev. 2.

Fischer, M.M., 2009. A spatial Mankiw-Romer-Weil model : Theory and evidence.

Fischer, M.M., Scherngell, T. & Jansenberger, E., 2006. The Geography of Knowledge Spillovers Between High-Technology Firms in Europe : Evidence from a Spatial Interaction Modeling Perspective. *Geographical Analysis*, 38, pp.288-309.

Flew, T. & Cunningham, S., 2010. Creative Industries after the First Decade of Debate. *The Information Society*, 26(2), pp.113-123.

Florida, R., 2002. *The Rise of the Creative Class: And How It's Transforming Work, Leisure, Community and Everyday Life*, Basic Books.

Florida, R., Mellander, C. & Stolarick, K., 2008. Inside the black box of regional development--human capital, the creative class and tolerance. *Journal of Economic Geography*, 8(5), pp.615-649.

Funke, M. & Niebuhr, A., 2005. Regional Geographic Research and Development Spillovers and Economic Growth: Evidence from West Germany. *Regional Studies*, 39(1), pp.143-153.

Greunz, L., 2005. Intra and inter-regional knowledge spillovers: Evidence from European regions. *European Planning Studies*, 13(3), pp.449-473.

Griliches, Z., 1957. Hybrid corn: An exploration in the economics of technological change. *Econometrica*, 25(4), pp.501-522.

Howkins, J., 2007. *The Creative Economy: How People Make Money from Ideas*, London: Penguin.

Hägerstrand, T., 1967. *Innovation diffusion as a spatial process*, Chicago: University of Chicago Press.

Jaffe, A.B., Trajtenberg, M. & Henderson, R., 1993. Geographic localization of knowlege spillovers as evidenced by patent citations. *The Quarterly Journal of Economics*, 108(3), pp.577-598.

Lazzeretti, L., Capone, F. & Boix, R., 2012. Reasons for clustering of creative industries in Italy and Spain. *European Planning Studies*, 20(8), p.DOI: 10.1080/09654313.2012.680585.

Maruseth, P. & Verspagen, B, 2002. Knowledge spillovers in Europe: A patent citations analysis. *The Scandinavian Journal of Economics*, 104(4), pp.531-545.

O'Connor, J., 2007. *The cultural and creative industries : a review of the literature*, London: Arts Council England.

Potts, J. et al., 2008. Social network markets: a new definition of the creative industries. *Journal of Cultural Economics*, 32(3), pp.167-185.

Potts, J. & Cunningham, S., 2008. Four models of the creative industries. *International Journal of Cultural Policy*, 14(3), pp.233-247.

Power, D., 2011. *Priority Sector Report : Creative and cultural industries*, Stockholm.

Power, D. & Nielsén, T., 2010. *Priority Sector Report : Creative and Cultural Industries*, Stockholm.

Rausell, P., Marco, F. & Abeledo, R., 2011. Sector cultural y creativo y riqueza de las regiones: en busca de causalidades. *Ekonomiaz*, 78, pp.67-89.

Sacco, P.L. & Segre, G., 2006. Creativity , cultural investment and local development : a new theoretical framework for endogenous growth.

Scitovsky, T., 1954. Two concepts of external economies. *Journal of Political Economy*, 62, pp.143-151.

UNCTAD, 2010. *Creative economy. Report 2010*, Geneva - New York.

Varga, A., 2000. Local academic knowledge spillovers and the concentration of economic activity. *Journal of Regional Science*, 40(2), pp.289-309.

Viner, J., 1931. Cost curves and supply curves. *Zeitschrift für nationalökomie*, III, pp.23-46.

Wallsten, S.J., 2001. An empirical test of geographic knowledge spillovers using geographic information systems and firm-level data. *Regional Science and Urban Economics*, 31(5), pp.571-599.