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Inter-American Development Bank
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Do Creative Industries Enhance Employment Growth? Regional Evidence from Colombia*

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Abstract

Do creative industries have positive spillovers for the local economy in middle-income countries, for instance by attracting creative workers who benefit entrepreneurs and workers in other industries? Creative industries are considered highly innovative and productive and several studies in high-income countries have revealed such spillovers. However, the institutional and economic settings in middle-income countries may not be as conducive to them. Creative industries represented between 2.7 and 3.3 percent of Colombian employment in 2008 and 2017. Using granular employment data, we study their agglomeration patterns between 2008 and 2017. We find agglomeration in the largest cities (Bogotá, Medellín, and Cartagena) and in a few smaller cities. Using methodologies from prior studies yields a positive relationship between creative industry agglomeration and employment in non-creative services industries. However, after controlling for endogeneity using a shift-share instrumental variable approach, we find, contrary to analyses of high-income countries, no significant impact of an increase of creative industries employment on employment growth in other industries.

Keywords: creative industries, agglomerations, relatedness, employment growth, Colombia

JEL Codes: Z18, O00, D62

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1 Introduction

Creative industries have attracted substantial attention in recent years because they are highly innovative and productive and may constitute an important driver of economic change. There is increasing evidence of the positive impacts of creative industries on the local economy. Creative firms are testbeds for innovation and human capital learning processes that favor the creation, diffusion, and rapid adoption of new ideas in other industries in the same region (Florida, 2002; Lee and Rodríguez-Pose, 2014).

The literature has mainly focused on the effect of creative industries in high-income countries. Do creative industries have the same potential in low- and middle-income countries? Should they be a priority for policies aimed at increasing the innovation and growth capabilities in these countries? Like many other activities, creative industries are likely to differ in low- and middle-income countries with respect to high-income countries. Although creative industries are generating increasing interest at the policy level in Latin America and the Caribbean (LAC), the available evidence is insufficient to understand their performance, let alone to estimate their contribution to the rest of the economy (see, some exceptions in Benavente and Grazzi, 2017; IDB et al., 2014; Quartesan et al., 2007).

This paper contributes to addressing both limitations. First, we map creative industries across the Colombian territory to study their agglomeration properties over time (2008-2017). Second, exploiting evidence of some clustering properties, we estimate the impact of clusters of creative industries on the employment growth of industries co-located in the same area.

We contribute to two main streams of related literature. One focuses on how different types of industries agglomerate in regions (see, e.g., Balland et al., 2020). Several studies have found that creative industries tend to locate in large urban areas (e.g., Baum et al., 2009; Foord, 2013; Lazzeretti et al., 2008; Power and Nielsén, 2010). The second studies multiplier effects of changes in employment and innovation of one industry on the rest of the local economy (e.g., David et al., 2013; Diamond, 2016; Ciarli et al., 2018; Hornbeck and Moretti, 2018; Moretti, 2010; Moretti and Thulin, 2013). Several studies have shown that some industries have positive spillovers that benefit innovation and the average workers in other industries (see, Lee and Rodríguez-Pose, 2016, for the case of high-technology industries), although the impact is not equally distributed across workers, and some are worse off. Several studies have shown that the agglomeration of creative industries plays an important role in the wealth of a region. For example, Power and Nielsén (2010) showed that regional creative and cultural specialization explains around 50 percent of the variance in the European gross domestic product per capita (also, see, De Miguel-Molina et al., 2012). However, to our knowledge, no study has analyzed if increases in employment or productivity of the creative industries have a local multiplier effect. Unlike most studies on creative industries, we use an econometric model that allows computing exogenous employment growth measures in creative industries.

We use employment data from the Colombian Integrated Report of Social Security Contributions (PILA), which provides information on formal employment, wages, and the number of firms by industry at different levels of geographical disaggregation.

We first map creative industries across Colombian regions to study whether and where they agglomerate. Using employment data, we estimate location quotients in 62 cities and metropolitan areas to capture agglomeration and co-location patterns. We analyze the agglomerations for distinct creative activities and other non-creative industries to study their co-location patterns. Next, we study if the agglomeration of creative industries affects employment growth of other industries in these locations.

We find that the economic relevance of creative industries in Colombia, in terms of employment, is small and grew little between 2008 and 2017. Creative industries are a relatively small share of the Colombian economy, with estimates between 2.7 and 3.3 percent of total employment in 2008 and 2017, respectively. Five creative activities—architecture, new media, publishing, advertising, and audio-visuals—contribute to more than 90 percent of the total employment of all creative industries. In general, creative industries tend to agglomerate in cities with higher population and economic output levels. However, there are a few important exceptions of smaller areas of lower economic development with relatively high agglomerations of creative industries. This evidence contrasts with that of several high-income economies where agglomerations are usually observed in the largest areas.

In the econometrics estimations, we find no significant impact of agglomerations of creative industries when we control for the degree of relatedness of creative industries with non-creative industries. Moreover, we do not find statistically or economically significant effects of the growth of creative industries employment on the employment growth of the wider local economy when we use a shift-share instrumental variable that controls for unobserved characteristics of firms, industries, and cities. Instead, estimations with ordinary least squares (OLS) predict positive impacts on the total economy and non-creative services. These results imply that not controlling endogeneity and the possible reverse causality between variables, as does most of the literature so far, can make estimations predict a spurious relationship and misleading conclusions.

In sum, although we find important relationship between creative industries and the rest of the economy in terms of co-location in a middle-income country like Colombia, the agglomeration of creative industries alone does not seem to be relevant for non-creative employment in the local economy. The evidence indicates that to have positive spillovers, creative industries should have a larger size or be more connected to other economic sectors.

The rest of the paper is organized as follows. Section 2 presents the literature review. Section 3 explains the data, defines creative industries, and discusses the methodology. Section 4 presents the analysis of the agglomerations of creative industries and the results of the econometric estimations of the effect of creative industries on the wider economy. Finally, section 5 provides policy implications and concluding remarks.

2 Literature Review

Creative industries have drawn significant attention from scholars and policymakers because they have become an important source of innovation, production, and employment in several

countries. Most empirical studies have focused on high-income countries and found that creative and cultural industries are highly innovative and productive and positively impact the wider economy.

Inspired by this evidence, low- and middle-income countries have also come to recognize the potential of creative industries to boost their economic development. Several LAC countries have identified new opportunities arising from creative industries, actively seeking sustainable solutions to maintain these industries as an integral part of their cultural and economic life (Quartesan et al., 2007). However, the available evidence for the region is not sufficient to understand the performance of creative industries and estimate their real contribution to the economy. Some evidence indicates that creative industries could also be drivers of economic change in middle-income countries. For example, Hong et al. (2014) showed that agglomerations of creative industries have a significant and positive impact on regional total factor productivity growth in China.

Although the size of creative industries is smaller than in high-income countries, a few recent studies have provided evidence of rising agglomerations of creative industries in LAC countries. In Mexico, creative industries had a share of 2.5 percent of total employment in 2018, with high concentration levels in Mexico City, especially in sectors such as Software, and Advertising and Marketing.¹ Besides, there are important clusters of digital activity in states such as Jalisco or Nuevo León. There is also evidence of co-location of creative services such as Advertising and Marketing, and Design and Software, which suggests synergies between them. Conversely, other creative activities, such as Crafts, appear less connected with the rest of the creative industries.

For the case of Colombia, a report from DANE (2019) provides the most comprehensive evidence available. The study found that the share of creative industries in total value added ranged from 1.8 to 2.0 percent between 2014 and 2018, with their share of total employment being roughly 2.7 percent throughout the period. The report also provides a geographical analysis of the consumption of creative and, mainly, cultural products. Not surprisingly, consumers of creative and cultural products concentrated in larger cities, but there were also smaller areas—in economic and population terms—that had high levels of consumption. Regardless of the measure, creative industries always appear highly relevant in Bogotá and have low relevance in other departments. The concentration in Bogotá is not obvious, given that there is no evidence of strong agglomerations in Bogotá for other industries (see Dueñas et al., 2009).

This growing interest in the creative industries has led to a proliferation of their studies on different aspects. In this literature review, we focus on two main issues illustrated by two streams of the literature. The first relates to whether and how creative industries agglomerate geographically. The second analyzes the multiplier effects that a specific industry may induce on the rest of the local economy. In several studies, both issues are studied together, as in our paper.

Focusing on the location of creative industries, studies for Italy, Spain, France, the United Kingdom, Australia, the Netherlands, and the European Union have found that creative

¹See *México creativo: Mapeando las industrias creativas en México*, available at: <https://centroculturaldigital.mx/compas-creativo/mexico-creativo/\#composicion-y-tamano>.

industries tend to agglomerate in the major urban areas. In a few cases, they were also found to agglomerate in smaller cities (Baum et al., 2009; Boix-Domenech et al., 2014; Chapain et al., 2010; Lazzeretti et al., 2008; Power and Nielsén, 2010). For 16 European countries, Boix et al. (2015) showed that creative firms were highly concentrated in clusters that were predominantly metropolitan, heterogeneous, cross borders, and might co-locate to form assemblages.

Within this literature, different authors also analyzed why creative industries tend to cluster and the determinants of the growth of creative industries and clusters (see, e.g., Branzanti, 2015; Boix-Domenech et al., 2014; Lazzeretti et al., 2012; Lee and Rodríguez-Pose, 2014). While the reasons for the clustering of creative industries are still a matter of debate, there is broader agreement on the determinants of the growth of creative industries. The concentration of creative workers is considered a key driving force behind firm competitiveness and the growth of the wider economy (Florida, 2002; Piergiovanni et al., 2012). This concentration allows for continuous interaction between creative workers and workers in other industries, exchanging ideas, potentially leading to the diffusion of knowledge and innovations in the area (Chapain et al., 2010).

The evidence that creative industries agglomerate often leads researchers to analyze whether clusters of creative industries affect the local economy. Different scholars addressed this effect for the United States (Knudsen et al., 2008), the United Kingdom (Bakhshi and McVittie, 2009), Italy (Lazzeretti et al., 2017), the Netherlands (Stam et al., 2008), and different countries of the European Union (De Miguel-Molina et al., 2012; Power and Nielsén, 2010). Most studies focused on the effect of creative industries on innovation and employment growth of other industries in the locations where they agglomerate and the economic growth and productivity of the wider economy (Boix-Domenech and Soler-Marco, 2017; Hong et al., 2014; Power and Nielsén, 2010).

This research builds on the idea that particularly innovative industries (e.g., high-tech industries) can generate multiplier effects in productivity, employment, and innovation on the rest of the local economy (e.g., Hornbeck and Moretti, 2018; Moretti, 2010; Moretti and Thulin, 2013). In the case of creative industries, the multiplier effects are attributed to the presence of creative workers and the so-called creative class (Florida, 2002). This positive externality is generated by the relatively high share of human capital in creative industries, which affect both firm innovation performance and the generation of social innovations, fostering employment growth in the area (Innocenti and Lazzeretti, 2019). Supporting this hypothesis, some studies have found empirical evidence of a positive impact of creative workers and industries on the growth of a region in high-income countries settings (see, e.g., Piergiovanni et al., 2012; McGranahan and Wojan, 2007).

However, other studies found that the effect on the rest of the local economy of creative industries agglomerations alone is not significant and requires other conditions. For example, Lazzeretti et al. (2017) found no relationship between employment growth of creative industries and employment growth of other sectors in Italy. Stam et al. (2008) found a positive effect of creative industries on urban employment growth in the Netherlands, but this impact vanished when they removed Amsterdam from the sample.

In some cases, the effect of creative industries on the rest of the local economy depends on the interaction of creative industries with other non-creative activities. Lazzeretti et al. (2017) showed that related variety has an important effect on the growth of creative industries, characterized by high internal connections between different creative activities. Likewise, Innocenti and Lazzeretti (2019) claimed that creative industries play a relevant role in the economic development of an area when there is a concentration of creative workers in sectors characterized by a high degree of cognitive proximity with the existing creative industries. They showed that the mere clustering of creative industries does not have a positive impact on employment growth.

Similarly, McGranahan et al. (2010) argued that the positive effect of the creative class depends on the ability to utilize new knowledge, perhaps generated elsewhere, in addressing local economic challenges. Their case study showed that the interaction of entrepreneurial context with the share of the workforce employed in the creative class is strongly associated with growth in the number of new establishments and employment, particularly in those rural counties endowed with attractive outdoor amenities.

Different authors have shown that creative firms tend to be more innovative and that, in some cases, their agglomerations produce positive impacts on the rest of the local economy. Lee and Rodríguez-Pose (2014) found that United Kingdom firms in local economies with high shares of creative industries employment were significantly more likely to introduce entirely new products and processes than firms elsewhere, but not simply new to the firm innovations. This effect was not exclusive to creative industries firms and seems to have been due to firms in medium-sized rather than large cities. The results imply that creative cities may have functional specializations in new content creation, so firms are more innovative. Knudsen et al. (2008) analyzed the effects of agglomerations of creative industries on innovation and economic growth of United States regions. They found that the density of creative workers is a key component of knowledge spillovers and regional innovation. Stam et al. (2008) showed that firms in creative industries were relatively innovative, but there were substantial differences across different domains. Firms in creative industries located in urban areas were more innovative than their rural counterparts. However, except for the metropolitan city of Amsterdam, they found no measurable spillover effect from creative industries. Bakhshi and McVittie (2009) showed that creative industries appeared to be more innovative than other sectors on a broad range of activities. They also found a significant positive impact from creative linkages for some key innovation measures. Chapain et al. (2010) showed that creative firms tend to locate close to each other even more than most other sectors. Some creative activities, such as Advertising, Design, and Software, provide inputs and skills crucial to the innovation processes of businesses in other sectors.

Rodríguez-Pose and Lee (2020) argued that scientific activity and creativity are key inputs for innovation. They examined how the simultaneous presence of Science, Technology, Engineering, and Mathematics (STEM) and creative workers in 290 U.S. Metropolitan Statistical Areas has contributed to determining city-level innovation between 2005 and 2015. They found that it

was the combination of both factors that maximized innovation in U.S. cities and that the most innovative cities were precisely those that more successfully combined the two.

Table A.1 in the Appendix shows a summary of the main findings of the literature reviewed in this section. The list is not exhaustive, but it represents the two research lines and the evidence relevant for this paper, considering a wide variety of countries and regions.

3 Data, Definitions, and Methodology

3.1 Data

To study the geographical distribution and measure agglomerations of creative industries, we use data from the Integrated Report of Social Security Contributions, or PILA (for its name in Spanish, Planilla Integrada de Liquidación de Aportes), which provides information on formal employment, wages, and the number of firms aggregated at different geographical levels. The database is a census of all individuals and companies that contribute to the Colombian social protection system. Thus, PILA is an indicator of formal employment covering all economic sectors, representative of all geographical and industry disaggregations and their intersections.

The data are available at Centre for International Development at Harvard University (CID) and Bancoldex (2020) for Colombian departments, cities, and metropolitan areas. The metropolitan areas are the combination of two or more municipalities connected through relatively large flows of workers (regardless of their size of contiguity). Metropolitan areas in PILA are defined by Duranton (2015), who used a simple algorithm to exploit cross-municipality commuting patterns and where municipalities are aggregated iteratively provided they send a share of their commuters above a given threshold to the rest of a metropolitan area. This method derives 19 metropolitan areas that include 115 municipalities and 43 additional cities. For simplicity, in the rest of the paper, when we refer to cities, we include both cities and metropolitan areas, which add up to 62. Table A.2 in the Appendix distinguishes between cities and metropolitan areas and orders them by their total employment levels.

According to the firm in which they work, employees are classified to a 4-digit level industry code (ISIC Rev. 3 adapted for Colombia). PILA provides employment data on all economic sectors: agriculture, construction, finance, mining, trade, public administration, transport, manufacturing, and services. Then, the employment level in a given area/industry refers to the aggregation of all employees reported by the firm, regardless of each worker's occupation within the firm. We use these data to study the agglomerations of creative industries and the relatedness with other non-creative activities at the city level.

3.2 Definition of Creative Industries

Despite the increasing interest in creative industries, there is still no agreement among scholars and policymakers on a unique definition, whether they should refer to cultural industries or creative industries, and which activities those industries should include (De Miguel-Molina et al.,

2012). The definitions are usually based on industry classifications, and different studies use different industry inclusion criteria, making the comparison across studies not totally reliable.

In this paper, we combine DCMS (2016) and UNCTAD (2010), two of the most widely used classifications. Additionally, we follow the classification of DANE (2019) built for Colombia. Combining these definitions, we distinguish creative and non-creative industries in the ISIC Rev 3, 3.1, and Rev. 4 classification codes, which are those used in Colombian statistics.

Table 1: Definition of Creative Industries. ISIC Rev. 3/3.1 and Rev. 4 (Adapted for Colombia)

Industry	Code Rev. 3/3.1	Code Rev.4	Description
Crafts	3691	3210	Manufacture of jewelry, bijouterie, and related articles
	3692	3220	Manufacture of musical instruments
	3694	3240	Manufacture of games and toys
Publishing	2211	5811	Book publishing
	2212-2213	5813	Publishing of newspapers, journals, and periodicals
	2219	5819	Other publishing activities
Audio-visuals	9211	5911	Motion picture, video, and television program production activities
	9211	5913	Motion picture, video, and television program distribution activities
	9212	5914	Motion picture projection activities
	9211	5920	Sound recording and music publishing activities
	9213	6010	Radio broadcasting
	9213	6020	Television programming and broadcasting activities
	9220	6391	News agency activities
	9220	6399	Other information service activities n.e.c
	7494	7420	Photographic activities
New media	7220	5820	Software publishing
	7220	6201	Computer programming activities
	7210	6202	Computer consultancy and computer facilities management activities
	7240	6312	Web portals
Architecture	7421	7110	Architectural and engineering activities and related technical consultancy
	7421	7410	Specialized design activities
Advertising	7430	7310	Advertising
Arts	9214	9002	Musical creation
	9214	9003	Theater creation
	9214	9006	Theater activities
	9214	9007	Live music show activities
Entertainment sites	9219	9008	Other live show activities
	9219	9321	Activities of amusement parks and theme parks
	9231	9101	Library and archives activities
	9232	9102	Museum activities and preservation of historical sites and buildings
	9233	9103	Botanical and zoological gardens and nature reserve activities

Notes: Adapted from DANE (2019), DCMS (2016), and UNCTAD (2010). We only include industries that can be entirely considered as creative. Those that might include only a share of creative firms are not considered.

We use data at 4-digit level of disaggregation. First, we identify those codes that can be entirely classified as creative. Next, we group these codes into distinct creative activities, which is relevant because creative industries include a variety of related industries in services and manufacturing, requiring different types of employment, business models, organization, and knowledge. We follow the literature and international classifications to build the sectoral disaggregation, and we end up with a classification of creative industries and creative activities

that can be compared with those used in studies in high-income countries (e.g., in Lazzeretti et al., 2008; Lee and Rodríguez-Pose, 2014). Table 1 shows our final list of creative industries in Colombia.

3.3 Agglomerations of Creative Industries

First, we investigate the geographical distribution of creative industries and the extent to which they agglomerate. To compute the agglomeration of creative industries, we employ the location quotient (LQ), which is one of the most commonly used methods to identify territorial specialization because it captures the spatial agglomeration independently of the size of the location (Lazzeretti et al., 2008).

More precisely, in the case of creative firms, the LQ compares the relative specialization of a location in an industry with reference to the national average and can be computed as:

$$LQ_{ck} = \frac{E_{ck} / \sum_{c'} E_{c'k}}{\sum_{k'} E_{ck'} / \sum_{c'} \sum_{k'} E_{c'k'}}, \quad (1)$$

where E_{ck} is the number of employees in city c in industry k , and c' and k' are summation indexes over cities and industries, respectively. An LQ above 1 indicates that industry k in city c is larger than the national average and, therefore, is concentrated in that specific location. That is, city c is specialized in industry k .

Second, we describe creative industries in Colombia and in the cities where they agglomerate. Further, we compare them with other industries in order to understand their relevance and their relationship with the wider economy of each city. To do this, we compute an index of economic complexity for each city (fitness) that takes into account both the city-industry specialization and the ubiquity of industries across cities (for details on the methodology, see Cristelli et al., 2013; Tacchella et al., 2012).

Finally, in order to identify statistically significant patterns of industry co-locations, we use a measure of proximity based on the Jaccard index:

$$C_{kk'} = \frac{V_{kk'}}{V_k + V_{k'} - V_{kk'}}, \quad (2)$$

where $V_{kk'}$ is the number of co-occurrences in which industry k and k' appear together across cities subject to these cities having LQs > 1 in each industry, and V_k is the total number of cities in which industry k has LQs > 1 , and similarly for $V_{k'}$.² We exploit the information on the proximity of industries to build a network representation of Colombian industries, which allows us to visualize if different groups of industries cluster in different communities (see, Bruno et al., 2018, for the case of Colombian exporting firms). To detect communities in the network, we use the Louvain algorithm, which is a widely employed community-detection algorithm for large graphs (Blondel et al., 2008).

²The Jaccard index has been widely used as a similarity measure to detect co-occurrences of data in different fields (see, e.g., Boschma et al., 2014; Campi et al., 2020, 2021; Utkovski et al., 2018).

Additionally, we compute the degree of relatedness of creative industries with the rest of the economy in each city as follows:

$$Relatedness_c^{CI} = \sum_{k' \in \Omega_{CI}} \sum_k C_{kk'} \frac{E_{ck'} + E_{ck}}{E_c}, \quad (3)$$

where k' is a creative activity in the set of creative industries Ω_{CI} , k is an index for all economic industries, and E_c is the total employment at city c . This indicator weights the degree of proximity between two sectors with the share of employees of those sectors in each location.

3.4 The Effect of Creative Agglomerations on the Wider Economy

Following the study of Innocenti and Lazzeretti (2019) for the case of Italy, we first analyze the relationship between the agglomeration of creative industries and their relatedness with other industries with the employment growth of non-creative industries.

We smooth city and sectoral time series by averaging employment biannually from 2008 to 2017, which leads to five periods. We use fixed effects on the panel data to estimate the following equation:

$$\Delta \ln E_{ct}^{NCI} = \alpha + \beta Z_{c(t-1)}^{CI} + \rho \ln E_{c(t-1)}^{NCI} + \gamma_c + \gamma_t + \nu_{ct}, \quad (4)$$

where $\Delta \ln E_{ct}^{NCI}$ is the employment growth of the non-creative economy in city c and time t ; $Z_{c(t-1)}^{CI}$ is either $LQ_{c(t-1)}^{CI}$ the location quotient of creative industries or $Relatedness_{c(t-1)}^{CI}$, defined in Equation 3, a measure that indicates the degree of relatedness of creative industries with non-creative industries in city c and time $(t-1)$; $\ln E_{c(t-1)}^{NCI}$ is the level of employment in the period $(t-1)$ in city c (the auto-regressive term); γ_c and γ_t are city and time dummies, respectively; and ν_{ct} is the error term.

Next, we analyze whether creative industries have a multiplier effect on the employment growth of non-creative industries. Again, we smooth short-run fluctuations in city and industry time series by averaging employment from 2008 to 2010 and 2015 to 2017.

We rely on the local multiplier framework (Moretti, 2010) to estimate the following equation:

$$\Delta \ln E_{ct}^{NCI} = \alpha + \beta \Delta \ln E_{ct}^{CI} + \nu_{ct}, \quad (5)$$

where $\Delta \ln E_{ct}^{NCI}$ and $\Delta \ln E_{ct}^{CI}$ are the growth rates of employment in city c for non-creative and creative industries, respectively, between the two periods (2008-2010 and 2015-2017), and ν_{ct} are the residuals.

The estimations of Equation (5) by OLS is likely to be biased since there might be time-varying shocks affecting the labor supply of a city in both creative and non-creative industries (e.g., due to internal migrations or regional industrial policies). To tackle this problem, we isolate arguably exogenous shifts in the demand for labor in the non-creative industry using a shift-share or Bartik instrumental variable, which allows us to compute exogenous employment growth

measures in creative industries, controlling for unobserved characteristics of firms, industries, and cities.³

More precisely, we use the eight creative activities defined in Table 1 to instrument for changes in employment in total creative industries in city c at time t with the national level employment growth in the same activity, excluding city c . The shift-share or Bartik instrument Z_{ct} is then computed as:

$$Z_{ct} = \sum_{k \in CI} \omega_{kt_0} \cdot g_{-ckt}, \quad (6)$$

where ω_{kt_0} is the share of industry k in the initial period t_0 and g_{-ckt} is the growth rate of industry k at the national level, excluding the contribution of city c .

Thus, this calculation includes the national share and the industry mix components but excludes the regional shift. In effect, of all the variations in employment in industry k in city c , the instrument isolates the variation from nationwide changes in industry k (where nationwide changes are computed excluding city c). Intuitively, the instrument captures exogenous changes in local labor demand because these nationwide changes do not reflect local economic conditions (Moretti and Thulin, 2013).

4 Analysis and Results

4.1 Agglomerations of Creative Industries

Creative industries represent a relatively small share of the Colombian economy, which has been growing at a slow pace. In Table 2, we observe that total creative employment increased from 2.7 percent of the total employment in 2008 to 3.3 percent in 2017.

Trade, non-creative manufacturing, and non-creative services generate most of the employment in Colombia (up to 70 percent). The relevance of non-creative manufacturing activities declined from 13.0 percent to 11.1 percent between 2008 and 2017, while the employment share of non-creative services increased from 41.8 percent to 45.1 percent over the same period. This is the case despite the potential attraction of jobs in creative industries in terms of salaries: workers in the creative industries, on average, earn a higher monthly salary than the average workers in the rest of the economy, with the exception of those in mining, finance, and the public sector.

It is interesting to note the large differences between different creative activities in terms of salaries. Higher salaries are in new media and audio-visuals, while lower average salaries are in entertainment sites, crafts, and arts. These differences reflect the fact that creative industries include a set of quite heterogeneous activities, with different types of employment, business models, organization, and knowledge.

Five out of eight creative activities absorb almost all creative industries employment: archi-

³This strategy, which was originally implemented by Bartik (1991), has been increasingly used to isolate labor demand shocks in urban economics. For recent applications of this identification strategy, see: Bartik (2014); Ciarli et al. (2018); Diamond (2016); Hornbeck and Moretti (2018); Moretti (2010) and Adao et al. (2019).

Table 2: Number of Workers, Firms, Average Monthly Salaries, and Shares of Economic Sectors (2008 and 2017)

Activity	Number of workers		Number of firms		Average monthly salary		Employment share in total		Share within creative industries	
	2008	2017	2008	2017	2008	2017	2008	2017	2008	2017
Advertising	21,060	27,288	1,432	2,843	1,315,788	1,839,360	0.46	0.41	17.49	12.40
Architecture	46,117	94,683	4,708	13,708	1,047,222	1,627,061	1.01	1.41	38.30	43.03
Arts	968	3,825	296	1,299	946,240	1,247,748	0.02	0.06	0.80	1.74
Audio-visuals	9,643	10,428	920	1,823	1,304,487	2,219,524	0.21	0.16	8.01	4.74
Crafts	2,286	2,712	217	331	679,440	1,149,182	0.05	0.04	1.90	1.23
Entertainment sites	7,848	10,344	565	1,221	785,496	1,289,573	0.17	0.15	6.52	4.70
New media	17,471	47,530	1,320	5,916	2,070,170	2,926,952	0.38	0.71	14.51	21.60
Publishing	15,022	23,211	832	8,563	1,213,570	1,482,280	0.33	0.35	12.48	10.55
Creative Industries	120,415	220,021	10,290	35,704	1,259,115	1,918,655	2.65	3.28	100	100
Agriculture	152,384	200,642	5,891	11,763	664,879	1,046,397	3.35	2.99		
Construction	218,661	536,841	9,880	36,854	733,382	1,075,864	4.81	8.01		
Finance	203,229	200,341	7,788	12,606	1,449,316	2,512,470	4.47	2.99		
Mining	46,038	53,793	1,464	3,340	2,160,327	3,381,146	1.01	0.80		
Non-creative services	1,897,971	3,022,106	125,886	358,804	798,546	1,277,807	41.76	45.11		
Non-creative manufacturing	591,046	744,280	25,648	43,149	1,071,679	1,637,250	13.01	11.11		
Other	286,250	197,042	11,989	15,305	607,633	1,198,125	6.30	2.94		
Public Administration	256,280	395,655	15,275	31,104	1,467,044	2,389,035	5.64	5.91		
Trade	598,807	879,364	58,938	100,812	868,941	1,369,752	13.18	13.13		
Transport	173,617	249,526	8,194	16,732	713,350	1,178,252	3.82	3.72		
Total Economy	4,544,698	6,699,611	281,243	666,173	913,243	1,441,124	100	100		

Notes: Salaries are in current Colombian pesos. We compute the average monthly salary for the total economy as the total sum of salaries in each sector divided by total workers.

ture, new media, advertising, publishing, and audio-visuals added up to 90.8 percent of all creative industries in 2008 and 92.3 percent in 2017. Arts, crafts, and entertainment sites made up for the remaining employment. Between 2008 and 2017, architecture remained the main creative activity, but new media gained relevance, displacing advertising to third place. Another change between 2008 and 2017 is that the share of audio-visuals decreased while the share of Crafts increased. Interestingly, some creative activities have notably increased the number of firms between 2008 and 2017, for example, publishing (from 832 to 8,536), with employment not increasing as much.

Figure 1 provides a visualization of the relevance and distribution of creative industries across cities for 2008 and 2017. The distribution of creative industries is skewed and concentrated in the cities with the largest populations and economic output, as measured by their employment levels and value added (see Table A.2 in the Appendix). Bogotá, Medellín, and Cali appear to be the main locations where all creative activities are concentrated. However, a high number of creative firms does not imply a high LQ (above 1).

Table 3 shows the number of workers, the number of firms, and the location quotients of all creative industries, non-creative manufacturing, and non-creative services in the 20 main Colombian cities in terms of total employment.

Although the distribution of creative industries is concentrated in the largest cities, these cities do not necessarily reveal agglomerations of creative industries (or other industries). This is partly because some of those large cities also have many firms and workers in other industries, such as services and manufacturing. For example, Cali, Barranquilla, and Bucaramanga are more

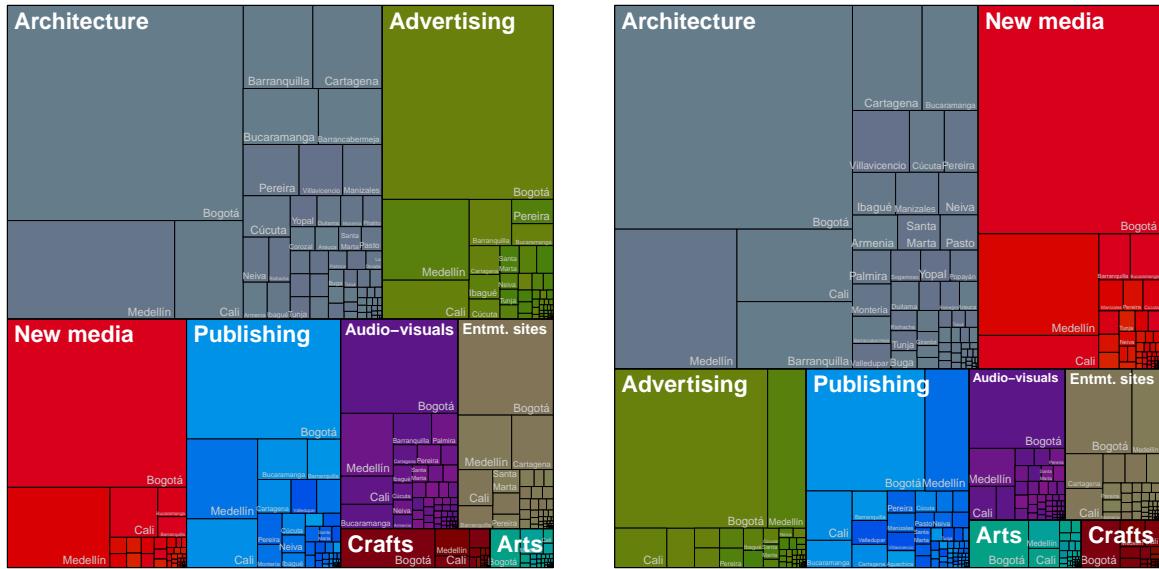


Figure 1: Employment Distribution of Creative Industries by Cities (left: 2008; right: 2017)

Table 3: Number of Firms and Location Quotients: Creative Industries (CI), Non-creative Manufacturing (NCM), and Non-creative Services (NCS) in Top 20 Colombian Cities (2017)

City	Number of Workers			Number of Firms			Location Quotient		
	CI	NCM	NCS	CI	NCM	NCS	CI	NCM	NCS
Bogotá	108,803	265,998	1,142,389	17,782	14,176	150,720	1.37	0.99	1.05
Medellín	33,333	164,349	391,091	4,655	8,434	30,682	1.03	1.50	0.88
Cali	14,236	87,850	295,471	1,983	3,596	21,850	0.69	1.26	1.04
Barranquilla	9,264	37,381	169,375	1,170	1,937	18,244	0.79	0.94	1.05
Bucaramanga	7,387	23,214	134,576	1,387	2,091	16,825	0.78	0.73	1.04
Cartagena	7,919	15,963	110,502	762	981	12,580	1.16	0.69	1.18
Pereira	3,163	23,999	64,318	703	1,359	7,170	0.61	1.37	0.91
Ibagué	2,266	7,891	53,970	478	762	7,453	0.57	0.59	0.99
Cúcuta	2,662	8,136	54,079	440	881	5,510	0.7	0.64	1.04
Manizales	2,812	14,744	53,812	508	777	4,972	0.76	1.18	1.06
Villavicencio	3,728	6,260	44,592	786	601	7,686	1.04	0.51	0.9
Santa Marta	1,984	5,172	39,881	354	450	5,841	0.69	0.53	1.00
Neiva	1,977	4,185	34,881	401	536	4,540	0.77	0.48	0.99
Armenia	1,784	6,358	32,114	336	561	4,342	0.7	0.74	0.92
Popayán	1,209	9,559	37,811	252	304	5,303	0.48	1.13	1.10
Valledupar	1,690	3,699	39,015	294	372	4,609	0.68	0.44	1.14
Montería	1,499	3,506	31,985	225	394	2,694	0.66	0.46	1.03
Pasto	1,419	4,234	32,346	316	750	4,642	0.63	0.56	1.05
Rionegro	851	8,043	19,679	298	607	2,387	0.46	1.28	0.77
Tunja	911	4,601	23,339	227	295	2,869	0.5	0.75	0.94

Notes: Colored cells are LQs above 1, which indicate agglomerations. Cities are ordered by the level of total employment.

specialized in non-creative services or manufacturing. Creative industries are relevant, but they do not agglomerate in these cities more than in others. This is like saying that most large and small cities will have a number of architects, artists, and media to satisfy local demand for those services. Some cities, such as Bogotá (large) and Villavicencio (small), tend to become hotspots and host a larger number of employees in creative industries than the average Colombian city.

In brief, creative industries agglomerate in Bogotá and Medellín, the two largest cities, in Cartagena, among the largest cities, and in a few smaller cities: Villavicencio, and Sogamoso,

Duitama, Arauca, and Aguachica (not reported in Table 3). Instead, we observe agglomerations of non-creative services and manufacturing in more cities than of creative industries. Figure 2 shows the estimated LQs of creative industries, non-creative manufacturing, and non-creative services in Colombian cities in 2017.

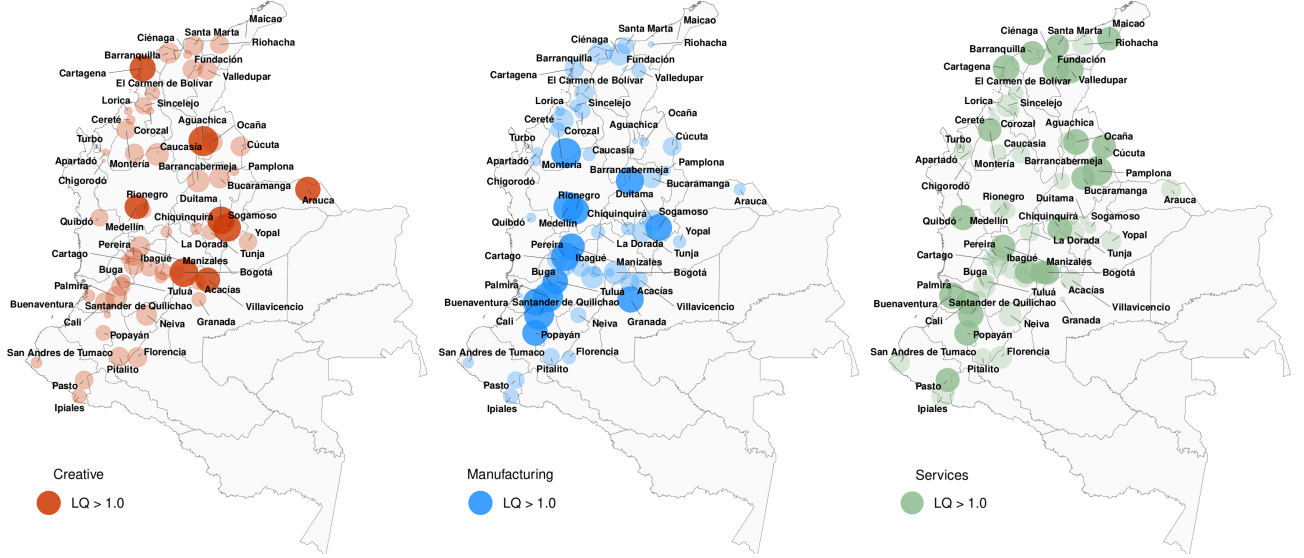


Figure 2: Location Quotients of Creative Industries, Non-creative Manufacturing, and Non-creative Services in Colombian Cities (2017)

Table 4 shows the evolution of the LQs for all creative industries in the top 20 Colombian cities. Bogotá and Cartagena have LQs above one during the whole period and Villavicencio during most years. Instead, Medellín starts concentrating creative industries more recently.

Table 4: Location Quotients of Creative Industries in Colombian Cities (2008 -2017)

City	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Bogotá	1.37	1.38	1.39	1.38	1.41	1.37	1.35	1.35	1.36	1.37
Medellín	0.84	0.87	0.92	0.96	0.94	0.96	0.97	1.01	1.03	1.03
Cali	0.64	0.66	0.63	0.63	0.63	0.69	0.70	0.67	0.66	0.69
Barranquilla	0.76	0.70	0.66	0.65	0.69	0.69	0.74	0.76	0.79	0.79
Bucaramanga	0.88	0.85	0.80	0.80	0.86	0.87	0.78	0.77	0.72	0.78
Cartagena	1.33	1.25	1.24	1.20	1.19	1.23	1.26	1.25	1.29	1.16
Pereira	0.78	0.67	0.62	0.59	0.54	0.56	0.56	0.59	0.59	0.61
Ibagué	0.61	0.52	0.49	0.47	0.52	0.65	0.57	0.56	0.61	0.57
Cúcuta	0.77	0.61	0.59	0.60	0.59	0.73	0.69	0.70	0.73	0.70
Manizales	0.79	0.73	0.65	0.76	0.78	0.66	0.69	0.81	0.76	0.76
Villavicencio	0.98	1.09	1.38	1.22	1.15	1.25	1.20	0.92	0.85	1.04
Santa Marta	0.62	0.62	0.56	0.54	0.57	0.65	0.62	0.63	0.70	0.69
Neiva	0.83	0.79	0.81	0.78	0.95	0.91	0.93	0.78	0.75	0.77
Armenia	0.58	0.59	0.57	0.53	0.59	0.59	0.92	1.20	1.04	0.70
Popayán	0.43	0.52	0.45	0.52	0.47	0.49	0.61	0.52	0.45	0.48
Valledupar	0.71	0.82	0.63	0.74	0.67	0.60	0.65	0.69	0.68	0.68
Montería	0.79	0.76	0.72	0.63	0.48	0.44	0.52	0.63	0.59	0.66
Pasto	0.50	0.49	0.46	0.51	0.56	0.53	0.62	0.63	0.55	0.63
Rionegro	0.35	0.31	0.34	0.34	0.26	0.29	0.39	0.42	0.41	0.46
Tunja	0.48	0.51	0.67	0.71	0.55	0.52	0.53	0.56	0.60	0.50

Notes: Colored cells are LQs above 1, which indicate agglomerations of creative industries. Cities are ordered by the level of total employment.

Next, we analyze these concentration patterns concerning the ability of a given city to

specialize in more or less sophisticated activities, requiring a higher level of capabilities to produce them. Figure 3 shows the LQ matrix for all economic activities in 2017.

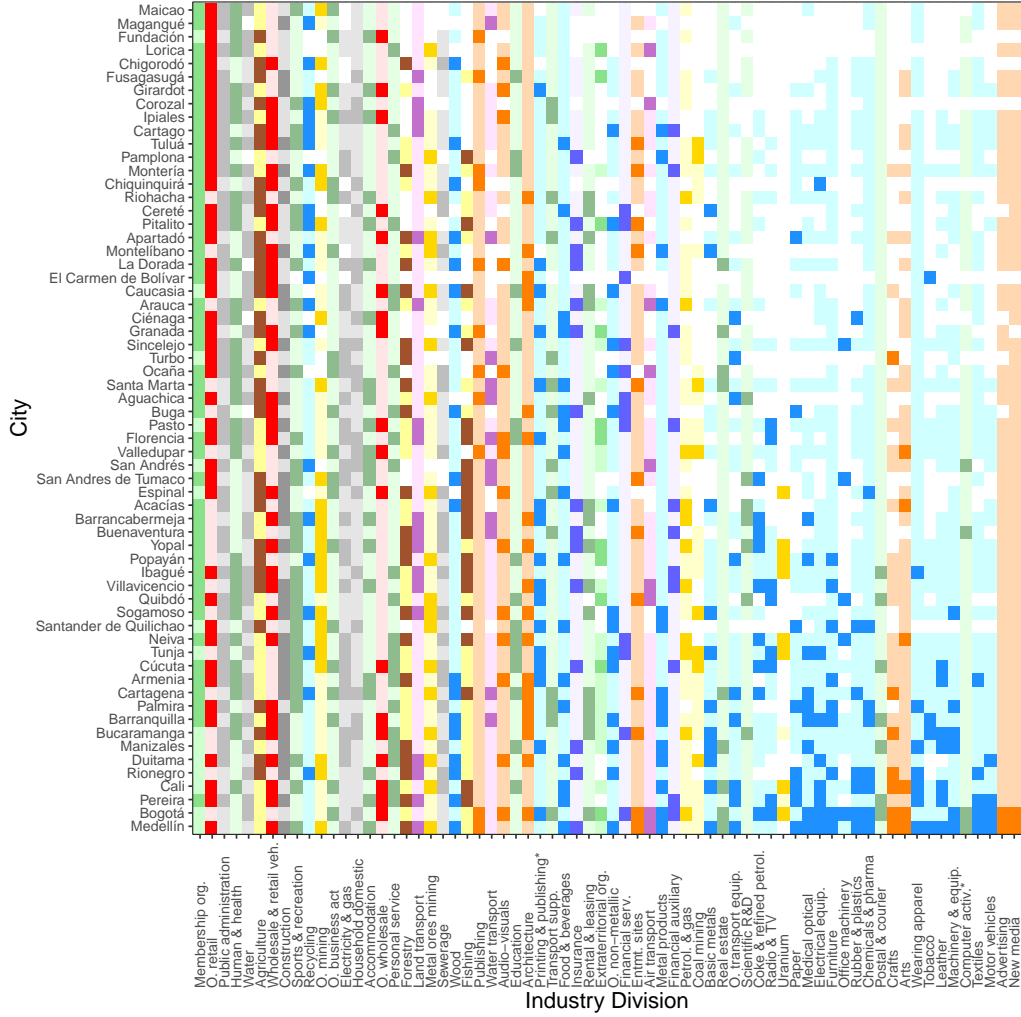


Figure 3: Location Quotient Matrix (2017).

Note: light colors represent LQs below 1 and dark colors represent LQs above 1. Matrix is arranged according to the fitness and complexity algorithm (Tacchella et al., 2012): more competitive cities from top to bottom, and more sophisticated products from left to right. Printing & publishing* excludes creative publishing. computer activ.* excludes computer programming, which is a creative activity. Short names are built from the ISIC Rev. 3.1 classification codes at two digits of disaggregation (see Table A.3 in the Appendix). The colors used for the economic sectors are as follows: ● agriculture, ● mining, ● manufacturing, ● services, ● creative, ● transport, ● construction, ● public administration, ● finance, ● trade, ● other (services).

The matrix entries are LQs for each industry or creative activity (horizontal axis) in each city (vertical axis). We arrange the matrix considering the sophistication of industries within Colombia (increasing from left to right) and the competitiveness of cities (increasing from top to bottom), specifically computed for the Colombian economy in each cross-section. More sophisticated industries are those that include products or services that more competitive cities can produce. More competitive cities are those that can support a broad set of industries, including the more sophisticated ones.

The matrix reveals that the largest cities of Colombia, in terms of employment, have a high

LQ in a relatively wide variety of industries. For example, Bogotá, Medellín, Cali, and Pereira can produce in all the industries and activities. Other smaller cities that appear at the top of Figure 3 reveal production capabilities (high LQ) in only a few industries. Likewise, some industries are ubiquitous (most cities present a high LQ in sectors such as retail trade, public administration, and health and social work (human & health)). In contrast, many industries, such as motor vehicles and new media, have a high LQ in only a few locations.

Similarly, some creative activities, such as architecture, audio-visuals, and advertising, are present in several cities. In contrast, other creative activities such as arts, crafts, and entertainment Sites are present in a few cities. Table 5 shows the estimated location quotients for creative activities in Colombian cities in 2008 and 2017.

Table 5: Location Quotients for Creative Activities in Colombian Cities (2008 and 2017)

Activity	Advertising		Architecture		Arts		Audio-visuals		Crafts		Entmt. sites		New media		Publishing	
	2008	2017	2008	2017	2008	2017	2008	2017	2008	2017	2008	2017	2008	2017	2008	2017
Bogotá	1.64	1.78	1.15	1.12	1.27	1.48	1.20	1.46	1.68	1.37	1.22	1.09	1.80	1.75	1.28	1.24
Medellín	0.74	1.10	0.80	0.88	1.34	1.12	0.76	0.81	0.91	1.18	0.83	1.15	1.05	1.26	0.84	1.13
Cali	0.64	0.57	0.58	0.67	0.61	1.19	0.61	0.67	0.71	1.16	0.64	0.88	0.54	0.65	0.92	0.74
Barranquilla	0.72	0.54	0.97	1.10	0.73	0.44	0.96	0.82	0.25	0.63	0.79	0.84	0.26	0.41	0.69	0.60
Bucaramanga	0.45	0.30	0.94	1.04	0.49	0.40	1.37	0.53	1.79	1.18	0.76	1.01	0.50	0.49	1.38	0.91
Cartagena	0.63	0.42	1.85	1.79	0.31	0.90	0.75	0.60	0.64	1.98	4.29	2.93	0.15	0.23	1.11	0.82
Pereira	0.77	0.52	1.00	0.67	0.51	0.48	0.79	0.77	0.23	0.14	0.80	0.91	0.25	0.38	0.81	0.80
Ibagué	0.99	0.64	0.51	0.77	0.51	0.33	0.98	0.58	0.22	0.16	0.41	0.27	0.33	0.23	0.64	0.60
Cúcuta	0.76	0.39	1.08	0.95	0.07	0.32	0.88	0.71	0.14	0.11	0.20	0.35	0.22	0.48	0.86	0.81
Manizales	0.54	0.74	1.03	0.82	0.56	0.64	0.84	0.59	0.10	0.20	0.31	0.42	0.32	0.68	1.27	0.99
Villavicencio	0.75	0.55	1.64	1.63	0.45	0.66	0.70	0.73	0.65	0.77	0.69	0.92	0.41	0.31	0.31	0.97
Santa Marta	0.86	0.47	0.41	0.86	0.09	0.44	0.95	0.99	0.04	0.28	2.73	2.18	0.05	0.15	0.43	0.59
Neiva	0.56	0.30	1.01	1.09	4.47	1.44	1.18	1.24	0.05	0.13	0.68	0.62	0.22	0.33	1.11	0.75
Armenia	0.43	0.28	0.75	1.04	0.61	0.38	1.09	1.21	0.26	0.83	0.71	0.55	0.29	0.34	0.21	0.42
Popayán	0.40	0.15	0.27	0.58	0.13	0.16	0.53	0.40	0.17	0.16	1.54	0.68	0.15	0.49	0.75	0.50
Valledupar	0.42	0.20	0.41	0.65	1.85	1.48	0.57	1.13	0.30	0.39	0.25	0.32	0.08	0.15	3.11	2.30
Montería	0.61	0.34	0.74	0.91	0.13	0.05	1.33	0.76	0.06	0.64	0.48	1.01	0.13	0.12	1.89	1.03
Pasto	0.44	0.08	0.54	1.00	0.39	0.84	1.06	0.53	0.11	0.14	0.85	0.30	0.09	0.20	0.41	0.89
Rionegro	0.21	0.15	0.51	0.50	1.31	0.19	0.32	0.34	0.86	2.45	0.38	0.70	0.12	0.19	0.16	0.94
Tunja	0.70	0.39	0.50	0.48	0.00	0.19	0.82	0.77	0.12	0.09	0.12	0.38	0.33	0.60	0.38	0.57

Notes: Colored cells are LQs above 1, which represent agglomerations of creative activities. Cities are ordered by the level of total employment.

Clearly, creative industries have more relevance in Bogotá, which has the highest population and also concentrates more non-creative industries, with agglomerations of creative workers in all creative activities in both 2008 and 2017. Medellín, the second metropolitan area of Colombia, also agglomerates creative workers in several activities. Instead, Cali only shows LQs above 1 for arts and crafts in 2017. Several smaller cities, both in economic output and employment levels, display LQs above 1 in diverse activities in different years.

In general, the estimated LQs are relatively stable between 2008 and 2017. A few steep changes are observed in cities with low economic activity, where small changes can significantly affect LQs. Given their weak and relatively unstable productive structure, small economic shocks or within-country migration can abruptly change industry composition.

Three of the five more relevant creative industries: architecture, audio-visuals, and publishing, tend to agglomerate in several cities, not only in the more relevant ones. Instead, despite their relevance in employment, advertising and new media only agglomerate in Bogotá and Medellín.

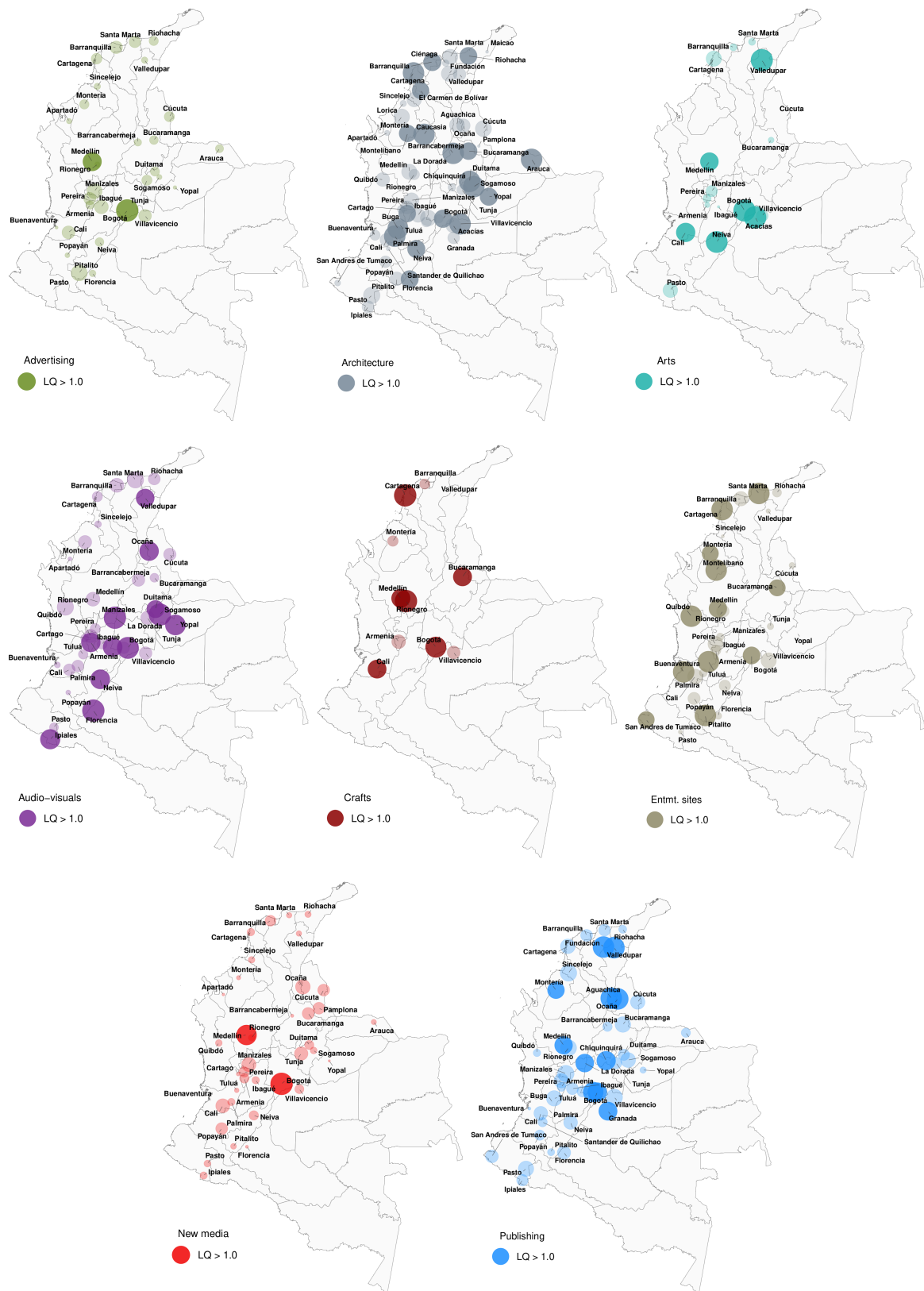


Figure 4: Concentration of Creative Activities in Colombian Cities (2017)

Figure 4 presents the estimated location quotients of creative activities in Colombian cities for 2017.

4.2 Co-location of Creative Industries

Having analyzed how aggregation patterns vary across cities, with larger cities attracting most activities and smaller cities more specialized in a subset of activities, we exploit those variations in the agglomeration patterns to investigate if industries, especially creative industries, tend to agglomerate closer to other agglomerated industries. This provides insights on how the industries might be connected, based on the choice of entrepreneurs to locate in one or the other city.

Figure 5 shows the network representation of the proximity between economic activities in Colombia for 2015-2017.⁴ The nodes' size represents the strength of the connectivity, and the size of the links represents the magnitude of the Jaccard index.

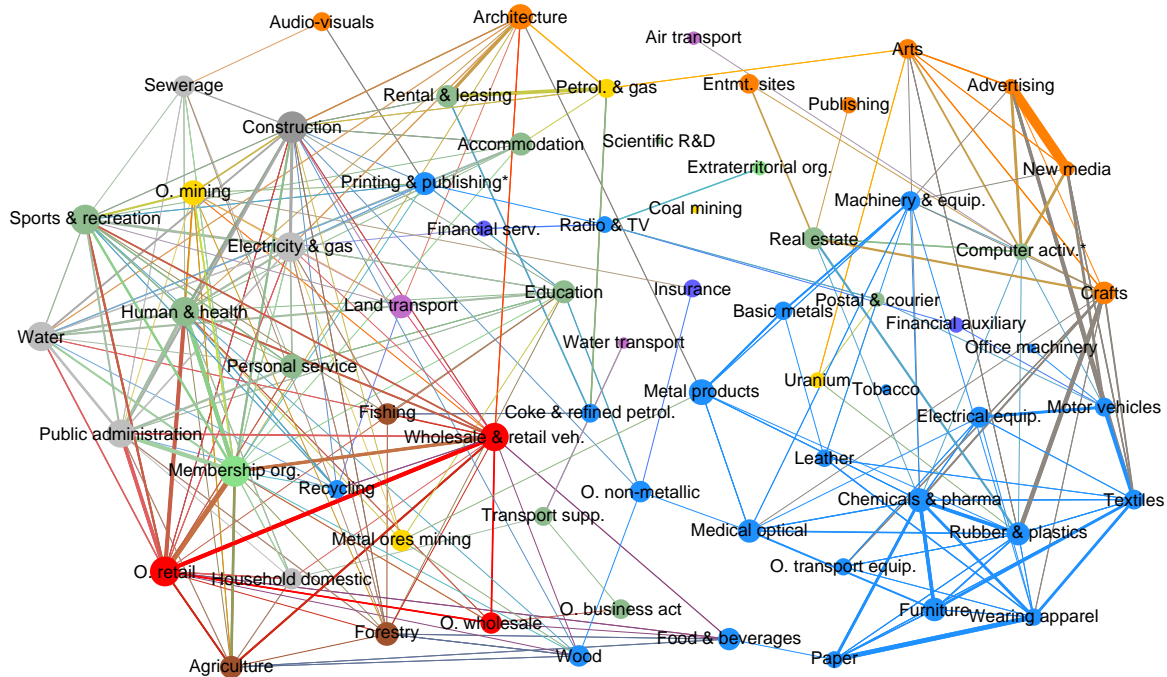


Figure 5: Network of Co-occurrences of Creative and Non-creative Industries (2015-2017).

Note: the size of the nodes represents the strength of the connectivity and links represent the magnitude of the Jaccard index. Weak connections are filtered when $C_{kk'} < 0.3$. The color used for the economic sectors are as follows: ● agriculture, ● mining, ● manufacturing, ● services, ● creative, ● transport, ● construction, ● public administration, ● finance, ● trade, ● other (services).

The geographical co-existence of industries relies on the geographical distribution of production inputs. The network is dense and fully connected, and most sectors show high connectivity, even though links can be sensitive to migrations due to internal conflicts, which can generate relatively large changes in the productive structure of the cities, and to the process of de-industrialization that has been taking place at different paces within Colombia (Brando, 2017).

To better interpret the pattern of connections across industries emerging from Figure 5, the left panel of Figure 6 provides another visualization of the co-location of creative and

⁴We averaged the Jaccard index in this period to obtain an average representation of the network since industry co-occurrences might be sensitive to employment and other shocks, especially in small cities.

non-creative industries estimated with the Jaccard index for 2015-2017. We organize the figure in three dashed diagonal blocks of communities. The low network modularity (0.14) reveals weak specialization of cities in these communities.

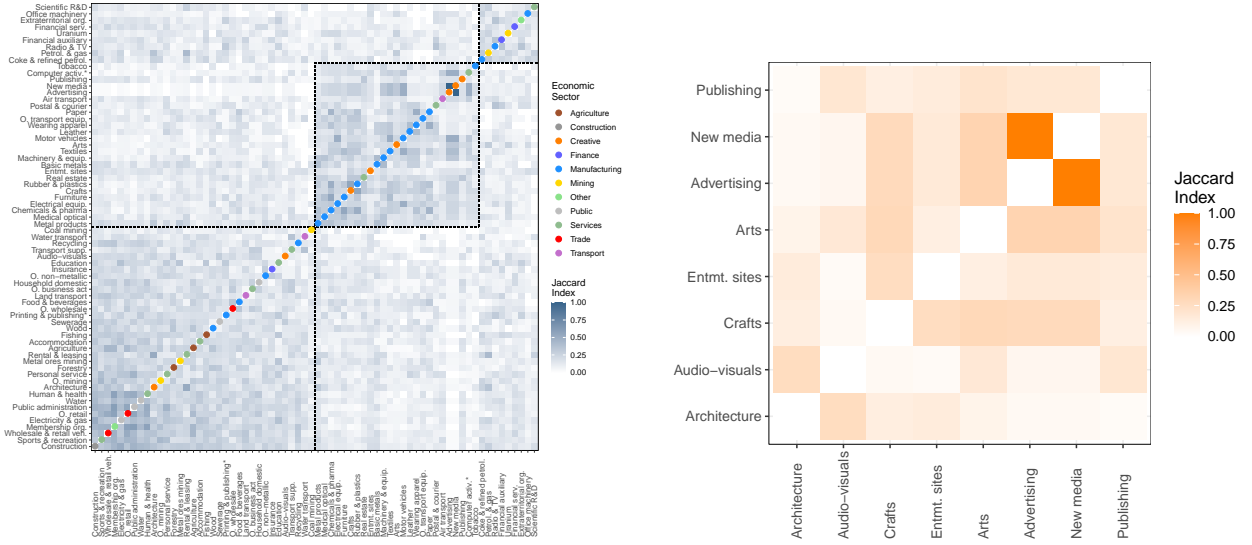


Figure 6: Heat Map of Co-location of Economic Activities. Left: Co-location of creative and non-creative industries, computed with the average for 2015-2017 of the Jaccard index. Colored dots in the diagonal indicate whether industries belong to the economic sectors listed at the right side of the figure. Blocks identify the communities that are detected in the proximity matrix using the Louvain algorithm (Figure 5). Right: Co-location of creative activities computed with the Jaccard index over 2015-2017.

The larger community, at the bottom, includes mainly services, the primary sectors, construction, the public sector, and a few localized, less traded manufacturing industries. Among the creative industries, this largest community includes audio-visuals and architecture. Most industries in this community are typically ubiquitous and do not reveal spatial specialization. In other words, these sectors tend to co-locate, not because they are particularly related, but because they provide goods and services that are not tradable and that are more likely produced locally. This is also the case for architecture, the most relevant activity among the creative industries (in terms of employment), and audio-visuals, services that tend to be present in all cities. Despite this, Figure 5 also reveals that these two creative activities are mostly connected to industries we would expect to be closest, such as the rental accommodation and construction industries (architecture) and the printing and publishing industry (audio-visuals). Because these non-creative industries are ubiquitous, we do not expect architecture and audio-visuals to strongly impact their performance and employment.

At the top, the smallest community groups some high-technology sectors and mining, which are relatively detached from the rest of the economy (in the middle in Figure 5). None of the creative activities seem to be strongly connected with these high knowledge-intensive industries, suggesting a quite different picture with respect to high-income countries, as documented, for example, in Rodríguez-Pose and Lee (2020). Therefore, we do not expect any particular relationship between the employment performance in these knowledge-intensive industries and

any of the creative activities in Colombia.

The third community, in the middle, includes more sophisticated industries than the first community but not as many knowledge-intensive industries as the second community. These are primarily among non-creative manufacturing, such as chemical and pharma, optical, electrical equipment, machinery and motor vehicles, and some more traditional industries, such as textile and leather. A few services, such as real estate and non-creative computer activities, are also present. This is the second largest component on the right side in Figure 5. In this community, we observe most creative activities: crafts, entertainment sites, arts, advertising, new media, and publishing. Some of these industries may be connected to sophisticated manufacturing industries (e.g., advertising, new media, and publishing) and contribute to their growth and competitiveness; some to the more traditional ones (e.g., arts and crafts), also contributing to their performance; and some to the advanced non-creative services (e.g., new media and publishing). However, some of these creative industries may also agglomerate around those sophisticated industries because of the demand for (personal) services that their better-paid workers generate (Ciarli et al., 2018; Eeckhout et al., 2014; Mazzolari and Ragusa, 2013).

The right panel of Figure 6 shows the co-location of creative activities, estimated with the averaged Jaccard index for 2015-2017, which provides measures of their tendency to co-locate in the same city. New media and advertising are perfectly co-located (1.00). Arts tend to co-locate with advertising and new media (0.33) and with crafts (0.30). To a lesser extent, crafts co-locates with advertising and new media (0.29), and audio-visuals co-locates with architecture, and crafts with entertainment sites (0.27). We do not observe intense co-location levels for other creative industries.

4.3 The Impact of Creative Industries on the Wider Economy

Having established some regularities in the agglomeration patterns of the creative industries around other industries, we move to analyze whether these agglomeration patterns are related to the performance of non-creative industries, measured with employment. First, we estimate the relation between the agglomerations of creative industries and their relatedness with non-creative industries with the employment growth of non-creative industries. Table 6 presents the estimation results of Equation 4. Models (1) include the LQs of creative industries and models (2) include the relatedness of creative industries with non-creative activities.

For the total economy and non-creative services, we find that both agglomerations (columns 1) and relatedness (columns 2) of creative industries are positively related with the employment growth in non-creative industries of the cities in which they locate. These estimations indicate that both the spatial relevance and the relatedness of creative industries with non-creative activities is important for the city's employment growth.

It can be interesting to study the interaction between spatial agglomerations and relatedness, as Innocenti and Lazzeretti (2019) for the case of Italy. However, the measures of agglomerations and relatedness for Colombian cities are highly correlated (in contrast with the Italian case, where the correlation is 0.57, in Colombia, it reaches 0.85).

Table 6: The Relation of Agglomerations and Relatedness of Creative Industries with the Employment Growth of the Wider Economy, Fixed Effects Estimations (2008 -2017)

Model	Employment Growth of					
	Total Economy		Non-creative Services		Non-creative Manufacturing	
	(1)	(2)	(1)	(2)	(1)	(2)
$LQ_{c(t-1)}^{CI}$	0.080** (0.035)		0.085* (0.047)		0.022 (0.036)	
$Relatedness_{c(t-1)}^{CI}$		0.717*** (0.099)		0.777*** (0.175)		0.078 (0.231)
$\ln Employment_{c(t-1)}^{NCI}$	-0.473*** (0.100)	-0.442*** (0.094)	-0.514*** (0.152)	-0.497*** (0.147)	-0.682*** (0.101)	-0.685*** (0.101)
Constant	4.932*** (1.025)	4.247*** (0.986)	4.926*** (1.417)	4.355*** (1.404)	5.240*** (0.750)	5.236*** (0.725)
Observations	184	184	184	184	184	184
R-squared	0.819	0.839	0.695	0.711	0.640	0.639
Number of cities	46	46	46	46	46	46

Notes: The dependent variable is the growth rate of the employment of non-creative industries (total economy, non-creative services, or non-creative manufacturing). We remove cities with less than 50 employees in creative industries. All the estimations include time dummies. Robust standard errors clustered by cities are in parenthesis. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Therefore, in order to observe the interaction between agglomerations and relatedness, we split the sample in cities with agglomerations below and above the median and estimate the effect of relatedness on the employment growth of non-creative activities.⁵ Table 7 presents the results.

For the total economy and non-creative services, we observe that in cities with agglomerations below the median, the effect of relatedness is positive and significant, while in those cities with agglomerations above the median the estimated coefficients are not statistically significant. This indicates that, in those cities where agglomerations of creative industries are relatively low, any effect on employment growth of non-creative industries should be expected in those sectors with high relatedness. Instead, in cities with high agglomeration of creative industries, relatedness is less important for employment growth. Given that those cities with higher spatial agglomerations of creative industries also tend to concentrate other non-creative industries, this result suggests that the employment growth of those cities might derive more from the co-location of other industries rather than from the co-location of creative industries.

Therefore, we next investigate whether there is a causal relationship between employment growth of creative industries and employment growth of all non-creative sectors, regardless of their degree of relatedness. We estimate the effect of an expansion of creative industries (measured with employment growth) in a given city on the employment growth of the wider economy of the city. Table 8 reports the estimated impact of the growth of employment in the

⁵We also did the estimations for the sample of cities with $LQs < 1$ and $LQs \geq 1$. The results lead to similar conclusions, but we prefer to use samples with a balanced number of cities.

Table 7: The Interaction between Spatial Agglomerations and Relatedness of Creative Industries and the Employment Growth of the Wider Economy, Fixed Effects Estimations (2008 -2017)

Sample	Employment Growth of					
	Total Economy		Non-creative Services		Non-creative Manufacturing	
	LQ<median	LQ \geq median	LQ<median	LQ \geq median	LQ<median	LQ \geq median
Model	(1)	(2)	(1)	(2)	(1)	(2)
Relatedness $_{c(t-1)}^{CI}$	0.804*** (0.105)	0.529 (0.310)	1.018*** (0.205)	0.232 (0.331)	-0.028 (0.250)	0.480 (0.614)
ln Employment $_{c(t-1)}^{NCI}$	-0.399*** (0.134)	-0.516*** (0.088)	-0.350* (0.203)	-0.773*** (0.094)	-0.685*** (0.138)	-0.661*** (0.154)
Constant	3.580** (1.343)	5.351*** (0.923)	2.705 (1.823)	7.640*** (1.001)	4.830*** (0.882)	5.239*** (1.238)
Observations	92	92	92	92	92	92
R-squared	0.846	0.841	0.701	0.794	0.624	0.680
Number of cities	23	23	23	23	23	23

Notes: The dependent variable is the growth rate of the employment of non-creative industries (total economy, non-creative services, or non-creative manufacturing). We remove cities with less than 50 employees in creative industries. All the estimations include time dummies. Robust standard errors clustered by cities are in parenthesis. Significance level: *** p<0.01, ** p<0.05, * p<0.10.

creative industries on the employment growth of non-creative industries in a given city (OLS and 2SLS results).

Table 8: Estimations of Local Multipliers of Creative Firms for Non-creative Industries in Colombia, OLS and OLS-2SLS Estimations (2008 -2010 and 2015 -2017)

Estimation Method	Employment Growth of					
	Total Economy		Non-creative Services		Non-creative Manufacturing	
	OLS	OLS-2SLS	OLS	OLS-2SLS	OLS	OLS-2SLS
Growth rate creative industries	0.153** (0.062)	-0.053 (0.411)	0.263** (0.111)	0.155 (0.654)	0.146 (0.115)	0.686 (0.440)
Constant	0.394*** (0.053)	0.546* (0.301)	0.495*** (0.069)	0.582 (0.477)	0.404*** (0.114)	0.026 (0.309)
N. of observations	46	46	46	46	46	46

Notes: The dependent variable is the growth rate of the employment of non-creative industries (total economy, non-creative services, or non-creative manufacturing). We remove cities with less than 50 employees in creative industries. Robust standard errors clustered by cities are in parenthesis. Significance level: *** p<0.01, ** p<0.05, * p<0.10.

With OLS, we find a positive relationship between the employment growth of creative industries and that of other industries in the total economy. Employment growth of 100 percent in creative industries is related to a 15.3 percent increase in employment in other sectors. When we split between non-creative service and manufacturing sectors, we find that this relationship is observed only for service sectors, not for manufacturing. Employment growth of 100 percent in creative industries is related to a 26.3 percent increase in employment in non-creative services only.

As we discuss in Section 3.4, to better identify the impact of growth in creative industries on other industries, we use a shift-share instrumental variable approach (OLS-2SLS). The instruments are valid, with the correct sign, and with F statistics of 60.29, above the standard threshold. When we instrument employment growth in the creative industries (OLS-2SLS), we find no significant impact on employment growth in the rest of the economy, neither in services nor in manufacturing.

In brief, we do not find a significant effect of the mere clustering of creative industries on employment growth of other sectors when we control for unobserved characteristics of firms, industries, and cities using a shift-share instrument. Therefore, the estimated effect with OLS may be the result of simultaneous changes in the employment of service sectors and creative industries due to a well-known process of urbanization.

This result calls attention to the relevance of controlling for endogeneity and possible reverse causality between the dynamics of the creative sector and other sectors in the local economy when analyzing the potential impacts of the creative industries.

5 Policy Implications and Concluding Remarks

The economic relevance of creative industries in Colombia is small but has increased slightly between 2008 and 2017. The employment share of creative industries in the total economy increased from 2.7 percent in 2008 to 3.3 percent in 2017. Given the different definitions of creative industries, it is challenging to make comparisons with other countries. However, the shares in Colombia seem less relevant than those observed in several high-income economies, such as the United Kingdom (8.7 percent, in 2013), the United States (9.5 percent in 2013), and Canada (13.0 percent in 2013) (Nathan et al., 2016), but closer, although still lower, to that found in others, such as Italy (around 5.0 percent in 2015) (Innocenti and Lazzeretti, 2019).⁶

Five creative activities—architecture, new media, publishing, advertising, and audio-visuals—explain more than 90 percent of the creative industry. Besides, some creative activities within the aggregated creative industry have increased their relevance, particularly new media and arts. We observe agglomerations of creative industries in three large metropolitan areas (Bogotá, Medellín, and Cartagena) and a few smaller cities. Instead, some large metropolitan areas, such as Cali, do not have clusters of creative industries. In general, larger cities attract most economic activities, while smaller cities tend to be more specialized in a subset of activities.

Looking at creative activities, we observe agglomerations in a higher number of cities compared to all creative industries. Within this general pattern, architecture and audio-visuals appear more connected to a set of ubiquitous non-creative services. Therefore, the effect of these two creative activities is not expected to be relevant. Moreover, creative activities are not highly connected to high-technology industries and mining. This suggests a quite different picture with respect to high-income countries, where creative industries appear connected to

⁶We must highlight that Colombia has a large informal sector, estimated to have been between 62 and 65 percent in 2013, which is not considered in this paper (International Labour Organization (ILO), 2014). The consideration of informal employment could generate changes in the employment share of creative industries.

knowledge-based industries.

Instead, several creative activities appear more connected to some relatively sophisticated non-creative manufacturing and a few non-creative services. Thus, we can expect an effect of creative industries in these type of activities. However, some of these creative industries may also agglomerate around those sophisticated industries because of the demand for (personal) services or goods that their better-paid workers generate, which was observed in several high-income countries (Ciarli et al., 2018; Eeckhout et al., 2014; Mazzolari and Ragusa, 2013).

In the econometric analysis, we estimate with OLS a positive effect of the growth of creative workers on the employment growth of the local economy, which is entirely explained by the employment growth of non-creative services. However, when we use a shift-share instrument to control for unobserved characteristics of firms, industries, and cities, the effect is not statistically significant. Thus, we conclude that the employment growth of creative industries has no significant multiplier effect on the employment growth of non-creative activities. Moreover, this result calls attention to the relevance of controlling endogeneity in this type of estimation because not doing it can predict a spurious relation and misleading conclusions.

Similar to Innocenti and Lazzeretti (2019), we observe that the relatedness of creative industries is more relevant than agglomerations for the employment growth of the non-creative economy. This implies that the potential of creative industries to foster regional development depends not only on the co-location but, more importantly, on the relations they have with other local sectors. In other words, creative industries need to interact with other sectors in order to promote innovation and growth (Bakhshi et al., 2008). For the case of Colombia, we observe that relatedness is more relevant in those cities in which the spatial agglomeration of creative industries is relatively low.

In sum, the evidence of the econometric estimations indicates that, to have positive spillovers, creative industries should have a larger size or be more connected to other economic sectors. We are not able to identify a significant causal relationship between the employment growth of creative industries and the employment growth of non-creative industries.

The analysis of creative industries in Colombia can provide useful policy design tools and indicate the need for future work providing further evidence. First, Colombia's creative industries are still relatively small, but their potential to generate changes in the wider economy makes them an interesting subject of development policy. Some creative activities have become more relevant, notably, architecture, new media, and, to a lesser extent, Arts. There is a wide place for improvement and growth of other creative activities, which should be encouraged considering their potential role for development. Currently, creative industries do not seem to play a relevant role in the Colombian economy.

Second, the presence of creative industries in several medium or small cities, with relatively low non-creative economic activities, could be an opportunity to reduce the regional inequalities characterizing Colombia. A potential positive impact of creative industries on the employment of other non-creative industries relies not only on their co-location but, probably more importantly, on their degree of relatedness with the non-creative economy. The interaction and learning

processes that can derive from this co-location might allow the generation of synergies and the exchange of knowledge and ideas, exploiting the potential of creative industries. Therefore, fostering agglomerations of creative activities should consider the rest of the economy and the possibilities of knowledge flows. In sum, the development of those regions cannot only rely on the expansion of creative industries alone.

Third, our analysis focuses on the quantity of employment without considering the qualification of workers. This is a relevant issue because creative industries usually have high levels of human capital and skills. An indication of this is that salaries in creative industries, particularly in some creative activities, are above those of most other non-creative sectors. Studying the composition of employment in terms of occupations and related skills could reveal an effect of creative industries on the employment structure of the wider economy. This opens a relevant area of analysis to understand creative industries in Colombia that requires better data on occupations and skills.

Finally, a probably relevant part of creative industries is not captured by our data sources that only consider formal activities or above a certain size. For example, informal or small cultural activities and different artistic expressions, which are not present in our data, should be considered. Similarly, we assume in this paper that the employment of creative firms is all creative employment. Data on the occupations of individual workers would provide a more accurate characterization of creative activities. In this sense, a systematic policy seeking to develop creative activities should consider a broader but more precise identification of creative activities and improve data availability to derive policy recommendations from better evidence.

References

- Adao, R., M. Kolesár, and E. Morales (2019). Shift-share designs: Theory and inference. *The Quarterly Journal of Economics* 134(4), 1949–2010.
- Bakhshi, H. and E. McVittie (2009). Creative supply-chain linkages and innovation: Do the creative industries stimulate business innovation in the wider economy? *Innovation* 11(2), 169–189.
- Bakhshi, H., E. McVittie, and J. Simmie (2008). *Creating Innovation: Do the creative industries support innovation in the wider economy?* London: Nesta.
- Balland, P., C. Jara-Figueroa, S. Petralia, M. Steijn, D. Rigby, and C. Hidalgo (2020). Complex economic activities concentrate in large cities. *Nature Human Behaviour* 4(3), 248–254.
- Bartik, T. (1991). *Who benefits from state and local economic development policies?* Kalamazoo, MI: Upjohn Institute.
- Bartik, T. (2014). How effects of local labor demand shocks vary with local labor market conditions. Upjohn Institute Working Paper 14-202. Available at SSRN: <http://dx.doi.org/10.2139/ssrn.2390222>.
- Baum, S., K. O'Connor, and T. Yigitcanlar (2009). The implications of creative industries for regional outcomes. *International Journal of Foresight and Innovation Policy* 5(1-3), 44–64.
- Benavente, J. M. and M. Grazzi (2017). Public policies for creativity and innovation: promoting the orange economy in Latin America and the Caribbean. Inter-American Development Bank. Available at: <https://publications.iadb.org/en/handle/11319/8550>.
- Blondel, V., J. L. Guillaume, R. Lambiotte, and E. Lefebvre (2008). Fast unfolding of communities in large networks. *Journal of Statistical Mechanics: Theory and Experiment* 2008(10), P10008.
- Boix, R., J. L. Hervás-Oliver, and B. De Miguel-Molina (2015). Micro-geographies of creative industries clusters in Europe: From hot spots to assemblages. *Papers in Regional Science* 94(4), 753–772.
- Boix-Domenech, R., F. Capone, L. De Propriis, L. Lazzeretti, and D. Sanchez (2014). Comparing creative industries in Europe. *European Urban and Regional Studies* 23(4), 935–940.
- Boix-Domenech, R. and V. Soler-Marco (2017). Creative service industries and regional productivity. *Papers in Regional Science* 96(2), 261–279.
- Boschma, R., G. Heimeriks, and P.-A. Balland (2014). Scientific knowledge dynamics and relatedness in biotech cities. *Research Policy* 43(1), 107–114.
- Brando, C. (2017). La industria en el siglo XX. In S. Kalmanovitz (Ed.), *Breve historia económica de Colombia*. Bogotá: Ministerio de Cultura: Biblioteca Nacional de Colombia.
- Branzanti, C. (2015). Creative clusters and district economies: Towards a taxonomy to interpret the phenomenon. *European Planning Studies* 23(7), 1401–1418.
- Bruno, M., F. Saracco, T. Squartini, and M. Dueñas (2018). Colombian export capabilities: building the firms-products network. *Entropy* 20(10), 785.
- Campi, M., M. Dueñas, and G. Fagiolo (2020). How do countries specialize in agricultural production? A complex-network analysis of the global agricultural product space. *Environmental*

- Research Letters* 15(12), 124006.
- Campi, M., M. Dueñas, and G. Fagiolo (2021). Specialization in food production affects global food security and food systems sustainability. *World Development* 141, 105411.
- Centre for International Development at Harvard University (CID) and Bancoldex (2020). Datlas Colombia. Retrieved from: <http://datlascolombia.com/#/>.
- Chapain, C., P. Cooke, L. De Propriis, S. MacNeill, and J. Mateos-Garcia (2010). *Creative clusters and innovation. Putting creativity on the map*. London: NESTA.
- Ciarli, T., A. Marzucchi, E. Salgado, and M. Savona (2018). The effect of R&D growth on employment and self-employment in local labour markets. Available at SSRN: <https://ssrn.com/abstract=3147861>.
- Cristelli, M., A. Gabrielli, A. Tacchella, G. Caldarelli, and L. Pietronero (2013). Measuring the intangibles: A metrics for the economic complexity of countries and products. *PloS one* 8(8), e70726.
- DANE (2019). Economía naranja. Primer reporte. Available at: https://www.dane.gov.co/files/investigaciones/pib/sateli_cultura/economia-naranja/1er-reporte-economia-naranja-2014-2018.pdf.
- David, H., D. Dorn, and G. Hanson (2013). The China syndrome: Local labor market effects of import competition in the United States. *American Economic Review* 103(6), 2121–68.
- DCMS (2016). Creative industries economic estimates methodology. Department for Culture, Media and Sport. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/499683/CIEE_Methodology.pdf.
- De Miguel-Molina, B., J. L. Hervás-Oliver, R. Boix-Domenech, and M. De Miguel-Molina (2012). The importance of creative industry agglomerations in explaining the wealth of European regions. *European Planning Studies* 20(8), 1263–1280.
- Diamond, R. (2016). The determinants and welfare implications of US workers' diverging location choices by skill: 1980-2000. *American Economic Review* 106(3), 479–524.
- Dueñas, M., M. E. Morales Rubiano, and L. E. Olmos Sánchez (2009). Aglomeración industrial en el área metropolitana de Bogotá DC. *Revista Facultad de Ciencias Económicas: Investigación y Reflexión* 17(2), 99–118.
- Duranton, G. (2015). Delineating metropolitan areas: Measuring spatial labour market networks through commuting patterns. In T. Watanabe, I. Uesugi, and A. Ono (Eds.), *The economics of interfirm networks*, pp. 107–133. Tokyo: Springer.
- Eeckhout, J., R. Pinheiro, and K. Schmidheiny (2014). Spatial sorting. *Journal of Political Economy* 122(3), 554–620.
- Florida, R. (2002). *The Rise of the Creative Class*. New York: Basic Books.
- Foord, J. (2013). The new boomtown? Creative city to Tech City in east London. *Cities* 33, 51–60.
- Hong, J., W. Yu, X. Guo, and D. Zhao (2014). Creative industries agglomeration, regional innovation and productivity growth in China. *Chinese Geographical Science* 24(2), 258–268.
- Hornbeck, R. and E. Moretti (2018). Who Benefits From Productivity Growth? Direct and

- Indirect Effects of Local TFP Growth on Wages, Rents, and Inequality. NBER. Available at: <https://www.nber.org/papers/w24661>.
- IDB, Oxford Economics, British Council, and Organization of American States (2014). The economic impact of the creative industries in the Americas. Available online at: <https://publications.iadb.org/publications/english/document/The-Economic-Impact-of-the-Creative-Industries-in-the-Americas.pdf>.
- Innocenti, N. and L. Lazzeretti (2019). Do the creative industries support growth and innovation in the wider economy? Industry relatedness and employment growth in Italy. *Industry and Innovation* 26(10), 1152–1173.
- International Labour Organization (ILO) (2014). Trends in informal employment in Colombia: 2009–2013. Available at: https://www.ilo.org/wcmsp5/groups/public/---americas/---ro-lima/documents/publication/wcms_245885.pdf.
- Knudsen, B., R. Florida, K. Stolarick, and G. Gates (2008). Density and creativity in US regions. *Annals of the Association of American Geographers* 98(2), 461–478.
- Lazzeretti, L., R. Boix-Domenech, and F. Capone (2008). Do creative industries cluster? Mapping creative local production systems in Italy and Spain. *Industry and Innovation* 15(5), 549–567.
- Lazzeretti, L., F. Capone, and R. Boix-Domenech (2012). Reasons for clustering of creative industries in Italy and Spain. *European Planning Studies* 20(8), 1243–1262.
- Lazzeretti, L., N. Innocenti, and F. Capone (2017). The impact of related variety on the creative employment growth. *The Annals of Regional Science* 58(3), 491–512.
- Lee, N. and A. Rodríguez-Pose (2014). Innovation in creative cities: Evidence from British small firms. *Industry and Innovation* 21(6), 494–512.
- Lee, N. and A. Rodríguez-Pose (2016). Is there trickle-down from tech? Poverty, employment, and the high-technology multiplier in US cities. *Annals of the American Association of Geographers* 106(5), 1114–1134.
- Mazzolari, F. and G. Ragusa (2013). Spillovers from high-skill consumption to low-skill labor markets. *Review of Economics and Statistics* 95(1), 74–86.
- McGranahan, D. and T. Wojan (2007). Recasting the creative class to examine growth processes in rural and urban counties. *Regional Studies* 41(2), 197–216.
- McGranahan, D., T. R. Wojan, and D. Lambert (2010). The rural growth trifecta: outdoor amenities, creative class and entrepreneurial context. *Journal of Economic Geography* 11(3), 529–557.
- Moretti, E. (2010). Local multipliers. *American Economic Review* 100(2), 373–77.
- Moretti, E. and P. Thulin (2013). Local multipliers and human capital in the United States and Sweden. *Industrial and Corporate Change* 22(1), 339–362.
- Nathan, M., T. Kemeny, A. Pratt, and G. Spenser (2016). *Creative economy employment in the US, Canada and the UK: a comparative analysis*. London: Nesta.
- Piergiovanni, R., M. Carree, and E. Santarelli (2012). Creative industries, new business formation, and regional economic growth. *Small Business Economics* 39(3), 539–560.

- Power, D. and T. Nielsén (2010). Priority sector report: Creative and cultural industries. European Cluster Observatory. Available at: <http://creativebusiness.org/images/CreativeAndCulturalIndustries.pdf>.
- Quartesan, A., M. Romis, and F. Lanzafame (2007). Cultural industries in Latin America and the Caribbean: Challenges and opportunities. Inter-American Development Bank. Available at: <https://publications.iadb.org/en/handle/11319/1143>.
- Rodríguez-Pose, A. and N. Lee (2020). Hipsters vs. geeks? Creative workers, STEM and innovation in US cities. *Cities* 100, 102653.
- Stam, E., J. De Jong, and G. Marlet (2008). Creative industries in the Netherlands: Structure, development, innovativeness and effects on urban growth. *Geografiska Annaler: series B, Human Geography* 90(2), 119–132.
- Tacchella, A., M. Cristelli, G. Caldarelli, A. Gabrielli, and L. Pietronero (2012). A new metrics for countries’ fitness and products’ complexity. *Scientific Reports* 2(1), 1–7.
- UNCTAD (2010). Creative Economy, Report 2010. Geneva: UNDP-UNCTAD.
- Utkovski, Z., M. F. Pradier, V. Stojkoski, F. Perez-Cruz, and L. Kocarev (2018). Economic complexity unfolded: Interpretable model for the productive structure of economies. *PloS one* 13(8), e0200822.

Appendix

Table A.1: Literature Review Summary

Authors (year)	Countries	Main Results
Agglomerations		
Lazzeretti et al. (2008)	Italy, Spain	Concentration of creative industries in the largest urban systems, although different patterns of concentration between the two countries.
Lazzeretti et al. (2012)	Italy, Spain	Different clustering patterns of creative employment in both countries. Common factors leading to a concentration of creative firms and creative employment in both countries are historical and cultural endowments, average size of creative industries, size of the place, productive diversity, and concentration of human capital and creative class.
Boix-Domenech et al. (2014)	France, Great Britain, Italy, Spain	Concentration of creative industries in capital cities, mainly for Great Britain and France, and in secondary cities in Spain and Italy. The countries differ in their specialization profiles.
Boix et al. (2015)	16 European countries	Creative firms are highly clustered, mainly in a creative belt stretching from the South of England to the South-east of Germany. The clusters are predominantly metropolitan, heterogeneous, cross borders, and may co-locate to form assemblages.
Effects on the wider economy		
McGranahan and Wojan (2007)	United States	The analysis supports the creative class thesis in rural areas. In urban counties there is also a strong relationship between creative class presence and growth, although natural amenities play a smaller role. The results depend on a recast creative class measure, which excludes occupations with low creativity requirements and those involved primarily in economic reproduction.
Stam et al. (2008)	Netherlands	Firms in creative industries are relatively innovative but there are substantial differences across different domains. Firms in creative industries located in urban areas are more innovative than their rural counterparts. There is no measurable spillover effect from creative industries, except for the metropolitan city of Amsterdam. The presence of the creative class in any industry is a much stronger driver of employment growth than creative industries.
Knudsen et al. (2008)	United States	Density and creativity separately and jointly affect innovation in metropolitan areas. There is a positive relationship between the density of creative workers and metropolitan patenting activity, suggesting that density is a key component of knowledge spillovers and innovation.
Baum et al. (2009)	Australia	Substantial spatial concentration of economic activity, reflecting the deep-seated influence of agglomerative forces that could seriously limit the development of creative industries outside large agglomerations.
Bakhshi and McVittie (2009)	United Kingdom	Creative industries appear to be more innovative than other sectors on a broad range of activities, which derives from a significant positive impact from creative linkages for some innovation measures.
Chapain et al. (2010)	United Kingdom	Creative firms tend to locate close to each other more than most other sectors. Some creative activities, such as Advertising, Design and Software, provide inputs and skills that are crucial to the innovation processes of businesses in other sectors.
McGranahan et al. (2010)	United States	The interaction of entrepreneurial context with the share of the workforce employed in the creative class is strongly associated with growth in the number of new establishments and employment, particularly, in rural counties endowed with attractive outdoor amenities.
Power and Nielsén (2010)	European Union	Regions with high concentrations of creative and cultural industries have Europe's highest prosperity levels. Large urban areas and capital city regions dominate the creative and cultural industries, but some city regions do better than others. The creative and cultural industries are significant generators of intellectual property. Most of the regions in the top 25 highest cultural and creative growth regions are small and medium-sized.
De Miguel-Molina et al. (2012)	European Union	Creative industries play an important role in the wealth of a region. Most creative regions are characterized by having more high-tech manufacturing sectors than others, but a similar number of low-tech manufacturing firms. The industrial structure of each region has a greater influence on regional wealth than the existence of industrial agglomerations, showing the importance of creativity.

Piergiovanni et al. (2012)	Italy	Net entry and increase in the number of active firms in creative industries increase regional employment growth. The share of legal immigrants also has a positive impact on employment growth. A high number of university faculties leads to less employment growth, whereas trademarks, patents, cultural amenities, and industrial districts have no significant effect. Value-added growth is largely determined by employment growth, but no additional productivity-enhancing effects are found.
Hong et al. (2014)	China	Creative industries agglomerations have significant and positive impacts on regional growth of total factor productivity.
Lee and Rodríguez-Pose (2014)	United Kingdom	Firms in local economies with high shares of creative employment are significantly more likely to introduce entirely new products and processes than firms elsewhere, but not simply new to the firm innovations. This effect is not exclusive to creative industries firms and seems to be largely due to firms in medium-sized, rather than large, cities. This implies that creative cities may have functional specializations in new content creation and that firms are more innovative in them.
Lazzeretti et al. (2017)	Italy	Related variety has an important effect on the growth of creative industries, characterised by high internal connections between different creative activities. No strong impact on economic growth in the wider economy emerges for Italy.
Boix-Domenech and Soler-Marco (2017)	European Union	Doubling of the share of employees in creative services increases average labour productivity by 6 percent (4 percent accounted for by factors internal to the region and 2 percent by the effect of creative services of neighbouring regions). About 90 percent of the effect is not explained by the higher productivity of creative services themselves but, rather, by the fact that the rest of the regional economy experiences higher productivity because it benefits from the spillover effect of creative services.
Innocenti and Lazzeretti (2019)	Italy	In order to favour growth, creative industries require the presence of other sectors with a high degree of proximity/relatedness.
Rodríguez-Pose and Lee (2020)	United States	The combination of scientific activity and creativity are key inputs for innovation in U.S. cities.

Table A.2: Cities and Metropolitan Areas with Departments: Employment and Value Added (2017)

City	Department	Employment	Value Added	City	Department	Employment	Value Added
Bogotá†	Cundinamarca	2,412,374	232,114	Guadalajara de Buga	Valle del Cauca	17,015	2,828
Medellín†	Antioquia	984,720	76,470	Girardot†	Cundinamarca	16,845	1,447
Cali†	Valle del Cauca	629,941	52,034	Cartago	Valle del Cauca	15,797	2,080
Barranquilla†	Atlántico	357,617	33,400	San Andres	San Andrés y Providencia	14,932	1,205
Bucaramanga†	Santander	287,425	23,815	Quibdo	Chocó	14,852	1,330
Cartagena†	Bolívar	207,182	21,195	Fusagasuga	Cundinamarca	12,542	1,644
Pereira†	Risaralda	157,504	10,570	Arauca	Arauca	12,523	1,840
Ibague	Tolima	120,411	7,859	Acacias	Meta	11,992	4,193
Cucuta†	Norte de Santander	115,104	8,893	Ipiales†*	Nariño	9,515	1,195
Manizales†	Caldas	112,946	6,602	Pitalito	Huila	9,464	1,534
Villavicencio†	Meta	109,444	7,361	Santander de Quilichao*	Cauca	9,112	1,574
Santa Marta	Magdalena	88,119	5,329	Aguachica	Cesar	8,263	736
Neiva	Huila	77,993	5,452	San Andres de Tumaco*	Nariño	7,763	1,398
Armenia†	Quindío	77,755	4,552	Ocana	Norte de Santander	7,400	746
Popayan	Cauca	76,150	4,182	Caucasia*	Antioquia	7,382	988
Valledupar	Cesar	75,857	4,764	Turbo*	Antioquia	6,584	2,073
Monteria	Córdoba	68,944	4,625	Espinal	Tolima	6,196	1,810
Pasto†	Nariño	68,461	5,215	La Dorada	Caldas	6,020	1,019
Rionegro†	Antioquia	56,530	3,179	Maicao*	La Guajira	5,982	1,336
Tunja†	Boyacá	55,080	3,230	Magangue*	Bolívar	5,751	1,311
Yopal	Casanare	42,154	4,389	Montelibano	Córdoba	4,957	1,683
Palmira	Valle del Cauca	40,250	5,944	Cienaga*	Magdalena	4,880	1,131
Sincelejo	Sucre	38,536	3,102	Pamplona*	Norte de Santander	4,703	310
Barrancabermeja	Santander	30,949	12,664	Granada*	Meta	4,631	727
Tulua†	Valle del Cauca	27,499	3,270	Chiquinquirá*	Boyacá	4,219	838
Apartado	Antioquia	27,248	2,204	Chigorodo*	Antioquia	3,125	821
Buenaventura	Valle del Cauca	25,783	3,893	Lorica*	Córdoba	3,105	962
Riohacha	La Guajira	25,287	2,010	Cerete*	Córdoba	3,089	802
Florencia	Caquetá	21,473	1,804	Fundacion*	Magdalena	2,882	430
Sogamoso†	Boyacá	18,824	2,763	Corozal	Sucre	1,925	418
Duitama†	Boyacá	17,344	2,083	El Carmen de Bolivar*	Bolívar	1,261	546

Notes: Ordered by employment level. † Metropolitan Area. * Not included in regressions. Employment level is from PILA. Value added estimated with data from DANE.

Table A.3: Code, Description, and Short Names of Non-creative Manufacturing and Services Industries

Code ISIC Rev. 3.1	Description	Short name	Economic Sector
1	Agriculture, hunting and related service activities	Agriculture	Agriculture
2	Forestry, logging and related service activities	Forestry	Agriculture
5	Fishing, aquaculture and service activities incidental to fishing	Fishing	Agriculture
10	Mining of coal and lignite; extraction of peat	Coal mining	Mining
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying	Petrol. & gas	Mining
12	Mining of uranium and thorium ores	Uranium	Mining
13	Mining of metal ores	Metal ores mining	Mining
14	Other mining and quarrying	O. mining	Mining
15	Manufacture of food products and beverages	Food & beverages	Manufacturing
16	Manufacture of tobacco products	Tobacco	Manufacturing
17	Manufacture of textiles	Textiles	Manufacturing
18	Manufacture of wearing apparel; dressing and dyeing of fur	Wearing apparel	Manufacturing
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	Leather	Manufacturing
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	Wood	Manufacturing
21	Manufacture of paper and paper products	Paper	Manufacturing
22	Publishing, printing and reproduction of recorded media	Printing & publishing*	Manufacturing
23	Manufacture of coke, refined petroleum products and nuclear fuel	Coke & refined petrol.	Manufacturing
24	Manufacture of chemicals and chemical products	Chemicals & pharma	Manufacturing
25	Manufacture of rubber and plastics products	Rubber & plastics	Manufacturing
26	Manufacture of other non-metallic mineral products	O. non-metallic	Manufacturing
27	Manufacture of basic metals	Basic metals	Manufacturing
28	Manufacture of fabricated metal products, except machinery and equipment	Metal products	Manufacturing
29	Manufacture of machinery and equipment n.e.c.	Machinery & equip.	Manufacturing
30	Manufacture of office, accounting and computing machinery	Office machinery	Manufacturing
31	Manufacture of electrical machinery and apparatus n.e.c.	Electrical equip.	Manufacturing
32	Manufacture of radio, television and communication equipment and apparatus	Radio & TV	Manufacturing
33	Manufacture of medical, precision and optical instruments, watches and clocks	Medical optical	Manufacturing
34	Manufacture of motor vehicles, trailers and semi-trailers	Motor vehicles	Manufacturing
35	Manufacture of other transport equipment	O. transport equip.	Manufacturing
36	Manufacture of furniture; manufacturing n.e.c.	Furniture	Manufacturing
37	Recycling	Recycling	Manufacturing
40	Electricity, gas, steam and hot water supply	Electricity & gas	Public
41	Collection, purification and distribution of water	Water	Public
45	Construction	Construction	Construction
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	Wholesale & retail veh.	Trade
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	O. wholesale	Trade
52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	O. retail	Trade
55	Hotels and restaurants	Accommodation	Services
60	Land transport; transport via pipelines	Land transport	Transport
61	Water transport	Water transport	Transport
62	Air transport	Air transport	Transport
63	Supporting and auxiliary transport activities; activities of travel agencies	Transport supp.	Services
64	Post and telecommunications	Postal & courier	Services
65	Financial intermediation, except insurance and pension funding	Financial serv.	Finance
66	Insurance and pension funding, except compulsory social security	Insurance	Finance
67	Activities auxiliary to financial intermediation	Financial auxiliary	Finance
70	Real estate activities	Real estate	Services
71	Renting of machinery and equipment without operator and of personal and household goods	Rental & leasing	Services
72	Computer and related activities	Computer activ.*	Services
73	Research and development	Scientific R&D	Services
74	Other business activities	O. business act	Services
75	Public administration and defence; compulsory social security	Public administration	Public
80	Education	Education	Services
85	Health and social work	Human & health	Services
90	Sewage and refuse disposal, sanitation and similar activities	Sewerage	Public
91	Activities of membership organizations n.e.c.	Membership org.	Other
92	Recreational, cultural and sporting activities	Sports & recreation	Services
93	Other service activities	Personal service	Services
95	Private households with employed persons	Household domestic	Public

Notes: Printing & publishing* excludes creative Publishing. Computer activ.* excludes computer programming, which is a creative activity.