Cities 89 (2019) 167–185

Contents lists available at ScienceDirect

Cities

journal homepage: www.elsevier.com/locate/cities

Culture counts: An empirical approach to measure the cultural and creative vitality of European cities

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ABSTRACT

How can we measure culture in urban areas? Can empirical metrics on culture function as an urban planning tool for cities' well-being? This paper fits into the research path examining the role of culture as a resource for development, with a specific focus on empirical measurement aspects. A novel dataset (The Cultural and Creative Cities Monitor – CCCM) gathering 29 indicators for 168 cities in 30 European countries is presented. The CCCM measures the presence and attractiveness of cultural venues and facilities (Cultural Vibrancy), the capacity of culture to generate jobs and innovation (Creative Economy), and the conditions enabling cultural and creative processes to thrive (Enabling Environment). Results show that cultural and creative assets are diversely distributed across European cities, which offer local authorities the opportunity to design context-specific development strategies. In particular, many medium-sized cities appear to have, on average, more cultural capital assets per inhabitant than larger cities. On the basis of these findings, we draw conclusions on the conceptual and methodological relevance of the CCCM and advance proposals on how to further use the CCCM data to drive culture-led and evidence-based urban policy design.

1. Introduction

The last two decades have recorded a massive increase of interest in culture as a major resource for urban change. Evidence of such attention can be found in the raise of academic publications with focus on the topic, alongside the interest from international organisations such as the United Nations, the OECD and the European Commission. Culture has been argued to be a constitutive part of local identity and life quality (Martínez, 2007; Rizzo & Throsby, 2006) as well as a competitive sector in its own (KEA, 2006; UNCTAD, 2010, 2013) having broader impacts on tourism (OECD, 2009), creativity and innovation (Bakhshi, MacVittie, & Simmie, 2008; Potts, 2009; Pratt & Jeffcutt, 2009), urban growth (Clark, Lloyd, Wong, & Jain, 2002; Nelson, Dawkins, Ganning, Kittrell, & Ewing, 2016) and cities' regeneration and well-being (Blessi, Grossi, Sacco, Pieretti, & Ferilli, 2016; Evans & Shaw, 2004).

Culture has thus emerged as a crucial policy response to attractiveness, innovation and social cohesion needs, at all spatial levels of policy interventions (Evans, 2009). Nevertheless, the practical implementation of culture-led development strategies remains a challenge. Among other reasons, this is related to the fact that culture is multidimensional, covering different domains of the economy, society and individuals' lives. Culture-oriented actions require a comprehensive policy approach supported by wide-ranging analytical frameworks. These should help measure the diverse sets of cultural resources that can be mobilised for development purposes and their varied impacts on the economic and society. Urban environments are indeed extremely varied in all kinds of ways. Provided that culture uniquely defines a city, which urban contexts are more culturally vibrant? In which ones culture is also a driver of creative economies? And under which conditions can the city-culture link work at its best? In the absence of an appropriate measurement framework, it is likely that the value added of culture for cities and communities remains largely elusive and that cultural budgets are progressively reduced.

The lack of proper monitoring tools in this field basically revolves around two main arguments: on the one hand, the difficulty of defining and delimiting culture, given the complexity of cultural production and consumption processes, and the heterogeneity of players involved; and, on the other, the lack of suitable and comparable data. This study tries to challenge these arguments by adopting an evidence-based approach to definition(s) and measurement attempts: while considering culture a multifaceted urban phenomenon, difficult to be mirrored in a prescriptive definition, attention has been placed on (some) meaningful aspects that can empirically be measured by making the most of available data, which come from both Europe-wide official statistics and 'experimental' web-based sources.

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https://doi.org/10.1016/j.cities.2019.01.014
Received 14 March 2018; Received in revised form 3 October 2018; Accepted 10 January 2019
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The main objective of this paper is thus to discuss the development of a newly created dataset - the Cultural and Creative Cities Monitor (CCCM) - along with making all the data available online.[1] The CCCM gathers 29 selected culture-related indicators for 168 cities in 30 European countries, which have then been aggregated in an overall Cultural and Creative Cities Index (C3 Index) as a synthetic measure of performance. The secondary aim is to use this new dataset to test a number of hypotheses on the performance of capitals and non-capital cities, based on major arguments discussed in the literature.

The reminder of this paper is structured as follows: Section 2 offers a brief literature review of the multi-fold relations linking culture and urban development. Section 3 clarifies the methodological steps leading to the development of the CCCM and the C3 Index. Section 4 presents and discusses the results of the hypothesis testing and the possible methodological, institutional or economic factors at play. Section 5 provides concluding remarks and ideas on how to further investigate our initial findings with a view to better target local investment efforts.

2. Conceptual background

Culture is a phenomenon that mostly 'happens' in urban areas. Through the ages, and in particular from the Renaissance, the best artworks and the most important circles of intellectuals and talents have been closely associated with cities, their power, and their economic strength. It is thus not surprising that, as of today, the cultural heritage of most nations – especially in Europe – is concentrated in cities, and that most artists would look for an urban location (Markusen, 2007).

Cities are indeed places of dense human interrelations and culture is a phenomenon that tends to have intensely local features (Scott, 2001; Cooke & Lazzeretti, 2007). Each city has its own culture, partly reflecting its past heritage, partly the way it projects itself into the world. In an increasingly globalised context, such 'indigenous' character of culture has assumed even greater relevance than in the past. Culture represents an authentic form of capital (Throsby, 2001) that contributes to defining a city as unique environment with its own features. Culture can thus help cities 'make a difference' both from the point of view of citizens and of external skilled workers, investments and visitors (Backman & Nilsson, 2016; Glaeser, Kolko, & Saiz, 2001; Smith & von Krogh Strand, 2011). It can help develop a sense of place and help reach socially relevant goals (e.g. Prior & Blessi, 2012).

In the breakthrough of the post-industrial transition, culture is also increasingly regarded as a fully-fledged economic sector, having impacts on employment and wealth creation as well as on innovation and local competitiveness (Currid, 2010). Culture's 'value chain' is in fact highly transversal to many other urban functions: the creative knowledge typical of art and culture thus has important spill-over effects on other information-intensive economic sectors, ranging from cultural tourism (OECD, 2009) to consumer electronics (Bakhshi et al., 2008; Potts, 2009; Pratt & Jeffcutt, 2009).

The idea that culture may have substantial effects on the aforementioned dimensions and possibly others is, in principle, not without a rationale. However, how and under which circumstances this occurs is an issue that requires attention. The United Nations (UNCTAD, 2013), for instance, have identified government support, private sector participation, civil society cooperation, education and training in arts and culture as well as media and communication opportunities as factors enabling cities to put "*[cultural] resources in good use*". Similarly, the World Economic Forum (2016) has acknowledged five key-factors for the development of creative economies, namely the proximity to academic, research and cultural centres, technological enablers as well as the presence of successful entrepreneurs, efficient laws and regulations, and attractive amenities.

Scholars have extensively argued about how these factors may actually affect cultural and creative processes. For instance, the presence of universities may be a crucial element for knowledge generation (Wolfe, 2005), for attracting highly skilled people (Benneworth, Charles, & Madanipour, 2010; Florida, 1999) as well as for fostering innovation and territorial development (see interesting review on the topic by Smith, 2007). High quality universities, in particular, can foster productivity and entrepreneurship (Fritsch & Slavtchev, 2007). The economic geography literature has then demonstrated that institutions promoting local autonomy and protecting economic and political freedom may importantly affect the location choices of creative individuals (Haisch & Klöpper, 2015; Serafinelli & Tabellini, 2017) and firms (Sánchez Serra, 2016) as well as creativity and innovation (Sleuwaegen & Boiardi, 2014). In addition to that, distance aspects are considered instrumental in facilitating mobility (Castells, 2000; Cooke, 2001) and accessibility to global knowledge and markets (Lorentzen, 2007; Palhares, 2003; Van Truong & Shimizu, 2017). Although much more difficult to grasp, the overall 'atmosphere' of a place is another crucial factor to generate ideas: it is argued that arts and creativity are indeed more likely to flourish in societies that are open to multiple perspectives (Florida, 2005; Landry & Bianchini, 1995) and where there is a high level of trust (Banks, Lovatt, O'Connor, & Raffo, 2000).

Despite this ample literature, however, the formulation of an effective culture-led urban policy agenda across European cities requires more (comparable) knowledge on the cultural capital, the creative economy and the 'enabling' factors that can be mobilised in a culture-led development perspective. A comparative framework, instead of having a generalising role, can be an operative anchorage, useful to (re-)orient the action of policy makers. First, it would serve to better understand strategic alternatives and elements that might have influenced cities' experiences. Second, it would be a benchmark for what a city needs to improve compared to other peer or 'best-practice' cities, and a basis for developing policies in key areas such as creative labour force, cultural amenities, transport infrastructure or governance.

3. Measuring culture in European cities

3.1. Review of existing indices

While certainly relevant as a starting point, existing statistical tools do not tell the whole story when it comes to understanding and capturing the multidimensional nature of culture. Since the mid-70s, culture-related indicators have been the object of in-depth research (for a review, see Ortega-Villa & Ley-Garcia, 2018) and much effort has been made to harmonise cultural statistics at the international level, for example by UNESCO (UNESCO, 2012a, 2012b) and Eurostat (European Commission, 2012). Interestingly, culture has also been progressively included in broader measurement frameworks focusing on innovation, territorial competitiveness or sustainability (Duxbury & Jeannotte, 2015). Yet, measuring culture at urban level mostly remains an 'uncharted territory', let alone in a multi-country context.

With a view to shape a more 'culture-specific' dataset while building on existing work, we took advantage of the recent proliferation of 'composite indicators' (or 'performance indices'). Composite indicators can indeed be very helpful in this context as they aggregate several indicators of performance to assess multidimensional and latent concepts such as innovation, competitiveness or human development. They offer two main advantages: first, they provide policy-makers with a summary measure of complex socioeconomic phenomena; secondly, they facilitate comparisons and benchmarking across space and time, thus forcing stakeholders to question their performance and possibly change behaviors (Kelley & Simmons, 2015).

Thirty six indices including both indices entirely focusing on culture or including culture-related indicators - such as the presence of cultural

[1] All the methodological details and data used in this paper are freely accessible at: https://composite-indicators.jrc.ec.europa.eu/cultural-creative-cities-monitor/downloads

Table 1
Analysis of the reviewed indices.

	Main focus of the reviewed indices		
	Group 1: Culture-specific	Group 2: Including culture-related dimensions	TOT
Geographical scope			
Europe	2 (18%)	9 (36%)	11 (31%)
World	2 (18%)	15 (60%)	17 (47%)
Other	7 (64%)	1 (4%)	8 (22%)
TOT	11 (100%)	25 (100%)	36 (100%)
Unit of analysis			
Cities	5 (45%)	9 (36%)	14 (39%)
Regions	0	4 (16%)	4 (11%)
Countries	1 (9%)	7 (28%)	8 (22%)
Other	5 (45%)	5 (20%)	10 (28%)
TOT	11 (100%)	25 (100%)	36 (100%)
*Geographical scope*Cities as unit*			
Europe*cities	1	2	3 (8%)
Typology of cities			
Global cities	1 (20%)	2 (22%)	3 (21%)
Medium-sized cities	0	1 (11%)	1 (7%)
No specific focus	3 (60%)	6 (67%)	9 (64%)
Not applicable*	1 (20%)	0	1 (7%)
TOT	5 (100%)	9 (100%)	14 (100%)
City sample size			
≤20	2 (40%)	1 (11%)	3 (21%)
21–50	0	4 (44%)	4 (29%)
51–100	1 (20%)	2 (22%)	3 (21%)
101–150	0	1 (11%)	1 (7%)
> 150	0	1 (11%)	1 (7%)
Not applicable*	2 (40%)	0	2 (14%)
TOT	5 (100%)	9 (100%)	14 (100%)
Number of editions			
≤2	9 (82%)	10 (40%)	19 (53%)
3–5	1 (9%)	8 (32%)	9 (25%)
6–8	0	1 (4%)	1 (3%)
> 9	0	5 (20%)	5 (14%)
Not applicable*	1 (9%)	1 (4%)	2 (6%)
TOT	11 (100%)	25 (100%)	36 (100%)
Latest edition available			
< 2013	7 (64%)	10 (40%)	17 (47%)
2014	0	1 (4%)	1 (3%)
2015	1 (9%)	2 (8%)	3 (8%)
2016	1 (9%)	3 (12%)	4 (11%)
2017	1 (9%)	5 (20%)	6 (17%)
2018	0	3 (12%)	3 (8%)
Not applicable*	1 (9%)	1 (4%)	2 (6%)
TOT	11 (100%)	25 (100%)	36 (100%)
Raw data available			
Yes	1 (9%)	5 (23%)	6 (18%)
No	6 (55%)	16 (73%)	22 (67%)
Not applicable*	3 (27%)	1 (5%)	4 (12%)
Unclear	1 (9%)	0	1 (3%)
TOT	11 (100%)	22 (100%)	33 (100%)

* = because not empirically developed or counting different editions, samples, etc. Note = figures may not add up exactly to 100% due to rounding.

facilities, number of cinema tickets sold or of cultural and creative jobs - were identified (see full list in Table A-1 in Appendix A). As regards the selection criteria, particular attention was placed on empirically developed indices for which sufficiently documented and accessible information was available, prevalently in English. Moreover, as a relatively few number of culture-related composite indicators have cities as units of analysis, the selection included also studies carried out at national and regional level under the assumption that they could help identify cultural indicators that are relevant for urban settings as well.

As can be seen in Table 1, 11 of the identified indices specifically focus on culture, while the remaining 25 include (but not exclusively) cultural indicators. Of these, 11 (or 31%) have a European scope but only 3 of them (or 8%) have cities as a unit of analysis, the emphasis is rarely on medium-sized cities and the typical sample size is relatively small (21–50 cities). Moreover, most of the reviewed works (53%) have issued two or one edition(s), mostly dating from 2013 or earlier (47%). Recent releases of indices include the Global Creativity Index 2015 (country level), the Washington's Creative Vitality Index 2016 and the Arts Index Netherlands 2013 and 2015; yet, these indices do not target European cities. Transparency also seems to be an issue: while methodological information is in most cases made available, albeit with a varying degree of detail, raw data are made publicly available only in 18% of the reviewed indices.

This literature review served a two-fold purpose: first, it confirmed the absence of a culture-specific and transparent measurement framework covering a large and diverse set of European cities; second, it offered the input needed for the identification of the relevant domains to be measured: taking into account the similarities between the indicators and after removing conceptually redundant items, a set of 16 dimensions was retained and analysed.

Table 2 clearly shows that only a few of the reviewed indices cover dimensions more strictly related to culture, and mostly in economic terms (44%). This is certainly not surprising considering the broad variety of analysed indices and the lack of culture-specific ones. At the same time, this analysis confirms that there is room for a more comprehensive framework that captures culture *beyond* its economic scope.

3.2. The city sample

In principle, a meaningful dataset measuring culture in European urban areas should include a reasonably large number of cities that reflect the diverse socioeconomic contexts and approaches to culture found across Europe. The choice of a sample, however, is never an easy task, not least due to the need to balance representativeness needs, on the one hand, and data availability, on the other. In this specific case, one main challenge was to be able to include cities considered 'relevant' to the topic of interest and, at the same time, try to remain as inclusive as possible considering that many and much diverse cities are today trying to engage with culture-led development paradigms.

The role of culture in creating lively cities and communities where people want to live, work and visit is among the central tenants of the creative cities' literature. However, despite the vivid debate on the topic (e.g. Camillieri, 2010; Grodach, 2017; O'Connor & Shaw, 2014; Pratt, 2011), the notion of 'creative city' remains highly controversial. It in fact originates from many different roots, ranging from the socially-embedded creativity model (Landry & Bianchini, 1995), to the production-based approach (Scott, 1997) to the related (and much criticised) notion of 'creative class' (Florida, 2003), where culture actually acquires only a secondary and instrumental role for talent attraction (see, for instance, Sacco, Ferilli, & Blessi, 2014 or Florida's 'apology' of his own theory, Florida, 2017). Such conceptual complexity not only has generated many diverse (and sometimes contradictory) applications and effects in urban contexts (Ponzini & Rossi, 2010; Pratt, 2011), but it has made the operationalisation of the term and of the related indicators particularly challenging. In addition to that, it is not so straightforward to build a relevant city sample based on the repertoire of comparable works analysed above, as the definition of unambiguous selection criteria seems not to be common practice.

Nevertheless, what appears to be a 'common thread' when dealing with the creative city concept is the willingness of cities to engage, at different levels and with different modalities, with their cultural resources and creative endeavors with a view to sustain socioeconomic health. To 'proxy' such engagement, different criteria were considered, such as the presence of cultural assets and events that have received

Table 2
Dimensions covered by the reviewed indices and frequency.

Dimensions		Frequency	%
1.	Human Capital, Talent & Education	29	81%
2.	Innovation & Research	20	56%
3.	Government & Regulations	19	53%
4.	Living conditions	16	44%
5.	Openness, Tolerance & Diversity	16	44%
6.	**Creative Output & Employment**	**16**	**44%**
7.	Technology & ICT	15	42%
8.	Economy	15	42%
9.	Transport & Accessibility	14	39%
10.	Globalisation, Networks & Exchange	14	39%
11.	**Cultural Participation**	**14**	**39%**
12.	**Cultural and Recreation-related Venues & Facilities**	**12**	**33%**
13.	Entrepreneurship	9	25%
14.	Environment & Ecology	8	22%
15.	Tourism	7	19%
16.	**Support for the CCS**	**6**	**17%**

Note: in bold, culture-specific dimensions; in dark grey, dimensions for which potentially relevant data was found (see also footnote 3).

international recognition (UNESCO World Heritage Sites, major international art fairs and Olympic Games). However, such indicators could not be retained due to their potentially 'overlapping' geographical scope (e.g. UNESCO sites can overcome cities' borders) and possibly restrictive (i.e. contemporary art) or dispersive (i.e. sports) thematic scope. The presence of at least one among three comparable types of initiatives (European Capital of Culture-ECoC, UNESCO Creative City, and international festivals) was instead deemed to be a more convincing cultural engagement proxy. These initiatives are indeed internationally recognised as being culture-led, have found application in many diverse urban contexts, and city-referenced data on the presence of such initiatives can be easily retrieved.

The final sample (also subject to data availability, see Section 3.3) thus includes: 93 cities which have been or will be ECoCs up to 2019, or which have been shortlisted to become an ECoC up to 2021; a further 22 UNESCO Creative Cities (up to 2015 winners); and 53 cities hosting at least two international cultural festivals[2] running until at least 2015 (for more details on the sample, see Montalto, Tacao Moura, Langedijk, & Saisana, 2017).

3.3. The conceptual framework

To build the conceptual framework, around 200 indicators were identified to measure the dimensions listed in Table 2, guided by the interplay of theoretical considerations and data availability check for the 168 selected cities. Indicators were mostly retrieved from Eurostat's Urban Audit but also from experimental web sources (TripAdvisor) (see Table A-2 in Appendix A).

Building on the relevant literature discussed above, these dimensions were then organised in sub-groups under the hypothesis that they may be ultimately traced back to three main conceptual areas[3]:

- As the ensemble of cultural facilities, activities and participation has important effects on urban identities and life quality, the first area aims to measure some of the most 'tangible' manifestations of culture and participation activities so to capture what scholars have called the *'Cultural Vibrancy'* (or cultural vitality, here used as synonyms) of a place. By gathering dimensions 11, 12 and 15 and building on the cultural vitality definition proposed by Jackson, Kabwasa-Green, and Herranz (2006), the 'Cultural Vibrancy' domain thus provides two main groups of metrics: the first one measures the presence of diverse participation opportunities, which is notably captured by 'physical quantities' of culture-related venues (Throsby, 2001, p. 46), while the second one relates to the capacity of such venues to attract audiences through indicators of the kind 'number of museum visitors'.
- As the interlinkages between local cultures and urban economic activities have become increasingly evident, thus contributing to put the 'cultural economy of cities' at the core of many cultural planning debates (Amin & Thrift, 2007), the *'Creative Economy'* domain intends to measure how well culture contributes to a city's economy. To this purpose, it groups together dimensions 2, 6 and 13 measured by widely used creative economy indicators (e.g. Throsby & Zednik, 2007; Van Der Pol, 2007) such as the 'number of jobs in cultural and creative sectors (CCS)'.
- As cities are expected to offer especially favourable conditions to the development of lively cultural environments and flourishing

[2] In order to apply the festival criterion in a coherent way across Europe, only Europe-wide comparable data sources have been used, notably: the platform EFFE (Europe for Festivals, Festivals for Europe, http://www.effe.eu/) and a Wikipedia page gathering around 500 film festivals in Europe (https://en.wikipedia.org/wiki/List_of_film_festivals_in_Europe).

[3] As a few or no indicators were found to adequately represent the dimensions 'Globalisation, Networks & Exchange' and 'Support for the CCS', they were not included in our hypothetical framework, despite their clear relevance as enabling factors of cultural and creative processes. Also, the 'Economy' and 'Environment & Ecology' dimensions were left out of the tested framework assuming that these ones could be seen as impact areas and that a study of causal relation requires a different modelling approach than a composite indicator.

creative economies (e.g. Landry & Bianchini, 1995; Van Der Borg, Russo, Lavanga, & Mingardo, 2005), the '*Enabling Environment*' domain means to apprehend at least some of these conditions by gathering together dimensions 1, 3, 5 and 9. These are captured by indicators measuring the presence of high quality universities, the availability of different typologies of transport connections, the level of diversity, tolerance and trust, and the efficiency of the governance system.

To test this hypothetical conceptual framework, multivariate analysis was performed to investigate correlation among variables (Pearson's correlation coefficient) and verify whether the available indicators can statistically be grouped to describe the multidimensional phenomenon in question. The goodness-of-fit of the different indicators with the assigned dimensions was, in various cases, in accordance with prediction. 52 indicators were indeed positively correlated to the purported latent constructs in all but two cases: the 'Living Conditions' and 'Technology & ICT' dimensions were thus removed from the framework. A further analysis of the correlation structure, looking for indicators positively but also strongly correlated to the assigned constructs (see also Section 3.4), ultimately suggested retaining 29 indicators, the appropriateness of which was assessed and validated based on both statistical properties and theoretical considerations.

More precisely, indicators were retained if the underlying data were available for at least 50% of the cities in the sample (*coverage*)[4]; if publicly available – either as peer-reviewed scientific data, as data compiled by international organisations or as 'experimental data' coming from the web (*availability*); if their quality could be verified - as in case of official statistics or when data quality control is performed such as in the case of ETER (Daraio, Scannapieco, Catarci, & Simar, 2017) - or they represented the best measure of a domain available in Europe at the moment of the data collection, as in the case of 'experimental data' (*quality*)[5]; if they represented the most up-to-date datasets available at the moment of the data collection, with data not older than 2010 up to 2016 (*timeliness*); and, last but not least, if considered to be pertinent measures of the hypothesised concepts based on the referred literature as well as on the opinion of a group of fifteen experts specialised in culture, creativity and urban issues, who participated in two consultation workshops (*relevance*) (see Table A-2 in Appendix A for a summary of the indicators' properties).

[4] More specifically, the minimum data coverage threshold for a city to be included in the C3 Index was set at 45% at the main Index level and at least 33% for the 'Cultural Vibrancy' and 'Creative Economy' sub-indices. Ideally, data coverage of 75–80% would have been preferred. Yet, adopting a more stringent criterion for a city's inclusion would have resulted in cities such as Venice being left out. We opted therefore for a more inclusive approach to allow a sufficiently large set of cities to be covered in the CCCM, while not compromising the accuracy of the findings. Consequently, for 75% of the 155 cities included in the calculation of the Index due to better data coverage, data coverage is very good (at least 81% at the index level, at least 89% for the 'Cultural Vibrancy', 100% for 'Creative Economy', and at least 75% for the 'Enabling Environment'). Almost 70% of available data refer to 2013–2015.

[5] While experimental data have not reached full maturity in terms of coverage or comparability, relevant (and culture-specific) data would have been left out of the CCCM in the absence of web sources. On the one hand, the indicators 'Sights & landmarks', 'Museums' and 'Concerts & shows' - all coming from TripAdvisor - risk to underestimate the total number of cultural sites and facilities present in some smaller cities, as TripAdvisor mainly gathers information on places of interest for external visitors. On the other, however, the conceptual and statistical relevance of these indicators, in addition to their very good coverage for the 168 sampled cities (from 94% to 100%, see Table A-2 in Appendix A), supported their use. To improve their quality, geolocalisation criteria (i.e. within the city administrative borders) and duplication checks were also applied.

3.4. Constructing the C3 Index

To construct a performance index that could help summarise and compare the performance of European cities on culture-related dimensions, a so called 'Cultural and Creative Cities Index' ('C3 Index') was constructed, closely following the guidelines provided in the OECD-JRC's Handbook on Constructing Composite Indicators (OECD-JRC, 2008).

First, and with a view to enable meaningful cross-city comparability, nearly all the indicators were divided by city population, whenever the correlation between an indicator and population size was considered noteworthy (Pearson's correlation > 0.3). Secondly, if the skewness of an indicator was > 2 and the kurtosis was > 3.5, the outliers of the indicator were winsorised, meaning that extreme values for each indicator were assigned the following highest value in the distribution so to avoid comparing the cities' performance with extremely well performing cities, possibly representing unrealistic benchmarks (Saisana, Becker, & Dominguez-Torreiro, 2018; Groeneveld & Meeden, 1984). Thirdly, missing data were imputed by applying an *ad hoc* three step-approach based on similarities between cities: 1) missing values in the variables Tolerance of foreigners and Integration of foreigners were replaced with the national average, assuming that the national average based on the scores of the included cities could be a relatively good proxy for this kind of opinion-based variables; 2) remaining missing values were then imputed using the triplet population–GDP–employment rate (with five groups for each variable), based on data for peer cities; 3) the last remaining missing values were replaced with the k-nearest neighbor (k-NN) method using the average of the values of the three nearest (or statistically closest) neighbors (Little & Rubin, 2002). Finally, to adjust for differences in units of measurement and ranges of variation, all 29 indicators were normalised into the [0, 100] range, using the min-max method, whereby higher scores represent better outcomes.

The normalised indicator scores were then weighted and aggregated into nine dimensions. The weights (see Table 3) were obtained using the Budget Allocation method (OECD-JRC, 2008), in which the same group of experts who was consulted on the conceptual framework was requested to allocate points to the three overarching domains and the nine underpinning dimensions, where more points would correspond to greater importance. Not all domains can indeed be put on the same 'level', especially when including indicators intended as *proxies* of more strictly but missing culture-related variables. Experts therefore devised a reasoned weight structure aimed to reflect the primary (policy) importance attributed to 'Cultural Vibrancy' and the connected 'Creative Economy' domain. Stated otherwise, the resulting weight structure is intended to stimulate greater investments in culture and creativity as genuine engines of sustainable development and growth than in complementary enablers such as the transport infrastructure or the governance system. For this reason, the 'Enabling Environment' domain was assigned 20% weight, while 'Cultural Vibrancy' and 'Creative Economy' were assigned 40% weight each. Similarly, the Intellectual Property & Innovation dimension within the Creative Economy counts only 20% of the total weight to compensate for the fact that CCS-led innovation is not only technological.

To test the internal consistency of the 29 indicators, the Pearson correlation was used. Overall, the analysis reveals that the statistical structure of the C3 Index 2017 is coherent with its conceptual framework: all correlations of the underlying indicators with the respective dimension are good and positive (> 0.5 in all but two cases - see Table B-1 in Appendix B). Furthermore, all dimensions correlate strongly with the three sub-indices and the C3 Index itself and are fairly in line with the expert-based weights. Robustness tests were also performed to check the sensitivity of the results to the modelling assumptions. First, the robustness of the results to the weighting scheme was assessed: 2000 alternative simulations were run for the C3 Index in the city-size groups, each corresponding to a different set of weights for the nine C3

Table 3
The Cultural and Creative Cities' Monitor: conceptual framework, indicators and weights.

Weights	Sub-index	Weights	Dimensions[a]	Indicators
40%	1. Cultural Vibrancy	50%	D1.1 Cultural venues & facilities	1. Sights & landmarks
				2. Museums
				3. Cinema seats
				4. Concerts & shows
				5. Theatres
		50%	D1.2 Cultural participation & attractiveness	6. Tourist overnight stays
				7. Museum visitors
				8. Cinema attendance
				9. Satisfaction with cultural facilities
40%	2. Creative Economy	40%	D2.1 Creative & knowledge-based jobs	10. Jobs in arts, culture & entertainment
				11. Jobs in media & communication
				12. Jobs in other creative sectors
		20%	D2.2 Intellectual property & innovation	13. ICT patent applications
				14. Community design applications
		40%	D2.3 New jobs in creative sectors	15. Jobs in new arts, culture & entertainment enterprises
				16. Jobs in new media & communication enterprises
				17. Jobs in new enterprises in other creative sectors
20%	3. Enabling Environment	40%	D3.1 Human capital & education	18. Graduates in arts and humanities
				19. Graduates in ICT
				20. Average appearances in university rankings
		40%	D3.2 Openness, tolerance & trust	21. Foreign graduates
				22. Foreign-born population
				23. Tolerance of foreigners
				24. Integration of foreigners
				25. People trust
		15%	D3.3 Local & international connections	26. Passenger flights
				27. Potential road accessibility
		5%		28. Direct trains to other cities
			D3.4 Quality of governance	29. Quality of governance

[a] Note: a city's dimension score is calculated from the simple average of all its underlying normalised indicator scores. Within a dimension, a scaling coefficient of 0.5 was assigned to 3 out of 29 indicators - Sights & landmarks, Museums and Tourist overnight stays -with the aim of arriving at dimension scores that were balanced in their underlying indicators. All other indicators were assigned a weight of 1.

dimensions, randomly sampled from uniform continuous distributions centred in the reference values provided by the experts and applying a perturbation of the weights ± 25% around the reference values. Second, the effect of normalising all indicators using percentile ranks was tested because the use of percentile ranks would make it possible not to have to treat outliers, as it was the case when adopting the min-max normalisation method. It was found that city ranks in the C3 Index and its three sub-indices are fairly robust to changes in the dimension weights and the normalisation method, for the majority of the cities analysed[6] (see Tables B-2 and B-3 and Figure B-1 in Appendix B for further details on the results of these tests).

4. Performance patterns across capital and non-capital cities

This section seeks to elucidate some general patterns of performance variation across capitals and non-capital cities and possible factors at play using the newly constructed measures of 'Cultural Vibrancy', 'Creative Economy' and 'Enabling Environment'. More specifically, three hypotheses are tested and discussed. The purpose is not to assess causal relations – especially given the cross-sectional nature of the data – but rather to comment the observed scores and advance some possible explanations, based on prevailing arguments in the literature.

First, as already discussed above, culture is essentially an urban phenomenon. Yet, research on culture and creativity has mostly focused on capital cities and major metropolitan areas. Only recently, there has been a growing academic and professional interest in the specific (cultural) assets and economies of smaller urban areas (e.g. Denis-Jacob, 2012; Lorentzen & van Heur, 2012; Miles, 2006; Waitt & Gibson, 2009). While larger cities usually have greater stock and a broader spectrum of cultural resources, this recent literature shows that notable cultural resources can be identified in smaller cities, too. Kresl and Ietri (2016), for instance, argue that smaller cities can have important advantages over larger ones which may include high life quality, educational resources and cultural assets, among others. With reference to the Netherlands, Marlet (2016) notes that in recent years there has been a rise of 'monumental cities' characterised by attractive built heritage sites. Many of these cities are small, such as 's-Hertogenbosch (Richards & Duif, 2018).

Building on these works, our first hypothesis is that high levels of 'Cultural Vibrancy', as measured by the CCCM, may be found in different typologies of cities, which include, but are not limited, to European capitals and metropolitan areas.

Fig. 1 seems to support this first assumption. In fifteen out of twenty-four countries (63%), non-capital cities, mostly medium-sized, outperform capitals on 'Cultural Vibrancy'. The analysis of the underlying indicators helps better understand what we observe. For instance, as probably expected, the very high performance of Florence is mostly explained by the museums indicator, where the city obtains an extremely high score (91.9/100). A different 'cultural specialisation' can instead be found in Cork, which excels on the number of concerts halls (100) notably due to its sound music tradition, while Ghent – UNESCO Creative City of Music – registers a score of 100 on the number of theatres and of 62.9 on concerts halls.

This finding is certainly influenced by the methodological choice of expressing most of the indicators in per capita term. This approach is

[6] The 'Cultural Vibrancy' rank is close to the median rank (fewer than two positions away) for 79% of the cities and the rank intervals are ± 3 positions for 72% of the cities. Similarly, the 'Creative Economy' rank is close to the median rank for 84% of the cities, and the rank intervals are ± 3 positions for 69% of the cities. Finally, the 'Enabling Environment' rank is close to the median rank for 83% of the cities, and the rank intervals are ± 3 positions for 60% of the cities.

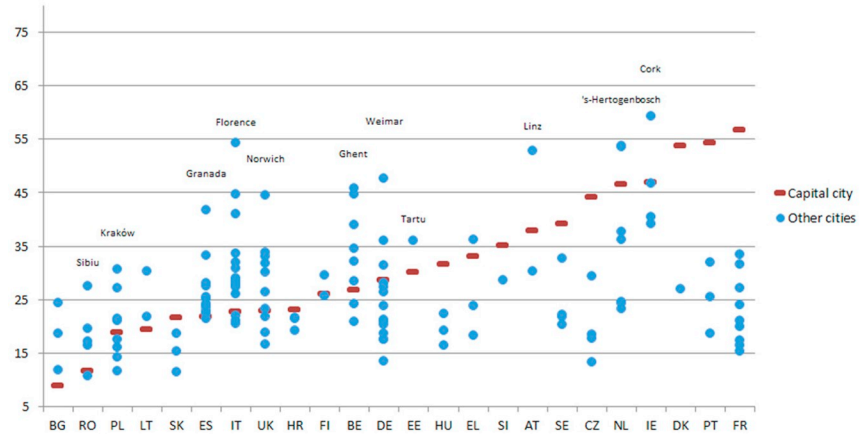


Fig. 1. Cultural Vibrancy: Ranked cities and related scores within EU Member States.
Note: Cities in Cyprus, Latvia, Luxembourg and Malta omitted due to poor data coverage.

primarily intended to enable cross-city comparability but also rewards smaller cities, which ultimately seem to have 'more' than larger cities in terms of cultural infrastructures per inhabitant. At the same time, however, it also confirms the multi-centric structure of Europe, particularly reinforced by countries with decentralised governance systems. Some European countries are indeed very much polarised around the capital city (e.g. Denmark, France, Portugal) whereas others are rather multi-polar (Belgium, Germany, Italy, Spain) – a trend that is very much reflected in these results.

Second, scholars have consistently found a strong empirical correlation between higher levels of density and the concentration of creative industries. Creative industries are characterised by their tendency to concentrate in space (Boix, Hervás-Oliver, & De Miguel-Molina, 2015; Cooke & Lazzeretti, 2007; Lazzeretti, Boix, & Capone, 2008) to take advantage of the existence of agglomeration economies (Lorenzen & Frederiksen, 2008). Turok (2003) shows that the locations of a creative firm close to other specialised firms increase its opportunity to trade and recruit specialised workers, among other advantages. Additionally, Turok (2003) underlines that the population and the economic size as well as the density of the economic agents of a territory determine the importance of the benefits that creative firms could gain from their co-location, for instance in terms of inter-sector synergies, and better access to public utilities (cultural, institutional and political) and information centres which facilitate knowledge sharing and innovation.

As we can reasonably assume that capitals have, on average, greater population and economic size than non-capital cities, our hypothesis is that national capitals will reach the best positions as regards 'Creative Economy' scores.

Fig. 2 shows clear supports for this second hypothesis. Capital cities not only obtain the highest score on 'Creative Economy' in nineteen out of twenty-four countries (nearly 80%) - with the sole exceptions being Austria, Germany, Italy, the Netherlands and Sweden – but they also perform considerably better than non-capital cities in most countries. Cultural, historical, economic but also methodological factors may help explain the observed exceptions. In Italy, for instance, agglomeration advantages have historically been found in Milan which, together with Rome (just a few points behind), represents a major cultural and creative economy hub. A closer look at the indicators underlying the 'Creative Economy' domain can instead better explain the results for

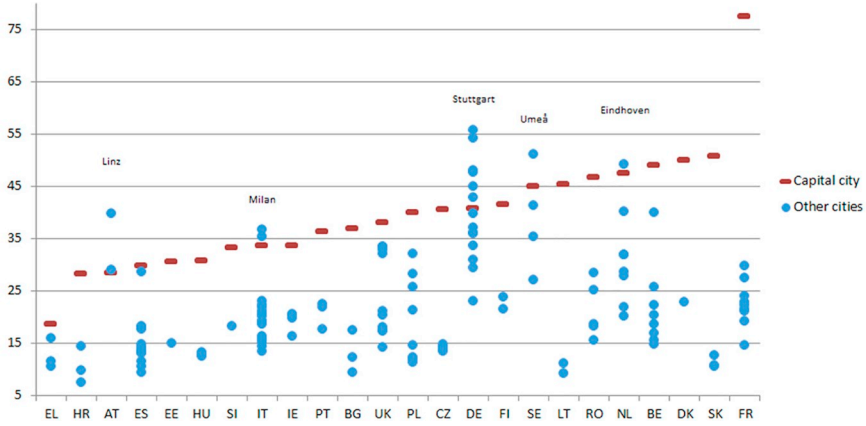


Fig. 2. Creative Economy: ranked cities and related scores within EU Member States.
Note: Cities in Cyprus, Latvia, Luxembourg and Malta omitted due to poor data coverage.

Austria, the Netherlands and Sweden. Generally speaking, while the capital cities have a more balanced score across the board, 'winning' cities rather excel on one single indicator which boosts the overall score. In Sweden, for instance, Umeå obtains the maximum score (100) on the annual number of jobs created, mostly due to the incredibly fast growth of the city in the last few decades. In the Netherlands, Eindhoven is particularly strong on innovation outputs (100) compared to the capital, Amsterdam, most likely due to its renowned and prolific high tech- and design-led environment (Lagendijk & Boekema, 2008). In Austria, Linz conquers the first place thanks to its very high share of cultural and creative jobs per capita, but it is the capital city of Vienna that registers a better capacity to create jobs in the creative economy.

Third, it is hypothesised that the presence of enabling factors, as measured by the CCCM, is not systematically related to capital cities. This is first and foremost due to the diversity of factors captured by the 'Enabling Environment' sub-index which, for instance, combines 'objective' indicators (e.g. Foreign-born) with 'subjective' ones (e.g. Tolerance of foreigners).

On the 'Enabling Environment' sub-index, we would therefore expect varied results. It is evident, for instance, that Europe counts on a considerable amount of high quality universities, which are often found in medium-sized and small cities such as Bologna or Leuven. According to Kresl and Ietri (2016), the presence of universities is a specific advantage of smaller cities over larger ones. However, bigger cities may have large universities and therefore a higher number of graduates per capita.

As regards openness and trust, results can again be mixed. Big cities may indeed feature better levels of diversity and tolerance, as found by Paas and Halapuu (2012), due to greater face-to-face contact opportunities (McLaren, 2003). However, greater levels of generalised trust may be found in smaller cities due to a stronger sense of community. Previous research has for instance indicated that local trust levels are inversely proportional to population density (Glaeser et al., 2001). Other studies have attempted to quantify rural-urban differences, finding that social capital within a local community is higher in rural areas (Andersson, Larsson, Wernberg, & Westlund, 2016; Sørensen, 2014).

Evidence is then mixed also as regards the relation between quality of governance and demographic variables such as population size. On the one hand, the argument that smaller populations are more manageable goes back to ancient Greece (Charron, Dijkstra, & Lapuente, 2014). The fact that small Nordic countries are notably known for the high quality of governance levels seems to well align with this argument. However, Charron et al. (2014) shows that there is no conclusive evidence in the literature on this matter: for instance, while Knack and Azfar (2000) shows that larger US states have higher-quality management practices, Knack and Keefer (1995) find no relationship between size and corruption in a large cross-country sample.

Finally, as regards transports, more flight connections are likely to be available in capitals and larger cities due to national policies and infrastructural investments centred around more densely populated areas. Yet, a more polycentric pattern may be found in decentralised countries. Patterns may also depend on the means of transports considered. For instance, as shown by the ESPON 2020 Cooperation Programme (2016) second tier cities in Western Europe are normally well connected by road and rail, while second tier cities in the east of Europe are well connected by road and partially by rail.

Fig. 3 shows a great variety of scores, supporting the third hypothesis. In fourteen out of twenty-four countries (58%), non-capital cities, outperform capitals on 'Enabling Environment'. The analysis of the underlying indicators shows different specialisation patterns. For instance, Milan is particularly good on the number of high quality universities (97.9/100), while Leuven excels on 'Graduates in ICT' (100) and registers an extremely good performance also on the indicators 'Potential road accessibility' (94.5) and 'Direct trains to other cities per capita (90.7), very similarly to Utrecht. As observed for 'Cultural Vibrancy', many cities tend to outperform the capital in multipolar countries such Italy, Belgium, Germany and the Netherlands. In Poland and Romania, the high number of cities outperforming the capital may mostly be explained by the good performance of many different cities on the number of Graduates in ICT and/or in arts and humanities. In Spain, instead, despite the typical decentralised setting which is well mirrored by the results on 'Cultural Vibrancy', only Barcelona registers the best performance, closely followed by Madrid. This result is mostly explained by the excellent performance of Barcelona on 'Average appearance in university rakings' (100) followed by a very good score also on 'People trust' (59.4) - which actually contradicts the literature that, as discussed above, would assume to find greater levels of trust in smaller areas.

Despite the methodological problems always inherent in capturing a complex concept like culture (e.g. Tubadji & Nijkamp, 2015), the collected data therefore show that diverse sets of cultural resources and

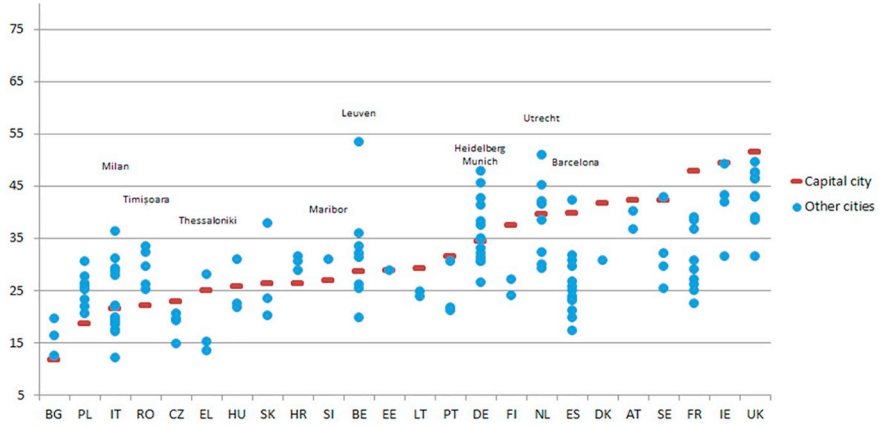


Fig. 3. Enabling Environment: Ranked cities and related scores within EU Member States
Note: Cities in Cyprus, Latvia, Luxembourg and Malta omitted due to poor data coverage.

enabling factors can be mobilised for targeted investment efforts by different typologies of cities. Although capital cities and metropolitan areas predominate in terms of creative economy performance, the literature has indeed provided evidence of cases showing how policy interventions can circumvent geographic determinism (Krugman, 1991). Specifically, under certain conditions, government policies can allow new economic centers to develop, beyond capital cities (Barberia & Biderman, 2010). Meijers and Burger (2017) for instance show that smaller cities can 'borrow size' and sustain functions, amenities or performance usually linked to metropolitan areas if well embedded in networks. As suggested by Lorentzen and van Heur (2012), the structural context of small cities could be challenged and transformed through the establishment of urban networks dedicated to specific fields of activities (such as tourism, food, culture or education) and the identification of new opportunities related to particular global market niches.

5. Concluding reflections and future research

Culture is a complex, multidimensional concept that has important implications from a social, symbolic and economic perspective. Culture may refer to people's traditions, beliefs and behaviors or to economic activities grounded on artistic creation, creative skills and symbolic values. Culture is a key to achieve inclusive development, to strengthen social bonds and cooperation, and to foster creativity and innovation. While all these elements are worth considering, the Cultural and Creative Cities Monitor (CCCM) presented herein focuses on the stock of cultural provision and the cultural participation of individuals, on creative economy variables as well as on a set of enabling factors – aspects that are rarely measured in a single framework and in a multi-country context – in an attempt to improve the measurement and understanding of the performance of Cultural and Creative Cities across Europe. To build this tool, this paper adopts a methodology combining literature review and composite indicators development techniques enhanced by the use of a varied mix of data, coming both from official statistics and experimental web sources.

The selection of pertinent metrics to capture culture and creativity is, however, far from being a trivial exercise. The indicators included in this set represent 29 *measurable* aspects. They have been selected to represent wider notions or processes for which more comprehensive data is unavailable and, as such, should be considered as 'proxies' in some cases. For instance, the notion of 'Cultural Vibrancy' certainly extends to intangible forms of cultural capital as well as to the *flow* of activities and services deriving from the *stock* of tangible and intangible capital. This includes informal and community (arts) centres, in addition to major cultural landmarks. Under 'Creative Economy', the impact of CCS on innovation would ideally encompass process-based forms of innovation or even innovation of social type, alongside the number of patents and new designs. As regards the 'Enabling Environment', more specific data on policies and funds for culture as well as on the 'creative mode' of urban governance (Healey, 2004) would provide a more comprehensive understanding of the local governments' ability to foster culturally vibrant and creative milieus. There is therefore potential to enrich and, to a certain extent, refine the current indicator framework as more information becomes available.

Nevertheless, the elicited notions and indicators seem to be consistent with the multi-dimensional foundations of culture argued in the literature. More particularly, the CCCM succeeds in breaking from a narrow economic perspective of culture. Moreover, by including indicators on cultural participation, diversity, openness and trust, the CCCM recognises that a culture-based development approach should be based not only on a flourishing creative economy but most notably on a socially and culturally inclusive environment, as promoted by the European Commission itself in the New European Agenda for Culture 2018. The conceptual scope of the CCCM thus seems to constitute a solid starting point, as also confirmed by the statistical coherence and robustness assessment tests.

To assess the current performance and development potential of larger and smaller European cities, three hypotheses were tested as regards the degree of variation of culture - intended as 'Cultural Vibrancy', 'Creative Economy' and 'Enabling Environment' - across capital and non-capital cities. We found that, while capital cities tend to excel on 'Creative Economy' indicators, with a few exceptions, more variety can be found on 'Cultural Vibrancy' and 'Enabling Environment'. As regards 'Cultural Vibrancy', non-capital cities, often medium-sized, perform particularly well in countries that are typically 'multi-polar' such as Italy, Belgium or Spain, with cities like Florence excelling on museums and Ghent on theatres. In countries more polarised around the capital such as France but also most Eastern Europe countries, it is rather the capital city that reaches the top position. As regards the 'Enabling Environment', in most countries capital cities are again outperformed by non-capitals but very different specialisation patterns emerge, ranging from the presence of high quality universities (e.g. in Milan) to high numbers of ICT graduates per capita (e.g. in Leuven). A varied set of cultural resources and enabling factors can thus be mobilised in a culture-led development perspective, not only by larger but also by many smaller cities across Europe, under certain conditions, as argued in the most recent literature on smaller cities discussed in the previous section.

The findings presented in this study, however, are not conclusive and actually open the door to several relevant questions which could be explored in future research. For instance, which cultural legacies, economic variables or institutional factors may explain the notable differences across cities? How does/can culture affect the 'rest' of the urban economic environment and individuals' well-being in different typologies of cities? How do changes in the urban structure feed the development of cultural venues and activities? Do residents have the same opportunities to access culture and build cognitive and relational skills *within* and *across* European cities? Do best scoring cities share common features, for instance in terms of policy governance and actions? The data presented herein can thus be used and complemented by scholars who may address these questions in fields as diverse as cultural and urban planning studies, comparative public policies or EU studies. In addition, with cities playing a growing role in the provision of public services and being the recipients of increasingly larger transfers – especially at the European level through the EU cohesion policy funds – the data presented here can serve as an initial tool of empirical assessment for practitioners interested in identifying 'development gaps' where funds should be allocated.

Table A-1
List of reviewed indices.

#	Short description	Developer(s) and year of latest edition
Main focus: arts, culture and creativity		
1	The **Arts Index Netherlands** provides facts and figures on arts and culture in the Netherlands, ranging from the number of cinema tickets sold, to the income of public libraries, to the percentage of people practicing amateur arts.	Lahaut, D., van den Broek, A. & Koen van Eijck - Boekman Foundation (2015).
2	Focused on the measurement and ranking of creative global cities, the **CCI Creative City Index** (CCI-CCI) covers eight dimensions, ranging from the size of creative industries, to the scale of cultural amenities to user-created content.	Hartley, J., Potts, J., MacDonald, T. with Erkunt, C. & Kufleitner, C. - ARC Centre of Excellence for Creative Industries and Innovation (CCI) (2012).
3	**Creative Grid** highlights 10 infrastructural conditions for creative industries growth and competitiveness that go from the presence of high profile cultural infrastructure to support services for the creative industries to connectedness.	Fleming, T. - Creative Consultancy (2010).
4	The **Creative Space Index** (CSI) comprises both quantitative and qualitative indicators grouped into five dimensions: Talent, Openness, Cultural Environment and Tourism, Technology, and Innovation and Industry.	Correia, C. M. & da Silva Costa, J. - FED, Faculdade de Economia - Universidade do Porto (2012).
5	The **Design, Creativity and Innovation Scoreboard** comprises seven dimensions: three measure the so called Creative climate (e.g. creative education, openness) and four capture Creativity & design (e.g. share of creative occupations and designers).	Hollanders, H. & van Cruysen, A. - Economic and Social Research and Training Centre on Innovation and Technology, Maastricht University (2009).
6	The **Euro-Creativity Index** (ECI) is aimed at assessing national competitiveness in the Creative Age by measuring Talent, Technology and Tolerance (see also Creativity Index).	Florida, R. & Tinagli, I. - Carnegie Mellon Software Industry Centre (2004).
7	The **European Creativity Index** (ECI) aims to measure the interplay of various factors that contribute to the growth of creativity in the EU, by combining dimensions concerning creativity, innovation and economic performance as well as arts and culture.	KEA European Affairs (2009).
8	The **Cultural Life Index** aims to measure the performance of nations or provinces in terms of availability of cultural resources (e.g. number of museums, TV sets), cultural participation (e.g. admissions to cinemas) and production (e.g. number of films produced, of web hosts, etc.).	Picard, R.G., Grönlund, M. & Toivonen, P. - prepared for the Finnish Ministry of Education and Culture (2003).
9	The **Creativity Index** is Richard Florida's overall measure of a territory's economic potential. It combines measures of Talent, Technology and Tolerance, such as: foreign born and gay/lesbian population share for Tolerance, patents per capita for Technology, and Creative Class occupational share for Talent.	Florida, R (various applications).
10	The **Global Creativity Index** (GCI) is a measure for advanced economic growth and prosperity based on the so called '3Ts': Talent, Technology, and Tolerance.	Richard, F., Mellander, C. & King, K. - Martin Prosperity Institute (2015).
11	The **Hong Kong's Creativity Index** has been developed to assess and monitor Hong Kong's competitiveness in the creative age over time as well as to compare its creative vitality with its neighbors. It measures outcomes of creativity and structural/institutional, human, social and cultural capital.	Hui, D., Ng, C-H. & Mok, P. - Centre for Cultural Policy Research, The University of Hong Kong with Fong, N., Chin, W. & Yuen, C. - The Hong Kong Special Administrative Region Government (2004).
12	The **Intercultural Cities Index** is a benchmarking tool combining data on: demographics (primarily quantitative); inputs: policies, structures (primarily qualitative); and impacts: attitudes and behaviors (primarily qualitative).	Council of Europe (2017).
13	The **Creative City Index** uses three elements - an internal assessment, an external assessment, and a web-based survey - to measure cities' performance across 10 domains, ranging from political frameworks to diversity and vitality, to entrepreneurship and innovation, to liveability and well-being.	C. Landry & Hyams, J. - Comedia with Basque Country region of Biscay and its core city Bilbao (2012).
14	The **Sharpie's Creativity Index** lists the UK's 20 most creative towns and cities as determined by data provided by 60 national and local organisations. It includes measures of creative subcultures and local environments, particularly of creative consumption.	Sharpie & The Future Laboratory (2007).
15	The **Silicon Valley's Creative Community Index** was based on two waves of study: the first one, in 2002, focused on cultural participation and the vitality of non-profit arts and culture organisations. The second one, in 2005, focused on the organisations' ability to attract and retain creative workers and cultural participation.	Rawson, B., Kreidler, J. & Trounstine, P. J. - Cultural Initiatives Silicon Valley, San Jose State University & Survey and Policy Research Institute (2006).
16	The **Washington's Creative Vitality Index** (now: Creative Vitality Suite) tracks 36 selected occupational categories – including art directors and musicians, photographers and editors, dancers, exhibit designers and authors - revenues of non-profit arts organisations, book store sales, and other arts participation data.	ArtsWA - Washington State Arts Commission & WESTAF - Western States Arts Federation (2016).
Main focus: covering culture/creativity-related dimensions as part of broader frameworks		
17	**Cities of Opportunity** (COO) is a benchmark of global cities designed to gain insights into what makes cities thrive out of 10 key variables (e.g. intellectual capital and innovation, technology readiness, city gateway, demographics and livability, and cost).	PricewaterhouseCoopers (PwC) (2016).
18	The Anholt-GfK **City Brands Index**SM (CBISM) evaluates cities' appeal across six dimensions: international Presence, Place (e.g. physical outdoors aspect), Prerequisites (e.g. affordable accommodations), People (e.g. cultural diversity), Pulse (interesting things to do) and Potential (economic and educational opportunities).	Anholt-GfK (2017).
19	The **Composite Indicator of the Creative Economy** (CICE) is a summary measure of an entity's creative capacity or capability in three key dimensions: Innovation, Entrepreneurship and Openness.	Bowen, H. P. & Moesen, W. & Sleuwaegen, L. - KU Leuven, Faculty of Economics and Business (2006).
20	The **European Competitiveness Index** measures, compares and examines the competitiveness of Europe's regions and nations by gathering data on Creativity, Economic performance, and Infrastructure and accessibility.	Huggins, R. & Davies, W. - Centre for International Competitiveness (2006).

(*continued on next page*)

Table A-1 (*continued*)

#	Short description	Developer(s) and year of latest edition
21	The **European Digital City Index** describes how well different European cities support digital entrepreneurs by measuring their performance across 10 dimensions ranging from Access to capital to Digital infrastructure to Entrepreneurial culture to Lifestyle and Skills.	Bannerjee, S. Bone, J., Finger, Y. & Haley, C. - Nesta & European Digital Forum (2016).
22	The **European ICT Poles of Excellence (EIPE) Composite Indicator** aims to evaluate EU regions (NUTS3) across three areas (business activity, R&D and Innovation in the ICT sector) with a view to set the conceptual and methodological conditions for defining, identifying, analysing and monitoring poles of excellence.	de Prato, G. & Nepelski D. - Joint Research Centre (JRC) of the European Commission (2014).
23	The **Global Cities** project has been designed to provide insights into the global reach, performance, and level of development of the world's largest cities across five key dimensions: Business activity, Human capital, Information exchange, Cultural experience and Political engagement.	ATKerney (2016).
24	The **Global City Indicators Program** (GCIP) is a decentralised, city-led initiative that aims at enabling cities to measure, report, and improve their performance and quality of life, facilitate capacity building, and share best practices across different areas ranging from urban planning to innovation.	Bhada, P. & Hoornweg, D. - World Bank & Global Cities Institute (2008).
25	The **Global Competitiveness Index** presents a framework and a corresponding set of indicators related to the following national economies policy domains: Institutions, Infrastructure, the Macroeconomic environment, Health and primary education, Higher education and training, Labor market efficiency and Market size.	World Economic Forum (2018).
26	The **Global Innovation Index** (GII) relies on two sub-indices - the Innovation Input Sub-Index and the Innovation Output Sub-Index, each one built around key pillars. Five input pillars capture national 'enablers' of innovative activities: Institutions, Human capital and research, Infrastructure, Market sophistication, and Business sophistication. Two output pillars capture innovation outputs: Knowledge and technology and Creative outputs.	Cornell University, INSEAD & WIPO (2017).
27	The **Global Power City Index** (GPCI) evaluates and ranks the major cities of the world according to their power to attract creative people and business enterprises from around the world, across five key dimensions: Economy, R&D, Cultural interaction, Liveability, Environment and Accessibility.	Institute for Urban Strategies - The Mori Memorial Foundation (2017).
28	The **Global Talent Competitiveness Index** (GTCI) is an annual study ranking countries and major cities in relation to five main dimensions: Enable, Attract, Grow, Retain and Skills.	INSEAD (2018).
29	The **Global Human Capital Index** ranks countries across the globe on how well they are developing their human capital across four thematic dimensions (Capacity, Deployment, Development and Know-how/skills) and five distinct age groups (from 0 to 14 to 65+).	World Economic Forum (2017).
30	The **Quality of Life Index** links the results of subjective life-satisfaction surveys to the objective determinants of quality of life across countries, such as Material well-being (GDP per capita), Health (measured by life expectancy at birth) or Community Life (measured through church attendance or union membership).	Economist Intelligence Unit (2005).
31	The **Regional Competitiveness Index** (RCI) allows regions to monitor and assess their development over time and in comparison with other regions, in three main dimensions: Basic (related to institutions and infrastructures), Efficiency (covering education and the labour market) and Innovation (measuring technological readiness and business sophistication).	European Commission (2016).
32	The **Regional Innovation Scoreboard** (RIS) is a regional extension of the European Innovation Scoreboard, assessing the innovation performance of European regions across four main areas: Framework conditions, Investments, Innovation activities and Impacts.	European Commission (2017).
33	The **Smart Cities Ranking** project aims at offering a new view on medium-sized cities in Europe and their respective differences and comparative (dis-)advantages towards each other: Smart economy, Smart people, Smart environment, Smart mobility, Smart living (e.g. presence of cultural facilities) and Smart governance.	Centre of Regional Science, Vienna UT (2015).
34	The **Sustainable Cities** project assesses cities against five categories (environmental quality, economic security, governance and empowerment, infrastructure and energy, and social well-being) along social, environmental and economic pillars.	Corporate Knights (2013).
35	The **Urban Indicators for Managing Cities** project explores the theory, development and application of urban indicator systems for improved urban management and performance measurement on dimensions ranging from Health and education, to Urban productivity to Culture.	Asian Development Bank (2001).
36	The **World Knowledge Competitiveness Index** is a composite measure of the knowledge economies of the globe's best performing regions. It measures Human capital, Knowledge capital, Regional economy outputs, Financial capital and Knowledge Sustainability.	Centre for International Competitiveness (2008).

Table A-2
The CCCM: indicators' properties.

	Description	Coverage	Availability (geo level)	Quality	Timeliness		Relevance
					Reference period	Mode year	
Sub-index:	1. Cultural Vibrancy						
Dimension:	*D1.1 Cultural venues & facilities*						
1. Sights and landmarks	Points of historical, cultural and/or artistic interest, such as architectural buildings, religious sites, monuments and statues, churches and cathedrals, bridges, towers and fountains, among other things, divided by the total population and then multiplied by 100,000.	99%	TripAdvisor (city)	Most comprehensive data source available at the moment of data collection	2016	2016	**Currently**, this group of indicators captures *measurable* forms of cultural capital (Throsby, 2001) as a major asset contributing to territorial identity, life quality and location choices of skilled workers, investments and visitors (e.g. Backman & Nilsson, 2016; Glaeser et al., 2001).
2. Museums	Number of museums that are open to the public divided by the total population and then multiplied by 100,000.	100%	TripAdvisor (city)	Most comprehensive data available at the moment of data collection (better coverage than Urban Audit)	2016	2016	**Ideally**, intangible forms of cultural capital, community spaces and the *flow* of services deriving from such capital should also be measured. Also, an objective evaluation of the embedded economic, cultural and social values would allow for a more detailed, value-based, classification of cultural capital assets and of their possible 'uses' to reach diverse economic or social policy objectives.
3. Cinema seats	Number of cinema seats in the city divided by the total population and then multiplied by 1000.	57%	Eurostat's Urban Audit (city)	Official statistics	2011–2014	2011	
4. Concerts & shows	Number of theatres and other music venues (concert halls, clubs, etc.) divided by the total population and then multiplied by 100,000.	94%	TripAdvisor (city)	Most comprehensive data available at the moment of data collection	2016	2016	
5. Theatres	Number of theatres in the city divided by the total population and then multiplied by 100,000.	64%	Urban Audit (city)	Official statistics	2011–2014	2011	
Dimension:	*D1.2 Cultural participation & attractiveness*						
6. Tourist overnight stays	Total annual number of nights that tourists/guests have spent in tourist accommodation establishments (hotel or similar) divided by the total population.	84%	Eurostat's Urban Audit (city)	Official statistics	2010–2014	2014	**Currently**, these indicators relate to the capacity of cultural capital to attract audiences, as a major step towards reaching broader city-relevant goals, going from tourism development (OECD, 2009) to urban regeneration needs (e.g. Blessi et al., 2016).
7. Museum visitors	Total number of museum tickets sold during the reference year divided by the total population and then multiplied by 1000.	71%	Eurostat's Urban Audit (city)	Official statistics	2011–2014	2011	
8. Cinema attendance	Total number of tickets sold, referring to all films screened during the year, divided by the total population and then multiplied by 1000.	52%	Eurostat's Urban Audit (city)	Official statistics	2011–2014	2011	**Ideally**, disaggregated data distinguishing between residents and tourists would allow for a more precise understanding of the cultural audiences attracted, with important implications in terms of policy strategies (e.g. for audience engagement).
9. Satisfaction with cultural facilities	Percentage of the population that is very satisfied with cultural facilities (i.e. concert halls, theatres, museums and libraries) in the city.	32%	Survey on 'Quality of life in cities' by TNS/EC (city)	Established survey and best measure available at the moment of data collection	2015	2015	
Sub-index:	2. Creative Economy						
Dimension:	*D2.1 Creative & knowledge-based jobs*						
10. Jobs in arts, culture & entertainment	Number of jobs in arts, culture- and entertainment-related activities such as performing arts, museums and libraries, divided by the total population and then multiplied by 1000 (NACE Rev. 2, R-U).	81%	Eurostat's Urban Audit (city)	Official statistics	2011–2014	2011	**Currently**, this set of indicators mirrors the interlinkages between local cultures and urban economic activities (Amin & Thrift, 2007; Scott, 1997, 2001), by measuring jobs in Cultural and Creative Sectors (CCS).
11. Jobs in media & communication	Number of jobs in media and communication-related activities such as book and music publishing, film production and TV, divided by the total population and then multiplied by 1000 (NACE Rev. 2, J).	70%	Eurostat's Urban Audit (city)	Official statistics	2011–2014	2011	**Ideally**, much more disaggregated data (e.g. at three, four or even five digits level) would help capture cultural and creative jobs in more precise ways, so to differentiate them from jobs more broadly related to the knowledge economy.
12. Jobs in other creative sectors	Number of jobs in professional, scientific and technical, administrative and support service activities such as architecture, advertising, design, and photographic activities, divided by the total population and	70%	Eurostat's Urban Audit (city)	Official statistics	2011–2014	2011	

(*continued on next page*)

Table A-2 (*continued*)

	Description	Coverage	Availability (geo level)	Quality	Timeliness		Relevance
					Reference period	Mode year	
	then multiplied by 1000 (NACE Rev. 2, M-N).						
Dimension:			*D2.2 Intellectual property & innovation*				
13. ICT patent applications	Three-year average number of ICT patent applications (e.g. consumer electronics, computers and telecommunications) filed to the European Patent Office by priority year divided by the total population and then multiplied by 1 million.	95%	Eurostat's Regional Statistics (NUTS 3)	Official statistics	2010–2012	2010–2012	**Currently**, this group of indicators measures (some types of) innovation outputs, intended as possible 'spillovers' of cultural and creative activities (Bakhshi et al., 2008; Pratt & Jeffcutt, 2009). Clearly, spillover effects are very much difficult to grasp and certainly go beyond new patents and designs. **Ideally**, comparable metrics capturing process-based and social innovation, for instance, should also be included.
14. Community design applications	Three-year average number of Community Design applications filed to the Office for Harmonization in the Internal Market (OHIM) divided by the total population and then multiplied by 1 million.	82%	Eurostat's Regional Statistics (NUTS 3)	Official statistics	2013–2015	2013–2015	
Dimension:			*D2.3 New jobs in creative sectors*				
15. Jobs in new arts, culture & entertainment enterprises	Number of persons employed in the enterprises established in the reference year, divided by the total population and then multiplied by 100,000 (see indicator 10 for NACE codes).	43%	Eurostat's Regional Statistics (NUTS 3)	Official statistics	2010–2013	2013	**Currently**, this set of indicators mirrors the interlinkages between local cultures and urban economic activities (Amin & Thrift, 2007; Scott, 1997, 2001), by measuring jobs in CCS.
16. Jobs in new media & communication enterprises	Number of persons employed in the enterprises established in the reference year, divided by the total population and then multiplied by 100,000 (see indicator 11 for NACE codes).	42%	Eurostat's Regional Statistics (NUTS 3)	Official statistics	2010–2013	2013	**Ideally**, much more disaggregated data (e.g. at three, four or even five digits level) would help capture cultural and creative jobs in more precise ways, so to differentiate them from jobs more broadly related to the knowledge economy.
17. Jobs in new enterprises in other creative sectors	Number of persons employed in the enterprises established in the reference year, divided by the total population and then multiplied by 100,000 (see indicator 12 for NACE codes).	43%	Eurostat's Regional Statistics (NUTS 3)	Official statistics	2010–2013	2013	
Sub-index:			3. Enabling Environment				
Dimension:			*D3.1 Human capital & education*				
18. Graduates in arts & humanities	Number of tertiary education graduates (ISCED 2011 levels 5–8) in arts and humanities divided by the total population and then multiplied by 100,000.	88%	ETER project (city)	Established data collection project	2010–2013	2010–2013	**Currently**, this set of indicators is intended to grasp the presence of highly educated people and of high quality universities as a crucial factor for knowledge generation (e.g. Smith, 2007; Wolfe, 2005). While, **ideally**, more specific data on arts schools should be included, artists and cultural professionals do not necessarily follow formal arts educational paths (Towse & Ruth, 2006). The retained indicators thus attempt to measure the presence of a high quality educational setting that is likely to appeal to certain typologies of creative people and entrepreneurs, while the more specific 'graduates indicators' try to capture the cognitive and creative capital that is likely to be relevant for all CCS.
19. Graduates in ICT	Number of tertiary education graduates (ISCED 2011 levels 5–8) in Information and Communication Technologies divided by the total population and then multiplied by 100,000.	88%	ETER project (city)	Established data collection project	2010–2013	2010–2013	
20. Average appearances in university rankings	Average number of universities' appearances in four different university rankings: QS, Shanghai, Leiden and Times.	100%	QS, Shanghai, Leiden, Times rankings (city)	Established rankings	2014	2014	
Dimension:			*D3.2 Openness, tolerance & trust*				
21. Foreign graduates	Number of foreign graduates in tertiary education divided by the total number of tertiary education	62%	ETER project (city)	Established data collection project	2010–2013	2012–2013	**Currently**, this set of indicators attempts to capture a city's 'climate' of tolerance and trust, building on the argument according to which arts

(*continued on next page*)

Table A-2 (*continued*)

	Description	Coverage	Availability (geo level)	Quality	Timeliness		Relevance
					Reference period	Mode year	
	graduates (ISCED 2011 levels 5–8) in the same academic year.						and creativity are more likely to flourish in societies that are open to multiple perspectives (Florida, 2005; Landry & Bianchini, 1995) and where there is a high level of trust (Banks et al., 2000). **Ideally**, as the relevance of diversity measures as proxies of openness and tolerance has been questioned on the grounds that diversity does not necessarily bring tolerance (Green, Strolovitch, Wong, & Bailey, 2001; Wessel, 2009), more qualitative aspects should also be considered. This is why the proposed indicators combine both 'objective' (e.g. foreign graduates) and 'subjective' (e.g. perceived tolerance) indicators as proxies of tolerance.
22. Foreign-born population	Percentage of the total population who is foreign-born.	73%	Eurostat's Urban Audit (city)	Official statistics	2011–2014	2011–2014	
23. Tolerance of foreigners	Percentage of the population who very strongly agrees with the statement: 'The presence of foreigners is good for this city'.	32%	Survey on 'Quality of life in cities' by TNS/EC (city)		Established survey	2015	
24. Integration of foreigners	Percentage of the population who very strongly agrees with the statement: 'Foreigners who live in this city are well integrated'.	32%	Survey on 'Quality of life in cities' by TNS/EC (city)		Established survey	2015	
25. People trust	Percentage of the population who very strongly agrees with the statement: 'Generally speaking, most people in this city can be trusted'.	32%	Survey on 'Quality of life in cities' by TNS/EC (city)		2015	2015	
Dimension:	*D3.3 Local & international connections*						
26. Passenger flights	Number of passenger flights per day, accessible within 90 min of travel by road, divided by the total population and then multiplied by 100,000.	86%	DG REGIO[a] of the European Commission (city)	Established data collection project	2013	2013	**Currently**, this group of indicators measures the availability of transport connections, building on the 'instrumental' importance of distance aspects to facilitate mobility (Castells, 2000; Cooke, 2001) and accessibility to global knowledge and markets, including from a tourism perspective (Palhares, 2003; Van Truong & Shimizu, 2017). **Ideally**, data on transport connections *within* a city could complement these indicators and allow for more detailed analyses, e.g. assessing the accessibility to (geolocalised) cultural facilities.
27. Potential road accessibility	Computed indicator based on road network data.	86%	DG REGIO[a] of the European Commission (city)	*Ad hoc* data collection project	2012	2012	
28. Direct trains to other cities	Average hourly number of departures between 6:00 and 20:00 of direct trains to other cities/greater cities divided by the total population and then multiplied by 1 million.	86%	DG REGIO[a] of the European Commission (city)	Established data collection project	2014	2014	
Dimension:	*D3.4 Quality of governance*						
29. Quality of governance	Computed indicator measuring the quality of government in three areas of public services: education, healthcare and law enforcement.	96%	DG REGIO[a] of the European Commission (NUTS 2/1)	Established composite measure of regional governance	2013	2013	**Currently**, this composite indicator measures the quality of regional government, broadly defined to include the presence of low levels of

(*continued on next page*)

Table A-2 (*continued*)

	Description	Coverage	Availability (geo level)	Quality	Timeliness		Relevance
					Reference period	Mode year	
							corruption, protection of the rule of law, government effectiveness and accountability (Charron et al., 2014). The economic geography literature has demonstrated that institutions promoting local autonomy and freedom may indeed affect the location choices of creative individuals (Haisch & Klöpper, 2015; Serafinelli & Tabellini, 2017) and firms (Sánchez Serra, 2016) as well as foster innovation (Sleuwaegen & Boiardi, 2014). **Ideally**, comparable data on policies and funds for culture as well as on the 'creative mode' of urban governance (Healey, 2004) would help having a more comprehensive understanding of the local governments' ability to foster culturally vibrant and creative milieus.

[a] Directorate-General for Regional and Urban Policy.

Table B-1
Statistical coherence in the Cultural and Creative Cities Monitor framework: Pearson correlation coefficients between indicators and dimensions.

Dimensions	Indicators	D1.1	D1.2	D2.1	D2.2	D2.3	D3.1	D3.2	D3.3	D3.4
D1.1 Cultural venues & facilities	Sights & landmarks	**0.63**								
	Museums	**0.71**	0.35	0.15						
	Cinema seats	**0.56**	0.39	0.22				0.16		0.16
	Concerts & shows	**0.71**	0.38	0.22			0.35	0.24		0.21
	Theatres	**0.71**	0.23	0.24						
D1.2 Cultural participation & attractiveness	Tourist overnight stays	0.35	**0.53**	0.27			0.21		0.21	0.22
	Museum visitors	0.32	**0.70**	0.41	0.35		0.25		0.32	0.27
	Cinema attendance	0.50	**0.59**	0.31	0.17			0.20	0.28	0.34
	Satisfaction with cultural facilities		**0.62**	0.31	0.35		0.15	0.33	0.29	0.44
D2.1 Creative & knowledge-based jobs	Jobs in arts, culture & entertainment	0.37	0.49	**0.85**	0.41		0.16	0.17	0.32	0.27
	Jobs in media & communication	0.19	0.46	**0.90**	0.55	0.35	0.28	0.33	0.36	0.34
	Jobs in other creative sectors	0.20	0.48	**0.91**	0.51	0.25	0.29	0.27	0.52	0.48
D2.2 Intellectual property & innovation	ICT patent applications		0.39	0.49	**0.90**		0.25	0.28	0.46	0.52
	Community design applications		0.36	0.48	**0.84**	0.23		0.16	0.37	0.34
D2.3 New jobs in creative sectors	Jobs in new arts, culture & entertainment enterprises					**0.84**			0.16	
	Jobs in new media & communication enterprises			0.29	0.23	**0.92**		0.24	0.17	
	Jobs in new enterprises in other creative sectors			0.26		**0.93**				
D3.1 Human capital & education	Graduates in arts and humanities	0.19					**0.73**			
	Graduates in ICT						**0.66**			
	Average appearances in university rankings		0.41	0.55	0.40	0.23	**0.60**	0.21	0.35	0.34
D3.2 Openness, tolerance & trust	Foreign graduates	0.18	0.17					**0.46**		0.23
	Foreign-born population	0.26	0.37	0.64	0.41	0.27	0.19	**0.44**	0.50	0.41
	Tolerance of foreigners				0.16	0.23		**0.72**		0.16
	Integration of foreigners							**0.57**		
	People trust		0.30	0.29	0.34			**0.59**		0.40
D3.3 Local & international connections	Passenger flights		0.39	0.46	0.46	0.19	0.28		**0.85**	0.46
	Potential road accessibility		0.31	0.33	0.33	0.17	0.22		**0.80**	0.24
	Direct trains to other cities		0.44	0.31	0.40		0.22		**0.82**	0.52
D3.4 Quality of governance	Quality of governance	0.18	0.52	0.41	0.50		0.25	0.35	**0.49**	**1.00**

Note: significant Pearson correlation coefficients at the 5% probability threshold are shown, for n = 168.
In bold, the correlation coefficients of the CCCM variables with the assigned dimension.

Table B-2
Statistical coherence in the Cultural and Creative Cities Monitor framework: Pearson correlation coefficients between dimensions and sub-indices and related weights.

	1. Cultural Vibrancy	2. Creative Economy	3. Enabling Environment	C3 Index	Expert-based weights	Implicit weights (squared Pearson corr. coefficient)	Implicit weights rescaled to 100% sum
1. Cultural Vibrancy	1.00	0.35	0.40	0.77	**40%**	59%	33%
2. Creative Economy	0.35	1.00	0.50	0.84	**40%**	71%	40%
3. Enabling Environment	0.40	0.50	1.00	0.69	**20%**	47%	26%
D1.1 Cultural venues & facilities	**0.88**		0.20	0.55	50%	77%	52%
D1.2 Cultural participation & attractiveness	**0.84**	0.47	0.50	0.78	50%	70%	48%
D2.1 Creative & knowledge-based jobs	0.47	**0.81**	0.49	0.80	40%	66%	41%
D2.2 Intellectual property & innovation	0.25	**0.67**	0.44	0.60	20%	45%	28%
D2.3 New jobs in creative sectors		**0.72**	0.23	0.48	40%	52%	32%
D3.1 Human capital & education	0.23	0.27	**0.75**	0.42	40%	56%	35%
D3.2 Openness, tolerance & trust	0.25	0.33	**0.64**	0.44	40%	41%	25%
D3.3 Local & international connections	0.28	0.46	**0.54**	0.51	15%	29%	18%
D3.4 Quality of governance	0.40	0.38	**0.58**	0.53	5%	34%	21%

Note: significant Pearson correlation coefficients at the 5% probability threshold are shown, for n = 168.
In bold, the correlation coefficients of the CCCM dimensions with the assigned sub-index and the final experts-based weights.

Table B-3
Uncertainty analysis for the C3 Index: normalisation and weights.

II. Uncertainty in the normalisation formula at the indicator level		
Reference: min-max	Alternative: percentile ranks	
II. Uncertainty in the weights at the dimension level		
Dimension/sub-index	**Reference value for the weight (within the sub-index)**	**Distribution assigned for robustness analysis (within the sub-index)**
D1.1 Cultural venues & facilities	0.5	U[0.38, 0.63]
D1.2 Cultural participation & attractiveness	0.5	U[0.38, 0.63]
D2.1 Creative & knowledge-based jobs	0.4	U[0.3, 0.5]
D2.2 Intellectual property & innovation	0.2	U[0.15, 0.25]
D2.3 New jobs in creative sectors	0.4	U[0.3, 0.5]
D3.1 Human capital & education	0.4	U[0.3, 0.5]
D3.2 Openness, tolerance & trust	0.4	U[0.3, 0.5]
D3.3 Local & international connections	0.15	U[0.11, 0.19]
D3.4 Quality of governance	0.05	U[0.04, 0.06]
1. Cultural Vibrancy sub-index	0.4	U[0.3, 0.5]
2. Creative Economy sub-index	0.4	U[0.3, 0.5]
3. Enabling Environment sub-index	0.2	U[0.15, 0.25]

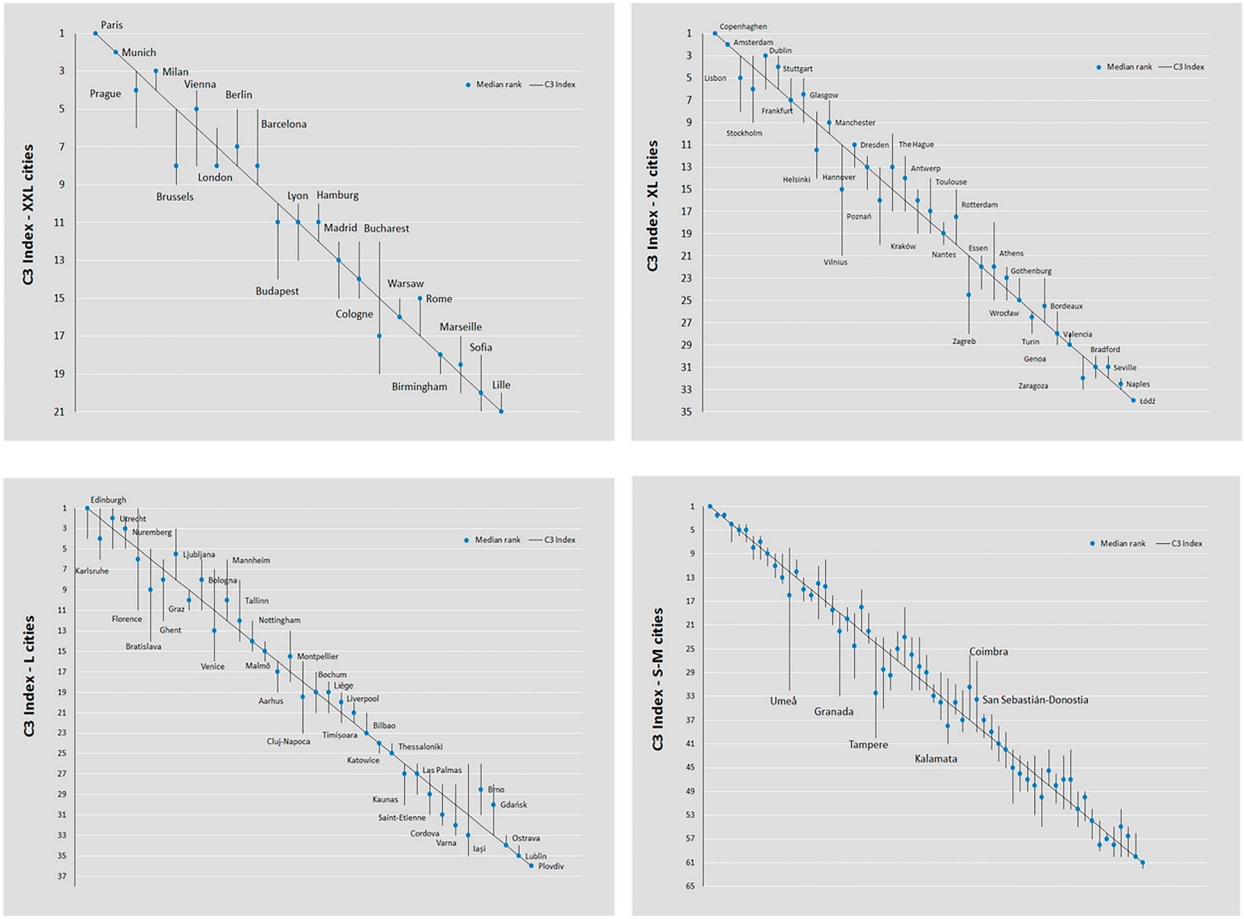


Fig. B-1. C3 Index rank vs. median rank - 90% confidence intervals, four city-size groups.
The Spearman rank correlation between the median rank and the C3 Index 2017 rank is 0.993. Median ranks and intervals are calculated over 2000 simulated scenarios combining perturbed weights (± 25% around the nominal weights assigned by experts) and percentile ranks versus min-max normalisation at the indicator level.

Acknowledgment

We would like to thank the anonymous reviewers for their very much constructive insights. We are also immensely grateful to Andrea Garnero and Desirée Campagna for their insightful comments and revisions on an earlier version of the manuscript.

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