Centrality and Creativity: Does Richard Florida's Creative Class Offer New Insights into Urban Hierarchy?

Mark Lorenzen
Kristina Vaarst Andersen
Department of Innovation and Organizational Economics
Copenhagen Business School
Kilevej 14A, 3
DK-2000 Frederiksberg
Denmark
mark@cbs.dk
kva.ino@cbs.dk

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abstract

To provide new insights into urban hierarchy, this article brings together one of economic geography's oldest and most well-established notions with one of its newest and most disputed notions: Christäller's centrality and Florida's creative class. Using a novel original database, the article compares the distribution of the general population and the creative class across 444 city regions in 8 European countries. It finds that the two groups are both distributed according to the rank-size rule, but exhibit different distinct phases with different slopes. The article argues that the two distributions are different because market thresholds for creative services and jobs are lower than thresholds for less specialized services and jobs. The article hence concludes that centrality exerts a strong influence upon urban hierarchies of creativity and that the study of creative urban city hierarchies yields new insights into the problem of centrality.

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One of the oldest problems in economic geography and a founding problem in regional science, the problem of urban hierarchy still warrants considerable attention. Harbingered by Christäller's (1933) theory of city centrality, economic geographers have strived for almost a century to explain the distribution of cities—in spatial, as well is as hierarchical, systems. While there has been progress, geographers cannot claim that they have made a good account of the spatial and hierarchical distribution of cities. As far as the problem of the size hierarchies of cities is concerned, it has been well described, but less well understood.

This article seeks to add new insights into the problem of urban hierarchy by contrasting a traditional analysis of the distribution of the sizes of the total populations of European cities with an unconventional analysis—that of the distribution of a particular European population group, with jobs and preferences that allegedly systematically differ from those of the rest of the population: Richard Florida's creative class (Florida 2002a, 2002b, 2002c, 2005a, 2005b, 2008). Florida (2002c, 2005a) claimed that because the creative class represents a profound shift in the nature of global competition, it also signals a new urban geography. In this article, we investigate whether the study of the creative class offers new insights into the urban hierarchy problem or whether the urban geography of the creative class exhibits hierarchical traits that are similar to those that economic geographers have been studying for almost a century.

One reason why the urban hierarchy and rank-size distribution problems have not been addressed before for the creative class is that studies of urban hierarchy require a significant number of observations (Thomas 1985). Florida's (2002c) study of the U.S. creative class included 268 cities, and until recently, this study was the largest of its kind. The study presented in this article drew on an integrated database of 444 cities in 8 European countries and thus was able to investigate the urban hierarchy of the creative class and compare it to the size distribution of the general population across European cities.

Our study revealed that even if the presence of the European creative class is well correlated with the European population, its distribution constitutes an urban hierarchy that is different from that of the total population. The distribution of the creative class follows a rank-size rule, but with a steeper overall slope than that of the total population (i.e., the size of a city's creative class grows more rapidly with its rank than a city's population grows with its rank). Furthermore, the slope across the rank-size distributions is much steeper toward the tail end of the distribution for the creative class than for the total population: the creative class is less attracted to the smallest cities than the total population is. To explain the differences between the creative urban hierarchy and the urban hierarchy of the total population, the article combines Christäller's notion of centrality with Florida's notion of creativity, hypothesizing that the creative urban hierarchy is shaped by the specialized consumer and job preferences of the creative class.

In the next section, we present the theoretical background of the article, in terms of urban hierarchy, rank-size distributions, and the creative class. Then we develop two hypotheses about how the preferences of the creative class may make creative urban hierarchies different from general population hierarchies. In the following sections, we present our basic findings on the distribution of the European creative class versus the general population and use these data to test and discuss the two hypotheses. Finally, we discuss some alternative explanations for the differences between the distributions of the European creative class and the general population, followed by a short conclusion.

Theoretical Background

Urban Hierarchy

A recurrent theme in economic geography is the uneven distribution of economic activity across space. *Urban (size) hierarchy*—how cities differ widely in the sizes of their populations—is a prime example of such uneven spatial distribution. Consequently, a richness of spatial models, originating with Christäller (1933) and later elaborated by numerous other scholars (e.g., Lösch 1954 [1940]; Berry and Pred 1961; Tinbergen 1968; Marshall 1996), has aimed to uncover the determinants of the distributions of city size, as well as the slope of the urban hierarchies.

In the formative years of economic geography, Christäller's (1933) central place model introduced the idea that the size distribution of cities is determined by a particular relationship between the size and *centrality* of cities. In a country (or other geographic region), the hierarchy of the centrality of cities determines the cities' size distribution. Centrality may be modeled in different ways (for a discussion, see Davies 1967), but a generally accepted method is to use the number of a city's functions (i.e., the goods and services that the city offers). Any type of economic specialization is limited by the extent of the market (Smith 2000 [1776]), and, hence, any city function will be offered only if there are enough consumers for it. In Christäller's (1933) terminology, every city function has a distinct *threshold*, namely, the minimum number of consumers needed to constitute a viable market for the particular good or service. Thus, specialized city functions demand larger populations (geographic hinterlands), while less specialized functions demand smaller populations (hinterlands). In this way, Christäller and his successors not only stipulated a relationship between the number of functions of a city (the city's centrality) and the city's size, but laid out the principle of urban hierarchy: the hinterland for a city of a given centrality c (with a given number of functions) will contain several hinterlands of cities of centrality c–1 (with fewer functions).

Christäller (1933) and Lösch (1954 [1940]) also had something to say about the slope of urban hierarchies (i.e., the number of cities with centrality c–1 relative to cities of centrality c). Aimed foremost at explaining the geographic distribution of cities, their models predicted that city hierarchies that serve the maximum number of consumers from a minimum number of central cities will divide hinterlands according to a simple geometric principle, into hexagons. Each city with centrality c will divide its hinterland with the neighboring city of same centrality and serve itself plus two cities with centrality c–1. This means a distinct slope of the urban size hierarchy, too: Christäller and Lösch predicted that a hierarchy contains twice as many cities of a size that can support c–1 city functions as it contains cities of a size that can support c city functions. Christäller called this the "k = 3"-type hierarchy (one central city serves itself plus two lower-centrality cities, a total of three, in its hexagonal hinterland).

Christäller (1933) and Lösch (1954 [1940]) made stylized assumptions about the uniformity of the geographic landscape and transportation costs and of the purchasing power and preferences of consumers. Hence, their predictions of the spatial distribution of cities only rarely hold up empirically. However, one prediction holds up much better, that of clearly observable urban size hierarchies.[1] Consequently, this theme has been more eagerly pursued in economic geography (e.g, Simon 1955; Richardson 1973; Rosen and Resnick 1980; Malecki 1980; Carroll 1982; Krugman 1996a).

Rank-Size Distributions

Economic geographers' research on urban hierarchy has consistently found that urban hierarchies—whether in smaller or larger countries or even in transnational regions like Europe—conform to Christäller's (1933) k = 3 rule (e.g., Simon 1955; Krugman 1996a). The k = 3 rule is a variety of the *rank-size rule*.[2] Rank-size distributions, in which values steadily drop from a few observations with high values to still more observations with small values, are captured mathematically by estimating the value (size) of each observation as its rank in the hierarchy with a given *exponent* (Zipf 1949):

$$P(r) = k * r^{-q}$$

where $P(r)$ is the value of an observation, r is its rank, k is a scaling constant, and q is the exponent of the distribution (inverted in the foregoing equation because it has a negative value in the rank-size distribution's downward sloping curve). The rule for an observed sample with a rank-size distribution of values is that the lower the rank of an observation, the higher its value (scaled in a way that is particular for that sample). In the sample, the negative exponent describes the downward slope of the distribution: with an exponent of –1, an observation has double the value of the observation one rank lower, and with an exponent of –2, it has four times the value.[3] Hence, Christäller's (1933) k = 3 distribution of an urban hierarchy follows a rank-size rule with the exponent of –1.

Economists (e.g., Simon 1955; Krugman 1996a) have typically evoked Gilbrat's principle of *proportionate growth* (Sutton 1997) to explain why urban hierarchies are distributed according to the rank-size rule: they have assumed that the growth rate of a city is higher the larger its population size and that the more pronounced this tendency, the more negative the exponent in the urban rank-size distribution.[4]

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[1] Christäller (1933) also discussed other types of hierarchies with other slopes, for example, a transportation cost-optimizing hierarchy with k = 4 (each city shares half its hexagonal hinterland with the neighboring city of same centrality) and an administration reach-optimizing hierarchy with k = 7 (each city grabs its entire hexagonal hinterland).

[2] Other well-known rank-size distributions in social science encompass words in the English language (Zipf 1949) and wealth in European populations (Pareto 1897; Reed 2001).

[3] The mathematical expression of the rank-size rule is, given the importance of the exponent (the power to which an observation's rank is raised), also often called a *power law*.

[4] Strictly speaking, that proportionate growth leads to a rank-size distribution is a *hypothesis,* rather than a *causal explanation*: that proportionate growth, ceteris paribus, leads to a rank-size distribution does not

To paraphrase Christäller (1933), the value of the exponent in an urban rank-size distribution depends upon the extent to which bigger cities develop specialized urban functions, serving bigger hinterlands, *faster* than do smaller cities. However, other possible self-reinforcing forces of larger cities are that these cities invest disproportionately in infrastructures that create advanced job options and educational opportunities, attracting a still higher number of new residents (Jacobs 1961; Florida 2002c).

Economic geography has devoted special analytical attention to the tail and the top of the distribution of the population among cities. First and foremost, it has been standard practice (e.g., Malecki 1980; Beguin 2006) to cut off the lower tail from urban hierarchies to obtain a statistically good fit to the rank-size rule (Yule 1924) because for small cities, growth may be nonproportionate (or growth rates may be so negligible) that these cities conform poorly to the rule. Furthermore, in some urban hierarchies—for instance, in small or developing economies—the one or few biggest cities have economical and possibly political *primacy*, monopolizing public administration, universities, and inward investments to such an extent that they are propelled beyond the proportionate growth pattern in the rest of those economies' urban hierarchies (Richardson 1973; Henderson 1988; Ades and Glaeser 1995; Krugman 1996b; Moomaw and Shatter 1996). Primary cities may thus not conform to the rank-size rule, in which case scholars typically exclude them from statistical analysis.

Two Unsolved Problems of Urban Hierarchy

The study of urban hierarchies contains a range of unsolved problems. One such problem pertains to the tail of the urban distributions. Simon (1955) suggested that although scholars want to cut off the observations below the threshold (minimum city size) under which cities stop adhering to the rank-size rule in order to calculate the exponent for the urban hierarchies, they should ideally also provide a viable theory of the rank-size system's "birth rate": how and when the smallest cities grow larger than the size threshold and become a part of the urban hierarchy. Such theories have not been abundant in economic geography, however.

Another unresolved problem pertains to the slope of urban hierarchies. As we mentioned earlier, in the study of urban size hierarchies in different contexts, regional scientists have repeatedly come up with the exponent of −1 (in Christäller's 1933 term, k = 3). While proportionate growth (or what Simon 1955 called "random" growth) may explain that urban hierarchies are distributed according to the rank-size rule, the fact that distributions of different urban hierarchies all approximate the exponent −1 has not been explained, to the extent that Krugman (1996a, 417) called this situation "disturbing," "baffling," and "intriguing." With rare humbleness, Krugman added, "Suggestions are welcome."

We would like to make one such suggestion: a strategy of looking for new insights into urban hierarchy is to analyze *other* urban hierarchies than the one constituted by total city populations. Hence, to cast new light on the twin problems of minimum threshold levels and exponents, this article compares the distribution of cities' total populations with the distribution of a particular subgroup of the population with jobs and preferences that allegedly systematically differ from those of the rest of the population. This subgroup is Richard Florida's creative class.

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imply that every *real-life* rank-size distribution is caused by proportionate growth. However, proportionate growth is by far the dominant hypothesis.

The Creative Class

Florida's theory of the creative class (2002a, 2002b, 2002c, 2005a, 2005b, 2008) has made a notable impact in both the policy and scholarly worlds (e.g., Gertler, Florida, Gates, and Vinodrai 2002; Andersen and Lorenzen 2005, 2009; Montgomery 2005; Boyle 2006; Raush and Negrey 2006; Weick and Martin 2006). Very simplified, Florida (2002a, 2002b, 2002c) argued that in a globalized economy in which innovation constitutes competitive advantage, it is possible to identify analytically a component of the labor force that is particularly important for competitive advantage and growth because it is technically, socially, and/or artistically creative on the job. This *creative class* within the labor force has particular preferences for work and private life, such as high-quality housing, work empowerment, and specialized consumption. Although the creative class shares these preferences with highly skilled labor, Florida demonstrated empirically that the U.S. creative class (which he empirically captured by selected types of jobs) has a more unique trait: it prefers to locate in cities with particularly high levels of cultural services, ethnic diversity, and tolerance toward nonmainstream lifestyles (as was captured by an array of now somewhat disputed indicators). Florida further claimed that as a result of the creative class's preference-driven pattern of location, diverse and ethnically and culturally rich cities prosper economically as innovation-intensive firms pursue the creative labor into these cities—a remarkable reversal of the industrial logic of labor-follows-capital. Florida sought to give credence to this claim by using (even more disputed) indicators of regional economic growth, such as the proportion of highly skilled labor and high-technology industries. Malanga (2004), Glaeser (2005), Peck (2005), and Scott (2006), for example, criticized Florida's argument and empirical designs.

Our purpose in this article is not to test Florida's claims about the causalities between labor and capital in a European context, because other researchers have done so using the same database as this article: Andersen and Lorenzen (2005, 2009); Andersen, Hansen, Isaksen, and Raunio (2008); and Clifton (2008) all found good correlations among the presence of a creative class, ethnic diversity, cultural services, and economic growth in a European context. Instead, we focus solely on analyzing the *distribution* of the creative class across European cities. Florida (2002c) hinted that the distribution of the creative class may adhere to the rank-size rule, and together with Robert Axtell (Axtell 2001; Axtell and Florida 2006), he has since explored the microfoundations of such a distribution, applying mathematical modeling to test (successfully) if a model assuming agglomeration and proportionate growth of the creative class can produce a rank-size distribution. However, so far, there has been little *empirical* investigation of whether the creative class is indeed rank-size distributed and what we may learn from comparing its distribution with that of the general population.

Using a novel European data set, this article seeks to fill this gap. We investigate the creative European urban hierarchy (i.e., constituted by the distribution of the European creative class across cities), compare it to the urban hierarchy of total city populations, and seek to explain the differences between the hierarchies.

Hypotheses on the Creative Urban Hierarchy

To set our analysis in motion, we first develop two hypotheses from Christäller's and Florida's work about what a creative urban hierarchy may look like and then test these hypotheses.

The Creative Class's Specialized Consumer Preferences Influence the Creative Urban Hierarchy

Drawing on Brooks (2001) and Robinson and Godbey (1997), for example, Florida (2002b) claimed that, to a growing extent, creative people identify themselves with artists. Artists are a part of the creative class: Florida (2002b, 2002c) described the creative class as consisting of *bohemians* (e.g., artists, designers, and writers), engaged in applying artistic forms of creativity; a *creative core* (e.g., researchers, engineers, and physicians), applying mostly technical creativity; and *creative professionals* (e.g., managers, finance people, and lawyers), mainly applying creativity in a generic and managerial sense (for more detailed definitions, see Appendix A). Whereas creative professionals are the largest subgroup, the creative core has the highest skill levels and accounts for most of the economic value produced by the creative class. However, even if the bohemians are relatively few and account for only a modest part of the creative class's contribution to economic growth, this group is, according to Florida, the most critical consumers of urban services. It has the most specialized preferences and pioneers the preferences of the creative class in general. Aspects of the preferences of the bohemians disseminate to the rest of the creative class, creating its "bourgeoisie-bohemian"—or, affectionately, "bobo" (Brooks 2001)—ethos.

Hence, the creative class is, allegedly, a particular and demanding consumer group, preferring high-quality and authentic consumer services and amenities—for example, nonmainstream cultural services and specialized research and educational institutions. Thus, Florida aligned with a growing number of researchers who have argued that urban amenities (or "quality of life," as it is also sometimes referred to) play a crucial role in attracting highly productive, innovative labor, hence adding substantially to regional economic growth (e.g., Roback 1982; Glaeser, Kolko, and Saiz 2001; Lloyd and Clark 2001; Shapiro 2006).

Let us exemplify which services and amenities we are talking about. In a recent survey of the Danish creative class's consumption of cultural services,[5] Bille (2007) found that the creative class consumes fewer spectator sports than does the rest of the workforce and resembles the general workforce with respect to culture consumed at home (such as television, videos, recorded music, computer games, and magazines) and mainstream public culture (such as movies, zoos, theme parks, and evening classes). However, Bille also showed that the creative class has a significantly different pattern of consumption of specialized public culture, as is shown in Table 1.

Table 1 lists how much more likely members of the Danish creative class are to consume a range of cultural services relative to a benchmark group in the labor force (constituted by selected service occupations). It shows that the creative class is by far the most eager consumers of concerts, museums, theater, and city architecture.

If the creative class indeed has certain specialized consumer preferences, we can hypothesize that the creative urban hierarchy will reveal them. Creative consumer preferences may, for instance, influence the lower *cutoff point* in the rank-size distribution. Because there are minimum efficient market sizes for particular services, there are city size thresholds below which these services cannot be found, and cities below such thresholds are likely to attract so few members of the creative class that they drop out of the rank-size hierarchy. Consumer preferences may also increase the *slope* of the creative urban hierarchy: the more proportionally cities' ability to offer the particular services

[5] The survey controlled for the effects of educational level, age, gender, income level, and geographic location.

Table 1

Cultural Services Consumed by the Danish Creative Class, 2004

Cultural Services	Estimated Parameter for the Creative Class (Positive Likelihood Relative to the Benchmark Group)
Attend classical concerts	0.99
Visit art exhibitions	0.81
Visit art museums	0.78
Perform arts, such as music, dancing, or acting	0.63
Visit libraries	0.63
Visit museums	0.62
Visit heritage sites	0.58
Visit landscapes	0.52
Visit historical architectures	0.48
Go to the theater	0.39
Do city walks	0.31
Walk or bike in nature or to work	0.31
Participate in sports	0.30
Attend rock or jazz concerts	0.26

Source: Bille (2007).
Note: The survey was based on another database than the one in this article, and the creative class is hence defined somewhat differently, emphasizing technical and artistic creativity. This definition approximates Florida's subgroups the *creative core* plus *bohemians*.

preferred by the creative class grows with city size, the higher (more negative) exponent the distribution of the creative class is likely to have.

The Creative Class's Specialized Job Preferences Influence the Creative Urban Hierarchy

Florida (2002c) defined the creative class as "labor creating new knowledge" and captured it not through educational level but through particular occupations, as we described earlier (for more detailed occupational definitions, see Appendix A). He also stressed that contrary to industrial workers or others in less creative jobs, members of the creative class are more mobile and carefully pick their workplaces. In other words, just as they have particular consumption preferences, members of the creative class have particular job preferences. In an analogy to Christäller's (1933) idea of thresholds for specialized consumer services that we applied earlier, there are bound to be thresholds for creative jobs because there are minimum efficient market sizes for specialized creative types of jobs. Not every city needs rocket scientists or scriptwriters, which means that there are also central places and urban hierarchies with respect to creative jobs.

We hypothesize that the creative urban hierarchy will reveal the creative class's job preferences, in terms of both its lower cutoff point and slope. It may be highly influenced by city-size thresholds below which creative people cannot find the jobs they are qualified to do: below such thresholds, cities may drop out of the rank-size city distribution. And analogous to the distribution of services discussed earlier, the more proportionally cities' ability to create creative jobs grows with city size, the higher (more negative) exponent the distribution of the creative class is likely to have. To test these hypotheses, we now turn to our database.

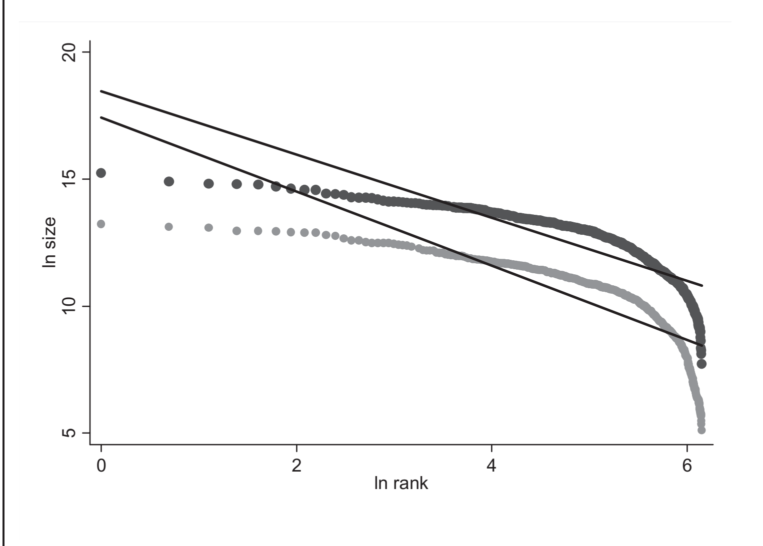
The Urban Hierarchies of the European Population and Creative Class

In our analyses, we used an original database of the population, the creative class, and a variety of indicators of diversity, cultural services, tolerance, and economic performance in the 444 NUTS 4 city regions in 8 countries in Europe that are at comparable levels of economic development: Denmark, Finland, Germany, the Netherlands, Norway, Sweden, Switzerland, and the United Kingdom. For definitions of how we measured the size of the creative class and other variables, see Appendix A.

Rank-Side Distributions

At first glance, there is a good correlation between the size of the general population and the presence of the creative class in European cities; this correlation has a Pearson's *r* value of 0.9427. However, this overall correlation obscures some notable differences in how the population and the creative class are each distributed. We calculated these distributions for the 444 European cities in 2000 and plotted them in Figure 1.

Figure 1 shows two graphs in which the logarithms of the size of the population and of the creative class of each city are plotted against the logarithm of the rank of the city. On such a log-log plot, a perfect rank-size distribution will show as a straight line, with the exponent revealed as the slope of the line (for information on calculating the plots used in this article, see Appendix B). Both the distribution of the general population and the creative class approximate rank-size rules, with fits to a perfect rank-size distribution of Pearson's $r = -0.8589$ and -0.8270, respectively. The creative urban hierarchy has a steeper slope than does the general population urban hierarchy; the exponent of the



Pearson's *r* (population): –0.8589***
Slope coefficient (population): –1.244146, 95-percent confidence interval [–1.3116; –1.176693]
Pearson's *r* (creative class): –0.8270***
Slope coefficient (creative class): –1.453236, 95-percent confidence interval [–1.543083; –1.36339]
*** 0.01 significance level (two-tailed).

Figure 1. The rank-size distribution of the European general population and creative class (2002). Note: Total population is shown in black, with the creative class in gray.

former's (fitted) rank-size distribution is −1.4532 compared to −1.2441 of the latter. We also calculated the distributions of the bohemians subgroup within the creative class, and while it has a similar fit to the rank-size rule (Pearson's $r = -0.8240$), it has an even steeper slope than does the creative class total: an exponent of −1.7606.

Top, Middle, and Tail Phases

In Figure 1, both distributions have a clearly visible tail with a negative deviation relative to a perfect rank-size rule. The standard exercise prescribed by regional scientists is to cut off these lower tails to obtain a better fit to a rank-size rule, and it is after this exercise that the exponent of city hierarchies usually ends up around the "magic" −1. If we cut the tails off, the remaining distributions of the population and creative class would have a fit to the rank-size rule of a Pearson's *r* value of −0.9185 and −0.9222. The exponents would be −0.8345 and −0.9488, respectively—close to the value of −1 that is common for urban hierarchies studied in regional science (Krugman 1996b).

However, because this solution would exclude 117 and 97 of our 444 cities for the general population and the creative class, respectively, from our samples, it is not satisfactory. Furthermore, as Figure 1 shows, the middles of the distributions also deviate, albeit positively, from the perfect rank-size rule, and so do the tops, again negatively. Hence, instead of cutting off the tails, we chose to divide the distributions of the total population, the creative class, and the bohemians (the latter exhibiting a similar deviating tail, middle and top) into three phases each: a top, a middle, and a tail. Figure 2 illustrates the distribution of the European creative class thus split up (see Appendix B for a technical explanation of how the splits were made).

Table 2 lists the exponent and fit to the rank-size rule for the total distribution and the three phases for the general European population, the European creative class, and the bohemians subgroup of the creative class. It also shows the number of cities included in each phase, plus the size of the population, the creative class, and bohemians in the lower threshold city, that is, where we chose to distinguish each phase from the next.

Arguably, our split into three phases allowed us to capture the distributions better than if we used the regional science standard procedure of merely cutting off tails. After this split into three phases, we found that the three phases in all distributions now fit remarkably well to a perfect rank-size rule. For example, the creative class's top, middle, and tail phases have Pearson's *r* values of −0.9553, −0.9510, and −0.99760, respectively.[6]

Relative Diseconomies of Top and Tail Cities

Another benefit of the split is that we can take a closer look at the behavior of the distributions for the cities with highest and lowest values. There are interesting insights here: the three phases for all distributions (the general population, the creative class, and the bohemians) exhibit strongly and significantly different exponents.[7] All three distributions have a higher (more negative) exponent for the tail phase and a lower (less negative) exponent for the top phase. Hence, European cities seem to suffer from some relative *diseconomies* of small or large populations. Since all phases are rank-size distributed,

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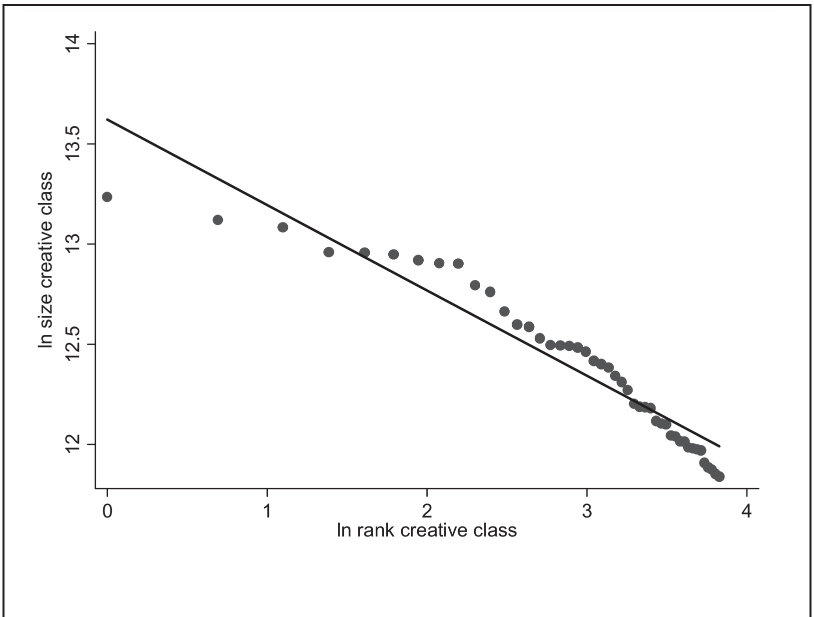
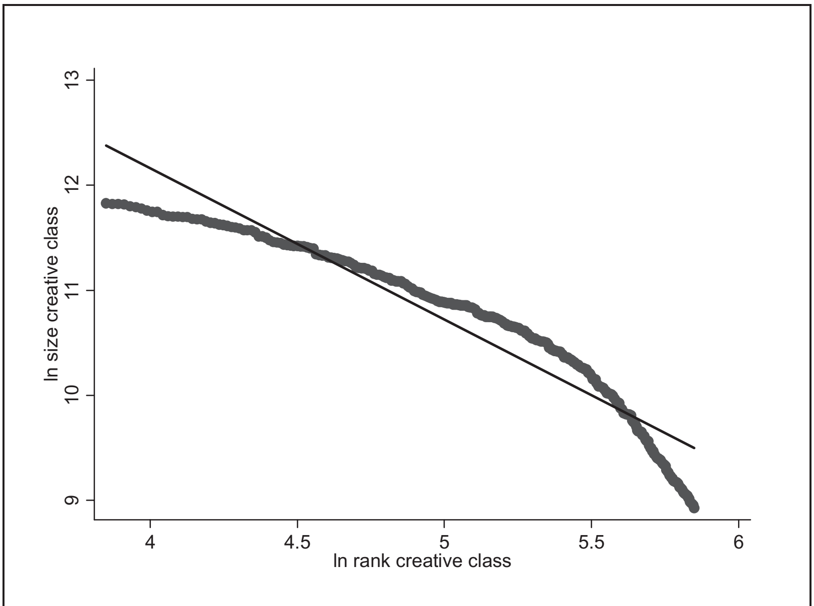
6 Splitting up the distribution ad infinitum would, of course, create still better statistical fits but yield less and less insight. We chose to split up the distributions into three and only three phases because of the clear negative deviation in the top, positive in the middle, and negative in the tail.

7 We calculated the 95-percent confidence intervals of the exponents for the different phases, delimiting the interval in which we are 95-percent sure that the exact value of the exponent is found. There is a significant difference between the exponents of two phases if their 95-percent confidence intervals do not overlap. None of the tested exponents does.



N = 46
Pearson's *r*: –0.9553***
Slope coefficient: –0.4263**
** 0.05 significance level (two-tailed).
*** 0.01 significance level (two-tailed).

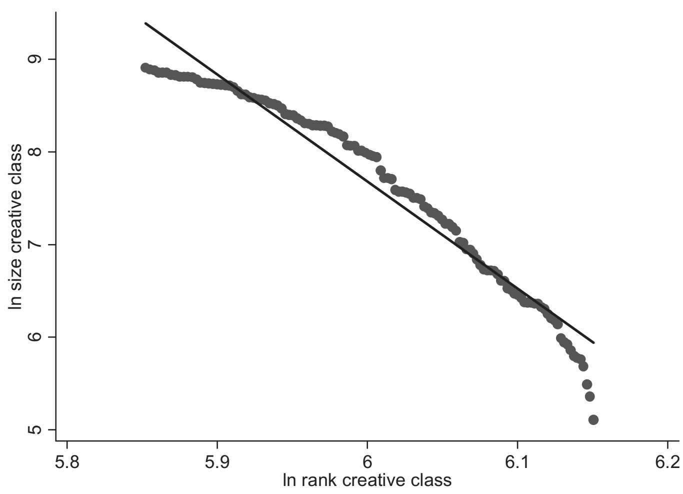
(a) Top phase



N = 301
Pearson's *r*: –0.9510***
Slope coefficient: –1.4409**
** $p = 0.05$ (two-tailed).
*** $p = 0.01$ (two-tailed).

(b) Middle phase

Figure 2. Phases of the rank-size distribution of the European creative class (2002).



N = 122
Pearson's *r*: –0.9760***
Slope coefficient: –11.5398
** *p* = 0.05 (two-tailed).
*** *p* = 0.01 (two-tailed).

(c) Tail phase

Figure 2. Phases of the rank-size distribution of the European creative class (2002) (continued).

we may assume a proportional growth (that is, the larger a city, the higher its growth). However, for the tail and top cities, such proportional growth is notably less than for the middle cities.

Thus, for the top cities, the positive-growth effect of increasing size tapers off (for each higher rank, the proportionate growth falls). These diseconomies are modest: the exponent drops (becomes less negative) by 70 percent from the middle phase to the top phase. However, it still means that the distributions of the European population and creative class exhibit no urban primacy. Contrary to the S shape of urban hierarchies with primacy (Stewart 1958; Vapnarsky 1969; Rosen and Resnick 1980; Carroll 1982), the top European cities slightly underperform.[8] This underperformance of the top phase (70 percent lower, less negative exponent relative to the middle phase) is similar for the general population and the creative class.

The diseconomies are much stronger for the smallest cities, evidenced by the high (strong negative) exponent of the tail phase. In this phase, for each lower rank, the size of the population and the presence of the creative class drop more dramatically than for middle cities. The tendency of cities to drop off steeply at the tail is more profound for the creative class than for the general population. The tail phase of the creative class distribution has 8 times the negative exponent of the middle phase and 27 times that of the

[8] That the distribution shows no urban primacy is not surprising because the database integrates city data for eight European countries. The integration of data blurs the effects of potential urban primacy within each country. Of the individual countries, only Finland exhibits urban primacy for the distribution of the population and the creative class (Andersen, Hansen, Isaksen, and Raunio 2008).

Table 2

Fit, Exponents, and Thresholds of Phases of the Rank-Size Distributions of the European General Population, Creative Class, and Bohemians (2002)

	Overall Distribution	Top Phase	Middle Phase	Tail Phase
General population				
Pearson's *r*	–0.8589***	–0.9900***	–0.9544***	–0.9333***
Slope coefficient	–1.2441***	–0.3886***	–1.2700***	–6.6941***
95-percent confidence interval	[–1.3116; –1.1767]	[–0.4071; –0.3701]	[–1.3162; –1.2237]	[–7.1245; –6.2636]
N	444	39	288	117
Lower threshold		Surrey (United Kingdom) with a population of 1,061,300	Lohja (Finland) with a population of 77,746	
Creative class				
Pearson's *r*	–0.8270***	–0.9553***	–0.9510***	–0.9760***
Slope coefficient	–1.4532***	–0.4263***	–1.4409***	–11.5398***
95-percent confidence interval	[–1.5431; –1.3634]	[–0.4664; –0.3862]	[–1.4942; –1.3876]	[–12.005; –11.0745]
N	444	46	301	97
Lower threshold		Staffordshire (United Kingdom) with a creative class of 138,524	Salo (Finland) with a creative class of 7,519	
Bohemians				
Pearson's *r*	–0.8240***	–0.9766***	–0.9636***	–0.9581***
Slope coefficient	–1.7606***	–0.6928***	–1.7070***	–16.1033***
95-percent confidence interval	[–1.8708; –1.6504]	[–0.7392; –0.6465]	[–1.7602; –1.6538]	[–17.0090; –15.1975]
N	444	46	309	89
Lower threshold		Mittelfranken (Germany) with a bohemian population of 5,670	Tromsø (Norway) with a bohemian population of 167	

* 0.1 significance level (two-tailed), **0.05 significance level (two-tailed), *** 0.01 significance level (two-tailed).

Note: The 95-percent confidence intervals of the exponents for the different phases delimit the interval in which we are 95-percent sure that the exact value of the exponent is found. There is a significant difference between the exponents of two phases if their 95-percent confidence intervals do not overlap. None of the tested exponents does. Hence, we can say that (a) the three intervals are significantly different from each other in all distributions (the general population, the creative class, and the bohemians); (b) the exponent, as well as all three-phase exponents, of the creative class are significantly different from the exponents of the general population; and (c) the exponent, as well as all three-phase exponents, of the bohemians are significantly different from the exponents of the creative class.

top phase. Hence, from the middle phase to the tail phase, the negative exponent of the creative class distribution grows 801 percent, compared to 527 percent for the general population. Whatever the diseconomies of small cities may be, they are 1.52 times stronger for the creative class than for the general population.

Test of Hypotheses

As we discussed, the creative urban hierarchy is distinctive from the general population hierarchy in a fundamental way. Its slope is steeper: exponents of both the total distribution and the three phases are higher (more negative) for the creative class. In the following sections, we explore possible reasons for this difference through testing the hypotheses stated earlier.

Hypothesis 1: The Creative Class's Specialized Consumption

One explanation for the steeper slope (more negative exponent) observed for the creative urban hierarchy may be found in Hypothesis 1: the specialized consumption of the creative class.

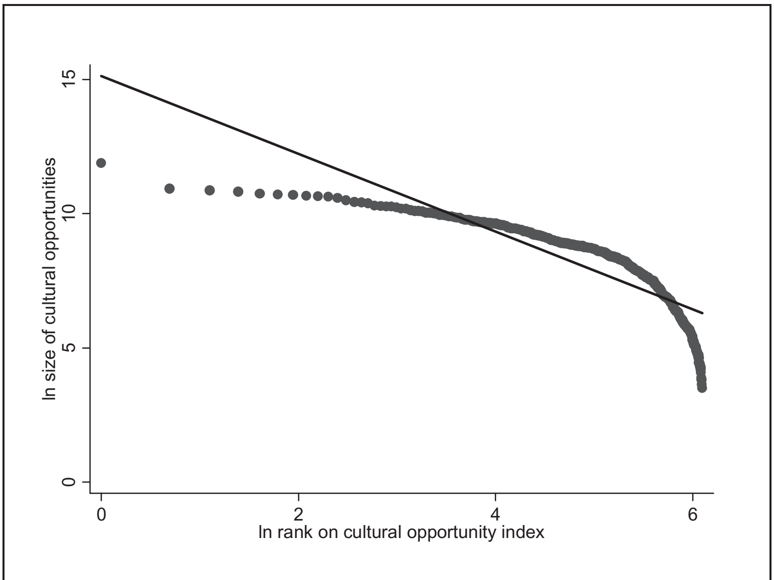
A simple way to test whether the creative class's consumption influences the creative urban hierarchy is to correlate the distribution of services with the distribution of the creative class. To do so, we chose a type of consumption that has been claimed to be particularly important to the creative class: cultural services. We calculated a cultural opportunity index for the European cities, measuring their economic activity in restaurants, cafés, entertainment, museums, and so on (for details, see Appendix A). The distribution of this index across European cities correlates well with the distribution of the creative class: a Pearson's r value of 0.8202. This correlation is better than the correlation of the cultural opportunity index with the general European population, which has a Pearson's r value of 0.6887. Both correlations are significant at a high level ($p = 0.01$).

With such a strong and significant correlation of the presence of cultural opportunities and the European creative class, we can confirm the hypothesis that specialized consumption in the guise of cultural offerings influences the European creative urban hierarchy in a more powerful way than it influences the general population.

To investigate the effect of such influence, let us look closer at the distributions of the creative class and cultural services. Hypothesis 1 suggests that there may be minimum market sizes for particular services that are demanded more by the creative class than by the general population. If this hypothesis is true, it would explain the dramatic (negative) growth of the exponent in the tail city phase of the creative class's distribution and hence account for the creative class's higher (more negative) overall exponent compared to that of the general population. Figure 3 presents the distribution across European cities of the cultural opportunity index. Evidently, one more rank-size distribution is observed here—one that we can split into three phases with different exponents. The exponents, fits, and thresholds of the phases are presented in Table 3.

This exercise illustrates the minimum efficient market sizes for cultural services in Europe. There is a notable drop-off of the cultural opportunity index, as well as its exponent, from the middle phase to the tail phase. In the tail phase, many cities have too few creative inhabitants to constitute sufficient consumer bases to sustain the specialized services that are demanded by the creative class.

The effects are much more profound for the "canary in the coal mine" when it concerns creative consumption—the bohemians. Figure 4 shows the rank-size graph of the distribution of the bohemians across the European cities.



N = 444
Pearson's *r*: –0.8613***
Slope coefficient: –1.4474**
** 0.05 significance level (two-tailed).
*** 0.01 significance level (two-tailed).

Figure 3. The rank-size distribution of European cities' cultural opportunity index (2000).

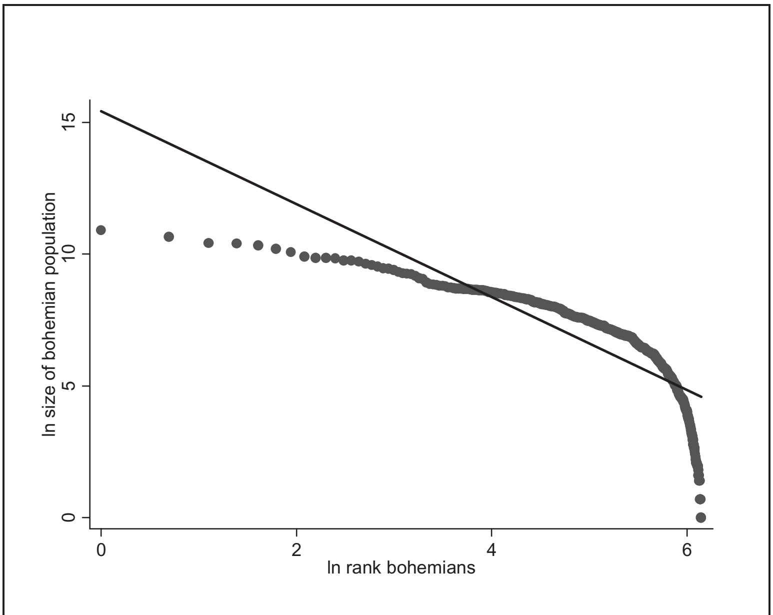
Table 3

Fit, Exponents, and Thresholds of Phases of the European Cities' Cultural Opportunity Index (2000)

	All Regions	Top Regions	Middle Regions	Tail Regions
Pearson's *r*	–0.8613***	–0.9739***	–0.9572***	–0.9628***
Slope coefficient	–1.4474**	–0.4702**	–1.4391**	–7.9040
N		40	280	124
Lower threshold		Northamptonshire (United Kingdom) with 17,487 employees in the cultural sector	Ystad/Simrishamn (Sweden) with 878 employees in the cultural sector	

* 0.1 significance level (two-tailed), ** 0.05 significance level (two-tailed), *** 0.01 significance level (two-tailed).

This distribution can also be split up into three phases. As Table 2 shows, bohemians account for the most dramatic drop-off in the tail phase of all the distributions, with a negative exponent much higher than the total creative class and almost double that of the general population. From the middle phase to the tail phase, the negative exponent of the bohemians' distribution grows by 943 percent, compared to 815 percent for the creative class and 535 percent for the general population. Hence, the adverse effects of small numbers for the bohemians are 1.16 times those of the total creative class and 1.76 times those of the general population. Because of the bohemians' preferences for consuming even more specialized services than the rest of the creative class, this group is the first to shy away from cities with poor services (Florida 2002b, 2002c).



N = 468
Pearson's *r*: –0.8240***
Slope coefficient: –1.7606*
* 0.1 significance level (two-tailed).
*** 0.01 significance level (two-tailed).

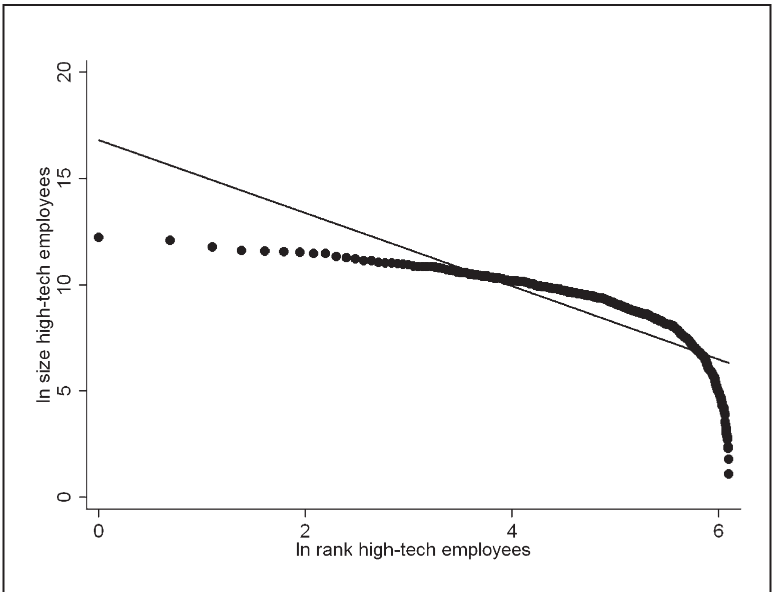
Figure 4. The rank-size distribution of European bohemians (2002).

Hypothesis 2: The Creative Class's Specialized Job Preferences

Another reason why the creative urban hierarchy has a steeper slope than the general population hierarchy may be found in Hypothesis 2: the creative class's specialized job preferences.

In the same way that we tested Hypothesis 1, we first correlated the distribution of the creative class with a proxy for specialized jobs. While the creative class works in a broad range of industries, it has, as Florida (2002a, 2002c) defined, a creative core, occupied with research and development in high-technology industries (defined as industries with high research-and-development intensities). Hence, as a proxy for specialized jobs, we constructed an index based on high-technology workplaces (for details of what we included as high technology, see Appendix A). The distribution of the high-technology index across European cities correlates well with the distribution of the creative class: a Pearson's r value of 0.8812. This correlation is slightly better than the correlation of the high-technology index with the general European population, which has a Pearson's r value of 0.8374. Both correlations are significant at a high level ($p = 0.01$).

The presence of the creative class in European cities correlates even better with the presence of high-technology workplaces than it does with cultural services (which had a Pearson's r value of 0.8202). Hence, specialized job preferences in the guise of preferences for high-technology jobs may well influence the European creative urban hierarchy. However, it also seems that such preferences are largely shared by the general population, since the differences in correlation are modest. This means that although we can support the hypothesis that specialized job preferences in the guise of preferences for high-technology jobs influence the European creative urban hierarchy, there is no strong



N = 444
Pearson's *r*: –0.8243***
Slope coefficient: –1.7202*
* 0.1 significance level (two-tailed).
*** 0.01 significance level (two-tailed).

Figure 5. The rank-size distribution of European cities' number of high-technology workplaces (2000).

support for claiming that a preference for specialized high-technology jobs is the factor that makes the *overall* creative urban hierarchy look different from that of the general population hierarchy.[9]

However, when we look more closely at the tail ends of the distribution of the creative class and the high-technology job workplaces, the picture changes remarkably. Figure 5 plots the distribution of the number of high-technology workplaces in European cities.

The distribution of high-technology workplaces in European cities follows a rank-size rule and demonstrates three phases with different exponents. The exponents, fits, and thresholds of the phases are presented in Table 4.

There is a dramatic drop-off of high-technology workplaces at the tail of the distribution: the negative exponent of the distribution of high-technology workplaces grows by 885 percent from the middle phase to the tail phase. Following our analogy to Christäller's (1933) argument (presented earlier), we can explain this drop-off by virtue of market thresholds. In the tail phase, we begin to see the effect of labor market thresholds because cities here have too few members of the creative class to constitute viable labor markets for high-technology jobs. The dramatic drop-off of high-technology jobs in the tail end of its distribution coincides with the equally dramatic drop-off of the presence of the creative class in the tail end of the latter's distribution. This finding suggests, but does not prove, that there may be a particularly strong effect of the creative class's preferences for

[9] Our proxy, high-technology jobs, is only part of the story. There are many other specialized types of jobs that may disappear with a declining city size and may effect the distribution of the creative class more than the general population.

Table 4

Exponents, Fit, and Thresholds of Phases of the European Cities' Number of High-Technology Workplaces (2000)

	All Regions	Top Regions	Middle Regions	Tail Regions
Pearson's *r*	−0.8243	−0.9867***	−0.9602***	−0.9496***
Slope coefficient	−1.7202*	−0.5126**	−1.6876**	−14.9251
N		41	295	108
Lower threshold		Franken (Germany) with 33,567 employed in the high-technology sector	Visby (Sweden) with 910 employed in the high-technology sector	

* 0.1 significance level (two-tailed), ** 0.05 significance level (two-tailed), *** 0.01 significance level (two-tailed).

high-technology (and other specialized) jobs and that this effect is partly a cause of the differences in the distributions of the European general population and the creative class.[10]

Discussion

In this section, we discuss a few alternative explanations for the differences between the creative urban hierarchy and the general population hierarchy.

Slope, Proportional Growth, and Social Networks

We used arguments of centrality (about market thresholds for creative services and jobs) to explain why the distribution of the creative class has a steeper slope than that of the general population. However, there are, of course, alternative explanations. One such explanation focuses on social networks.

If we accept proportionate growth as a general explanation for rank-size distributions (and, as we discussed earlier, this is not an unproblematic explanation), the argument for the rank-size distribution of the creative class in this case is "creative begets more creative": cities with a higher number of creative people are particularly good in attracting more creative people. The social network theory (e.g., Wasserman and Faust 1994; Burt 1992; Barabási, Albert, Jeong, and Bianconi 2000; Barabási 2002; Watts, Dodds, and Newman 2002) offers some insights into why creative people would be particularly good in attracting each other. In accounting for how networks grow, this theory outlines the principle of preferential attachment: the nodes with the most preexisting links to other nodes are strongest in attracting new links (Barabási 2002). Where network nodes are people and network links consist of social relations, ceteris paribus, the larger the population of a city, the more social relations it will have to outside people. Because the number of moves to a city is often proportional to the number of social relations between old and new or potential residents (Gans 1962; Tilly 1990; Granovetter 1995; Portes 1995; Gold 2001), bigger cities, which have more network relations, attract the most newcomers. In this social network perspective, the reason why the creative class has a high proportional growth is that creative people are often the network nodes with the most links (not the least because much creative work is organized in temporary projects [Lorenzen

[10] Because the tail ends of the distributions of high-technology workplaces and the creative class do not necessary contain the same cities, they cannot be readily compared.

and Frederiksen 2005]), and hence a particularly high potential for attracting more creative people (Uzzi and Spiro 2005; Powell, White, Koput, and Owen-Smith 2005).

The growth of the number of members of the creative class in a city may not just be due to *geographic* mobility; it may also be due to *job* mobility. For example, an information technology (IT) engineer who is hired by a big corporation to do development work instead of maintenance, a graduate who is starting his or her own company, or a writer who is finally realizing his or her artistic aspirations by getting a manuscript published in effect shifts job type into the creative class category. For this type of growth of the creative class, the importance of social networks also causes a significant proportionate growth of the bigger cities: cities with more networks yield the most entrepreneurial opportunities (Burt 1992; Granovetter 1995; Casson and Giusta 2007). This line of argument aligns well with the observations on entrepreneurship and city growth in economic geography (e.g., Klepper 2002; Håkansson 2005).

The social network proposition should be subjected to future testing. It should also be noted that while this alternative explanation may account for the higher overall exponent of the distribution of the creative class, it does not offer much by way of explaining the differences among the exponents of the three different phases in the two distributions. Here, centrality seems a much more fruitful explanation.

Small-City Diseconomies and Political Representation

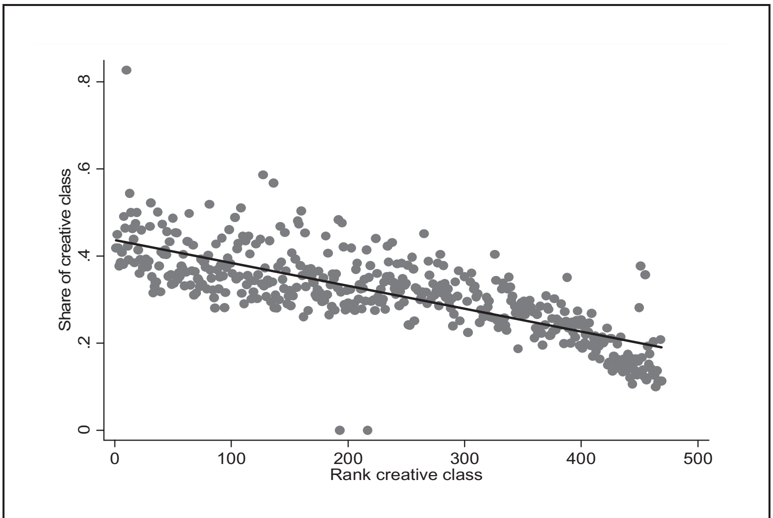
There is one possible alternative explanation for the drop-offs in the tail phase of the distribution of the creative class. Florida (2005b, 2008) proposed that the creative class is keen on influencing change and, hence, that its influence in professional and public decision making may also play a role in its choice of location.[11] May such a preference for political influence of the creative class explain the relative diseconomies of the cities with the smallest presence of the creative class (i.e., the dramatic growth of the negative exponent in the rank-size distribution)? Does the creative class shy away from small towns because it enjoys less representation there?

To conduct a tentative test of this proposition, we used the share of the creative class in the local workforce as a proxy for the strength of its influence. Ceteris paribus, the higher the share of the creative class, the higher its influence on professional, everyday, and political life, as well as on political decisions on the use of public spaces, funds, and other resources. Figure 6 shows the European cities, ranked by the *size* of their creative class, plotted against the *share* (in percentage) of their resident labor force constituted by the creative class.[12]

As we reported earlier, the distribution of the general population and the creative class are well correlated: as the population size of cities drops, so does the creative class. In Figure 6, we showed that the correlation between the size rank and the share of the creative class has a Pearson's r value of –0.7781. For city regions with the smallest creative class (ranks higher than 400), there is a clear tendency for the error terms to be negative because most observations are under the regression line. This finding indicates

[11] The fact that the creative class may influence whether public resources are used in ways that allow for and stimulate creativity, by building particular amenities, for example, of course adds to the (alleged) proportional growth of cities that have a high presence of the creative class.

[12] The reason for presenting the correlation between cities' shares of the creative class and cities' creative class size *ranks*—but not absolute sizes—is pragmatic. The correlation between size and share of the creative class has a much lower correlation coefficient. It does so because of the different scales; for example, there may be a great difference in size between a city with rank 1 and a city with rank 10 but only a small difference in size between a city with rank 101 and a city with rank 110.



N = 444
Pearson's *r*:–0.7791***
*** 0.01 significance level (two-tailed).

Figure 6. European cities' creative class size rank versus the share of the creative class (2002).

a slight drop in share—and thus the possible political representation—of the creative class for the city regions with the smallest presence of the creative class. However, since there is no significant drop-off in the share, we cannot argue that there is a size threshold under which the creative class rapidly looses political representation.

In sum, although political representation may matter, we cannot demonstrate that it should be a factor in causing the rapid drop-off of the exponent in the tail phase of cities with a small creative class. Nor does the idea of political representation offer any explanation of why we can also see a drop-off of the exponent in the tail phase of the *general population's* distribution. Centrality is again the most reasonable explanation for this phenomenon.

Large-City Diseconomies and Congestion

In our analysis, we focused on the problem of the relative diseconomies of the smallest cities—the drop-off in the tail of the distributions of the population and the creative class. However, as we outlined earlier, there is also a small drop-off in the top of the distributions. Why are there slight diseconomies of the largest cities, preventing them from enjoying the same effects of proportionate growth as the middle-sized cities do?

The explanation may simply be urban congestion. While there are scale economies of urban infrastructures up to a certain point, the largest cities, which are also the cities with the highest growth rates, may be chronically behind with respect to investing in basic infrastructures. Ironically, the most populated cities that have managed to develop world-class specialized urban functions and infrastructures, such as universities and airports, sometimes lack basic infrastructures, such as public transportation capacity and pollution control (and sometimes crime control). Even more important, housing prices and other living costs grow disproportionately in large cities with high growth rates. As Colby (1933), Myrdal (1957), and Hirschman (1958) argued, such urban congestion serves to spread or "centrifuge" growth from large cities, and we may trace such centrifugal effects in the drop-off in the rank-size exponent in the top of the distributions of the population and the creative class.

Our data did not allow us to test whether congestion is the reason for large-city diseconomies. It was not possible to obtain data on land rents, pollution, traffic delays, or other proxies for congestion for the European cities in our database (we could not even obtain this information for the biggest European cities). However, a range of qualitative interviews that we conducted in connection with our survey did exemplify members of the creative class who, in their choice of location, balance the diversity in services and job offers of the largest cities against congestion (Andersen and Lorenzen 2005, 2009; Andersen, Hansen, Isaksen, and Raunio 2008).

Although Florida (2002c, 2005b, 2008) presented no empirical evidence, he proposed that the creative class, who have higher average incomes and more frequently work in temporary projects and shifting workplaces (Lorenzen and Frederiksen 2005), may be more geographically mobile than the general population. However, our data provide no indication that congestion effects in the largest cities counteract the growing attractiveness of city size most for the creative class: the diseconomies of the top cities are about the same magnitude for the general population and for the creative class.

Conclusion

This article has brought one of economic geography's longest-standing problems, urban hierarchy, together with one of its newest, most hyped, and most criticized ones, the creative class. Using a novel original database of 444 European cities in 8 countries, we departed from the usual approach in regional science and analyzed both the urban hierarchy of the general European population and the creative urban hierarchy of the distribution of the creative class. Although some of Florida's claims about the creative class may be unsubstantiated, we wanted to investigate whether analyzing the distribution of the creative class offered any new insights into the urban hierarchy problem. We found that it did: even if the European creative class is a subset of the total European population, the urban hierarchy of the European general population and the urban hierarchy of the European creative class are quite distinctive. The rank-size distribution of the creative class indicates a greater proportionate growth (it has a steeper overall slope) than that of the general population's and the slope across the creative class's distribution suggests that it has greater diseconomies of small cities.

We developed and tested two hypotheses that combined Christäller's idea of centrality with Florida's idea of creativity.

1. *The creative class's specialized consumer preferences influence the creative urban hierarchy* because of market thresholds for creative amenities and services. We found a good correlation between the distribution of the creative class and an index for specialized cultural services, as well as clear lower thresholds for cultural opportunities, which we argued (partly) accounts for the dramatic transition of the distributions of both the total creative class and its most critical consumers, the bohemians, into tail phases with strong diseconomies (strong negative exponents). Owing to these influences upon the creative urban hierarchy, we accepted the hypothesis as true.
2. *The creative class's specialized job preferences influence the creative urban hierarchy* because of labor market thresholds for creative jobs. We found an even better correlation between the distribution of the creative class and an index for specialized jobs and a noticeable lower threshold for these jobs, and we argued that this finding partly explains the strong negative exponent in the tail end of the distribution of the creative class. Owing to these influences upon the creative urban hierarchy, we also accepted this hypothesis as true.

In addition, we briefly discussed some alternative explanations for the distribution in the European creative urban hierarchy: the creative class's social network structures, big-city congestion, and the creative class's alleged search for political representation.

Although the article does not provide answers to the pending questions regarding urban hierarchy, it offers some new insights. Concerning the question of the slope of rank-size urban hierarchies, it demonstrates that whereas urban *total population* hierarchies approximate an exponent of −1, it makes sense to study *other* hierarchies that are embedded in population hierarchies because they may have other exponents (in our case, the creative urban hierarchy did). Furthermore, the article proposed that rather than cut off the lower tails of urban hierarchies and ponder cities' "birth into the rank-size system" (Simon 1955), regional scientists could instead study transitions between different phases, all within the same system. Instead of cutting off the lower tails of distributions, we divided them into phases with different exponents. Consequently, we were able to capture the fact that even if some rank-size distributions may have similar *overall* exponents, they may still behave differently near their tail and top. We can imagine distributions of other social phenomena with phases that all follow the rank-size rule, but

with different exponents. For example, among the richest or poorest few of a country's population, wealth may attract more wealth in a much more dramatic way than is the case for the middle class. Students of such phenomena should not seek to cut off the lower tail of observations but instead find the transitions between the phases with different exponents.

To explain *why* the distributions of the European population and the creative class exhibit different phases, particularly lower phases with strong negative exponents, we applied Christäller's (1933) insights, analyzing market thresholds for specialized consumer services and for specialized types of jobs. However, we departed from Christäller's strong assumption of uniform preferences and assumed instead that the market thresholds for the services and jobs preferred by the creative class systematically differ from the thresholds for less specialized services and jobs and consequently exert an influence on the creative urban hierarchy. In short, leaning on both Christäller and Florida, we argued that centrality exerts a strong influence on urban hierarchies of creativity.

Appendix A

The Database and the Definitions Used

The data used in this article are the result of a common European project with participation from Denmark, Finland, Germany, the Netherlands, Norway, Sweden, Switzerland, and the United Kingdom. We chose countries with a high level of economic development for reasons pertaining to the availability of data to avoid large effects of different political regulation regimes upon the distribution of the creative class and problems in integrating data from economically less-developed countries with high urban primacy with countries with more perfect rank-size urban hierarchies (for problems of incorporating less developed countries into such data sets, see Soo 2005).

Partners from all of the countries participated in developing the variables in the data set to ensure the best possible homogeneity among the European countries and possibilities for comparability between European and North American analyses of the creative class. The source of the data varies among the European countries. Data for the Nordic countries (Denmark, Finland, Norway, and Sweden) are register data supplied by the national statistical bureaus, containing accurate information on the whole population. For the remaining countries, data are national census data supplied by the national statistical bureaus, containing information on a substantial and representative sample of the national populations.

To ensure comparability among the European countries, the city region is used as the unit of analysis. Although the European countries use slightly different definitions of a city region, all of the definitions correspond to Eurostat's NUTS 4 regions. NUTS 4 (which after 2003 are called "Local Administrative Units, level 1") are, in fact, not administrative but functional regions that should capture metropolitan regions akin to those used by Florida (of course, there are subtle differences between EU countries in how NUTS4/LAU1 are defined statistically). Hence, the NUTS 4 region is an appropriate regional unit for minimizing cross-regional travel-to-work and other spillovers. The majority of people living in one NUTS4 region are likely to work and use the services in that region.

The point of departure for each variable in the data set is the indicators that Florida (2002c) developed and presented in his analyses of the creative class. This article uses the following variables:

- *Population*: number of all inhabitants (residents).
- *The creative class*: the share of the employed residents within creative professions defined by the ISCO codes 245 (journalism, art, and writing), 3131 (work with sound, light, and pictures related to photography, film, and theater), 347 (work in art, entertainment, and sports), 521 (modeling), 211 (work in physics, chemistry, astronomy, meteorology, geology, and geophysics), 212 (work in mathematics and statistics), 213 (IT planning and development), 214 (architecture and engineering), 221 (work in biological natural science), 222 (work in medicine, odontology, veterinary science, and pharmaceuticals), 231 (university and college teaching), 232 (high school teaching), 233 (elementary school teaching), 234 (specialty teaching), 235 (other work related to education), 243 (work related to information and the distribution of culture), 244 (work in social sciences, humanities, and high-level social work), 247 (work related to administration of the law within the public sector), 1 (high-level management), 223 (midwifery and high-level nursing), 241 (work related to the organization and economy of business), 242 (work in law), 31 (technical work in nonbiological areas), 32 (technical work in biological areas), 341 (high-level sales and marketing), 342 (business services), 343 (administrative work), 345 (work related to police investigation), and 346 (work related to social guidance and care).
- *Cultural opportunity index:* the number of employees in a city region working in industries with NACE 553 (restaurants and related activities), NACE 554 (bars, nightclubs, cafés, and related activities), NACE 921 (film and video), NACE 922 (television and radio), NACE 923 (other entertainment), NACE 925 (libraries, archives, museums, and other cultural activities), and NACE 926 (sports).
- *High-technology jobs*: the share of the employees in the city region who work in high-technology industries defined as the NACE codes 244 (manufacture of pharmaceuticals, medicinal chemicals, and botanical products), 300 (manufacture of office machinery and computers), 321 (manufacture of electronic valves and tubes and other electronic components), 322 (manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy), 323 (manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods), 331 (manufacture of medical and surgical equipment and orthopedic appliances), 332 (manufacture of instruments and appliances for measuring, checking,

testing, navigating, and other purposes, except industrial process control equipment), 333 (manufacture of industrial process control equipment), 334 (manufacture of optical instruments and photographic equipment), 335 (manufacture of watches and clocks), 341 (manufacture of motor vehicles), 342 (manufacture of bodies [coachwork] for motor vehicles and manufacture of trailers and semitrailers), 343 (manufacture of parts and accessories for motor vehicles and their engines), 353 (manufacture of aircraft and spacecraft), 642 (telecommunications), 721 (hardware consultancy), 722 (software consultancy and supply), 723 (data processing), 724 (database activities), 725 (maintenance and repair of office, accounting, and computing machinery), 726 (other computer-related activities), 731 (research and experimental development in the natural sciences and engineering), 732 (research and experimental development in the social sciences and humanities), 742 (architectural and engineering activities and related technical consultancy), 743 (technical testing and analysis), and 921 (motion picture and video activities).

- The creative class is further divided into three subgroups:

The creative core: the share of the employed residents within specific (technical or educational) creative professions defined as the ISCO codes 211, 212, 213, 214, 221, 222, 231, 232, 233, 234, 235, 243, 244, and 247.

The creative professionals: the share of the employed residents occupied within specific (generic or managerial) creative professions defined as the ISCO codes 1, 223, 241, 242, 31, 32, 341, 342, 343, 345, and 346.

Bohemians: the share of the employed residents within specific (artistic) creative professions defined as the ISCO codes 245, 3131, 347, and 521.

Appendix B

The Methods Used in Calculating and Plotting the Distributions

A rank-size distribution is a correlation of the size of a variable for a group of observations with the rank of those observations on the same variable. We used a mainstream method (see, e.g., Gabaix 1999; Gabaix and Ioannides 2004) to calculate and plot the distribution of the creative class, the total population, cultural services, and high-technology jobs among the 444 European cities.

All of the cities were ordered by the value of the observation (i.e., of the number of members of the creative class, the total population, those employed in cultural industries, and those employed in high-technology industries—for definitions, see Appendix A). The largest observation was given rank 1, the second largest rank 2, and so forth. We plotted the values as a graphic plot, placing the log of the rank on the *y* axis and the log of the size of the corresponding observation on the *x* axis. As Gabaix and Ioannides (2004, 6) noted, perfect rank-size distributions should then appear as "something very close to a straight line." This is an indication that the distribution is scale free (Barabási and Albert 1999).

One may choose to cut off the lower tail of observations if it has no scale-free distribution to obtain a fit to a rank-size rule (Gabaix 1999)—or, as in the case of our analysis, in which no cutoff was made, it may be necessary to split up the distribution into phases with a better fit to the rank-size rule. We chose to divide our distributions into three phases because they all exhibit a clear tail phase with a negative deviation relative to a perfect rank-size rule, a middle phase with a positive deviation, and a top phase with a negative deviation.

We cut off at the point where the error term of the observations shifts sign, that is, the top and bottom of the middle phase is defined by the shifts of the error term from positive to negative. This statistical method is not aimed at optimizing the statistical fit of each phase to the rank-size rule (the method for doing so would be more complex); rather, it is meant to be a simple way of ensuring that we can compare the three phases and their fits across different analyses, such as comparing the cutoff points and fits of the total population to those of the creative class. The number of observations in each phase of the distributions is not so small as to cause any statistical problems (e.g., the smallest phases are the top ones, where $N = 39$ and 46 for the total population and the creative class's top phases, respectively).

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