Cities as Hierarchists or Specialists?

Evidence from Occupational Profiles

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Abstract

Urban geographers conceptualize the distribution of economic activity across city systems in terms of hierarchy, where functions are related to size, and specialization, where places compete against each other for functional primacy. Using occupational data, we explore the salience of each for U.S. metropolitan areas. We find that large, urbanized places — including “world cities” and “second tier cities” of 1 million workers or more — are disproportionately endowed with financial, legal, science and technology, and arts occupations. But apparent hierarchy by urban size masks considerable occupational diversity among similarly-sized metros, revealing specialization and competition among places over functional mix. World cities Chicago, New York, and Los Angeles reveal highly differentiated specialization. By showing that urban occupational structures are shaped by both hierarchical and specialization processes, our findings suggest that economic development assistance might successfully be targeted to specific economic functions as well as underwriting generic growth approaches.

I. Introduction

Urban geographers have for a long time attempted to conceptualize the patterns by which economic activities are distributed across cities within a single nation. Two starkly different approaches have dominated this discourse: one where cities hold their place within an urban hierarchy in which functions become increasingly elaborated as size increases; and as specialists, where cities compete against each other for primacy in various functions. The hierarchical view is rooted in central place theory dating back to Christaller and Lösch; it sees cities as serving predominantly their hinterlands, even if these (today) span continents and oceans. The specialist view finds its intellectual origins in sequential eras of international trade theory (Ricardo, Heckshur and Ohlin, Krugman and Venables) which posits that regions specialize according to their comparative advantages and relative factor endowments, especially in activities with increasing returns to scale. The former envisions a world of relatively dispersed urban hierarchies where each city's markets are distance-sensitive. The latter depicts a world in which successfully specializing cities are able to serve markets around the globe and whose regional and proximate markets are relatively less important in explaining their overall size and economic complexion.

Through the mid-20th century, urban geographers demonstrated that the hierarchical theory was relatively consonant with American and European urban patterns (e.g. Borchert and Adams 1963). Given the heightened pace of trade and economic integration of the latter decades of the century, however, we hypothesize that hierarchical

theories are no longer sufficient and that specialization explains a relatively high degree of metropolitan economic differentiation.

In this paper, we probe the relative salience of each of these views by examining American metropolitan economic functions at the end of the 20th century. We characterize urban functional profiles in terms of their occupational rather than industrial structure. We show that some functions are indeed related to size while others are spatially skewed among metros of similar size and thus contested among cities. From these data we suggest that some metros have been much more successful than others at capturing certain functions and generating and/or attracting workers in these spheres of activity. Our results suggest that policies targeted on attracting and retaining firms and workers in particular activities may be more important than more generalized urban growth approaches.

II. Hierarchy versus Specialization in Theory and Practice

Theories of hierarchy and specialization have coexisted within economic geographic thought despite their differential interpretations of how urban economies develop and the extent to which urban economic structures can be influenced. A brief review of these theories and their practical implications lead us to competing hypotheses about whether we can expect cities to act as hierarchists or specialists with regards to their functional specializations.

As mentioned, theories of urban hierarchy have their origin in the central place theories of the early 20th century. These theories held that the location of different economic activities could be predicted by the size and nature of the market for the particular good or service. Central place tendencies were believed to be most important in activities that pertained to consumer markets, such as retail trade and services like legal services, health care, etc. The more specialized the activity and the larger the scale economies for it, the more likely it would be found in larger, higher-order urban centers. In contrast, more routine, less specialized activities with modest scale economies would be distributed more ubiquitously across the urban landscape. For example, primary medical care would be distributed relatively evenly, while difficult surgical procedures and medical specialists would be found in central places that allowed access to and from adjacent hinterland areas, resulting in sufficient demand for the specialized offerings.

Two recent strands of economic geographic literature exhibit influences of urban hierarchical theories. Noyelle and Stanback (1984) found that a system of cities had emerged as a result of the rapid growth of producer service activities beginning in the 1970s. In particular, they noted the prevalence of nodal places of varying scales (national, regional, subregional) and their specialization around intermediate (distributive and corporate complex) services such as transportation and communications, wholesaling, finance, and business services (p. 53). Their analysis of industrial structure by urban size found that the data "demonstrate(s) conclusively that industrial composition is influenced by the size of SMSA" (p. 58). Similarly, Esparza and Krmenec (1996)

found that geographic markets for producer service activities were hierarchically based, with larger metros serving broader markets than smaller metros.

A related body of literature in the hierarchist vein emerged in the late 1980s and 1990s around the so-called "world city hypothesis" (Friedmann 1986). This theory suggested that global integration of economic activity would result in a new spatial division of labor and hierarchy among urban places. "World cities" like London, New York City, and Tokyo would increasingly serve as global centers of corporate control activities that interface with their respective national and regional chains of production. Their "hinterlands" in this case would be far-flung and hemispheric. Both the producer service and world cities literatures stress the agency of multi-establishment, multinational corporations in the emergence of spatial and functional urban hierarchies (Noyelle and Stanback 1984; Lyons and Salmon 1995).

Based on the hierarchical view, one would expect to find regularities in the economic structure among cities of similar size. Further, it implicitly consideres the relationship between urban size and functional specialization to be deterministic in nature. In other words, cities would have relatively little opportunity to intervene to influence changes in their industrial and occupational specializations over time. Their policy options would be constrained to general growth agendas designed to help them ramp up in size (e.g. better business climates, urban redevelopment).

In contrast, specialization theories emphasize the interrelated nature of urban and

regional economies within a broader global competitive framework. Regions trade with one another in the goods and functional areas in which they enjoy a comparative advantage relative to other regions. Grounded in the classical trade theories of Ricardo, subsequent neoclassical frameworks (e.g. Heckscher-Ohlin-Samuelson), and more recent "new trade" theories (Krugman 1990), this approach suggests that regional specializations are based on scale economies that enhance productivity and that these can to some extent be "constructed." For regional planners and leaders, then, nurturing and maintaining particular specializations enables them to find niches within an increasingly competitive and integrated global economy.

With the specialist view of urban economies, one would expect to find substantial variation in the functional composition of urban economies of the same size. Compared to the deterministic nature of urban function within the hierarchical view, specialization would be stochastic in nature, with considerable irregularity from place to place. And while increasing returns and "first mover" advantages would imply a degree of durability in regional specialization over time, it is also likely that specializations could change and shift over time. Such "footloose" tendencies suggest that economic development efforts could work to shape a region's functional specializations in ways that benefit its development path.

A third hypothesis is that hierarchical and specialization tendencies are not mutually exclusive but rather coexist within different functions in the economy. In this view, the distribution of some functions across urban places would be tied to the size,

while others would exhibit specializing tendencies that skew their distribution across urban economies. In this case, planners and policy makers would want to know which functions exhibit hierarchical tendencies and show a tendency to specialize between places based on factors other than urban size.

If some functions tend to distribute themselves hierarchically and others do not, then the question of whether cities are hierarchists or specialists depends on the nature of their occupational specializations. To the degree that urban places exhibit specializations that are consistent with other places of similar size, then they can be considered hierarchists. But to the extent that they have occupational profiles that deviate substantially from the norm for their size, one can infer that those places have been successful in developing and nurturing advantages around particular specialized functions.

III. Methodology

The functional activities of a regional economy are best reflected in its occupational composition. Unlike industrial data, which characterize what regions make, occupational data characterize what regions do (Thompson and Thompson 1985). This "occupational frame" (Authors, 2003) is increasingly important as diverse activities (administration, R&D, production, distribution, sales) of multi-unit corporate entities within an industry become increasingly segregated spatially.

To analyze the interregional distribution of occupational/functional activity, we examine published data from the U.S. Bureau of Labor Statistics, Occupational Employment Statistics (OES) series, for the year 2000. The OES is an annual survey of approximately 400,000 establishments in industries covered by federal unemployment insurance programs. Occupational employment and wage estimates are published at the national, state, and metropolitan (MSA/PMSA) level for over 700 detailed occupations in 22 major occupational categories[1] included in the Standard Occupational Classification (SOC) system.

Because OES data are collected from business establishments, data on self-employed individuals within occupations are not included in these totals. While the survey uses alternative sources to estimate employment in certain occupations with strong tendencies toward self-employment (e.g. dentists), others, such as farmers, are much more underrepresented in OES than in population-based sources such as the decennial Census or Current Population Survey. Farm occupations are included in the OES survey but are counted only when they occur in non-farm establishments. Thus because the OES is an establishment-based source, it measures the occupational characteristics of *jobs* within the economy and not necessarily of *workers*.

We calculate employment specialization coefficients (location quotients or LQ's) for detailed occupations and occupational groups in 203 metros across five size groups based on employment level — under 250,000 (N=111), 250–500,000 (N=33), 500,000–1

million (N=33), 1–4 million (N=23), and over 4 million (N=3) (Table 1). The 203 metropolitan areas represent roughly three-fourths (74%) of total United States employment in the OES survey, and approximately 88% of employment in metropolitan areas. Data for 137 metropolitan areas, almost exclusively smaller ones with less than 250,000 in employment, were excluded from this analysis due to data deficiencies.[2]

Location quotients were calculated by dividing the occupation's share of total metropolitan employment by the occupation's employment share nationally. In addition to calculating the LQ's for the specific metropolitan areas, occupational specialization by urban size group was calculated by summing across metropolitan areas where occupational data were published and dividing by the total employment in those metros.[3]

In the analysis that follows, we examine whether the distribution of occupational employment exhibits tendencies to cluster hierarchically, with specialized functions becoming more pronounced with urban size. We then examine whether aggregate measures of occupational concentration by urban size reflect homogeneity or heterogeneity among cities of similar size, testing the robustness of hierarchical tendencies. And finally, we explore the special case of the United States' three "world cities" — New York, Los Angeles, and Chicago — to determine the degree to which they exhibit similarity in their occupational profiles.

IV. Evidence for Hierarchy by Function

Economic functions, as reflected in occupational composition, do sort themselves out by metro size, although not necessarily monotonically. For 16 of the 22 occupational groups shown, at least one metro size group accounts for ten percentage points more than the per employee average for all metros (Table 2). Of greatest interest to us are those occupations toward the top of the table that distinctly more clustered in metropolitan areas than in smaller cities, towns and rural areas. Computer specialists and mathematicians are among the most cosmopolitan of workers, followed by law, business and finance, arts/sports/media workers, and architecture and engineering occupations.

The most revealing pattern from Table 2 is the failure of the largest metro areas to dominate across-the-board the more specialized occupational groupings, as central place theory posits. The world metros of New York, Los Angeles and Chicago, each with more that 4 million covered workers in 2000, do excel in seven occupational groups, in order of prominence: arts/entertainment/sports/media, law, protective services, business and finance, community and social services, office and administrative support, and personal care. But they are outclassed by the second tier metros, those with between 1 and 4 million employees, among computer professionals and mathematicians, architects and engineers and life, physical and social scientists. These occupations form the heart of the "high tech" phenomenon. Their concentration in second tier cities provides evidence for the contention that these cities are winning in a competition for high tech against the world metros. We caution, however, that MSA definitions place in the second tier group suburban metros such as Silicon Valley, Orange County, and Middlesex/Somerset, NJ

that are really portions of world city conurbations. We return to this issue below.

Mid-sized metros, of 500,000 to 1 million in employment, show little deviation from the all metro average (they account for 24% of metro employment) while the two smaller metro groups specialize in education, library and training, perhaps due to large numbers of small colleges around the country; in health care occupations, perhaps reflecting retirement communities; and in production, food preparation and farming, forestry and fishing-related occupations.[4] Production occupations are under-represented in metropolitan areas in all but the smallest size group, a finding consistent with the trend toward ruralization within manufacturing. Although the non-inclusion of self-employment renders the farming/fishing/forestry occupational count quite problematic, the analysis does confirm a tendency for the smallest metros to be heavily specialized in resource-related activities.

The majority of the occupational groups in Table 2 show no or minimal tendency to rise in concentration with size of metro. Five occupational groups closely correlate with metro workforce (location quotients at or near 1.0) and can thus be considered primarily residentiary: food preparation and serving workers; installation, maintenance and repair workers; building and grounds maintenance workers; office and administrative support occupations and sales workers. A second set of occupations are only very moderately skewed: construction, healthcare practitioners, transportation and management occupations. We pay less attention to these in the rest of our paper, because

they exhibit neither hierarchy nor specialization. However, in certain cases, we show that more finely-drawn occupations within the larger groupings are candidates for interest.

Are there occupations that uniformly increase their over-representation with metro size? At this relatively high level of aggregation, only law, business and finance, and the arts/sports/media occupations exhibit a clear pattern. If we roll the world metros in with the second tier metros, the three high tech occupational groups would also warrant inclusion. These six occupational groups, then, can be considered hierarchically ordered and present in "national cities." They form the core of the analysis which follows.

Before leaving this metro size theme, it is worth looking more closely at the extent to which bulky occupational groupings obscure significant differences at the more finely-drawn occupational scale. Our working hypothesis was that greater disaggregation would reveal both more hierarchical and more competitively specialized functions than we have discovered so far. The results of the analysis at the detailed occupational level confirm our hunch. For selected occupations within the key six occupational groups,[5] location quotients far exceed the group ratio, and their distribution across metros often diverges from that of their parent group (Table 3). Thoroughly hierarchical occupations include medical scientists, financial analysts and personal finance advisors, architects, and several that are related to the arts and media. Occupations favoring second tier cities include technical writers, electronic engineers, management analysis and economists, as well as all the computer-related professional occupations.

Some occupations spurn second tier metros but favor those either larger or smaller. Among the former are two arts occupations — actors and musicians — and three occupations associated with film, TV and recordings (camera operators, film and video editors and sound engineering technicians). Actuaries form another occupation under-represented in second tier cities and skewed towards mid-sized and smaller metros.

Of perhaps greatest interest, and most problematic for hierarchical theorists, are occupations that are decidedly anti-hierarchical. In Table 3, these include petroleum engineers, geoscientists and atmospheric, space scientists and landscape architects, who while highly urbanized might be expected to favor to resource-based or environmentally sensitive metros. But it also includes microbiologists, statisticians, choreographers, music directors and composers whose gravitational attraction toward smaller metros is not easily explained.

Caution should be used in interpreting these findings, because not all metros are covered in the analysis. The smaller the metro, the more apt it is to be excluded in the count for a particular occupation; thus high LQs at the 500,000 or less level are over-representations of selected metros. But they confirm that at least some metros in these size groups host unusually large concentrations of key occupations. In what follows, we probe the extent to which metro members of each size range deviate from the norm from their group, an excellent test of the robustness of our tentative finding for hierarchical functions in this section.

V. Specialization within Hierarchy

The analysis of functional hierarchy by metropolitan size in the previous section implicitly assumes that similarly sized cities will exhibit similar occupational profiles. To the extent that they do, we can feel more confident about the robustness of apparent urban hierarchies and can treat each layer as more or less generic, as Noyelle and Stanback do in their typology. But if substantial occupational diversity characterizes urban areas of the same size, we can conclude that size does not dictate economic function or specialization.

We measure the degree of within-group similarity by taking the standard deviation of the occupational location quotient across metropolitan areas in the size set. The higher the standard deviation, the greater the diversity or "noise" around a given sample mean. At the occupational group level for all metropolitan areas in the set, we find that computer and math, architecture and engineering, science, and production occupations show the highest levels of standard deviation, or skewness, around their average metropolitan concentration ratios (Table 4). These occupations are the most unevenly distributed across metropolitan areas. At the bottom end in terms of standard deviation are sales, office and administrative, maintenance, and installation and repair occupations, which are relatively evenly distributed across metropolitan areas of all size groups. This finding confirms the analysis in the previous section, where we found that

employment in many occupational groups exhibits minimal tendencies toward hierarchy or specialization.

Do metropolitan areas of similar size possess occupationally similar economies? We focus here on six occupations we found to be relatively concentrated in the larger urban areas: computing, engineering, science, business and financial, legal, and arts and entertainment occupations. This group includes occupations most often associated with higher order cities in hierarchical accounts. Computer and engineering occupations are both relatively evenly distributed among very large metros of four million jobs or more but show substantial variation within second-tier metros (1–4 million) and very small metros (less than 250,000) (Table 5). Science occupations are very evenly distributed among the largest urban areas, but even more unevenly so among each of the smaller subgroups. This may reflect patterns of technological localization among similarly sized metropolitan areas, particularly among smaller cities. High tech occupations, then, are relatively specialized in their patterns of distribution and cannot be assumed to accompany size.

Legal occupations show relatively high levels of diversity and specialization among metro areas with 1 million jobs or more, where they also happen to be the most concentrated. This is also the case for entertainment and arts occupations, which are highly concentrated in the very largest metropolitan areas but show the greatest variance within that group as well. This suggests that unusually high average levels of occupational concentration among metropolitan size groups may mask the crowding of

an occupation into a smaller number of metropolitan areas within the size group, rather than connoting a regularized tendency for larger metros to perform those functions.

Of the six occupational groups discussed here, only business and financial occupations adhere closely to the hierarchical model. While the overall level of variation in the distribution of business and financial occupations is exactly at the norm for overall occupational variation, each of the five metropolitan size subgroups show lower levels of within-group variation than in the broader metropolitan sample. This indicates that the presence of business and financial functions in metropolitan economies is strongly related to its size, with levels of occupational concentration increasing with urban size.

Are these deviations really significant in size? Knowing the absolute size and relative shares that these occupations account for in a metro's economic structure vis-à-vis others of its size group will help the reader put these deviations into perspective. We compare the absolute numbers, location quotients and surplus or deficits from the norm for computer and math occupations among the 23 second-tier cities (1–4 million in employment) in our dataset (Table 6). They show that if Riverside-San Bernardino were to possess a computing group equivalent to the average for its size set, it would have to add almost 30,000 computer-related workers, while Washington, DC would have to shed nearly 70,000 — over 40 percent — of its workforce in this occupational group. In all, over 236,000 computer-related jobs would have to be shuffled among these cities, with eight over-represented metro areas donating to fifteen underrepresented metros. These large differentials among relatively similar-sized urban areas illustrates the potential for

significant diversity to underlie aggregated data on occupational specialization by urban size.

The evidence from this analysis of similarity and dissimilarity within metropolitan size groups indicates that patterns of specialization may be more prevalent than patterns of hierarchy among occupational groups that tend to be concentrated in larger urban areas. In general it appears that high average occupational concentrations (LQ) among groups of similarly sized metropolitan areas are positively associated with within-group diversity and dissimilarity, suggesting specialization. But the exceptional case of financial occupations, which exhibit clear hierarchical patterns, shows that occupational functions can distribute themselves in a variety of ways, and that no one pattern fits for the entire range of occupations.

VI. The Special Case of New York, Chicago and Los Angeles

To what extent do the very largest metros display similar occupational structures? In the 1990s, a literature on world cities argued that certain first order cities in every nation of the world were increasingly performing the functions of globalization and thus were distinguishing themselves even more from their national counterparts, or in our parlance, second tier cities (Hall, 1966; Friedmann, 1986; Sassen, 1991). In attempting to test this characterization, others have found contrary evidence. Markusen and Gwiasda (1993) found that New York, Chicago and Los Angeles, along with Washington, Chicago

and Boston, were highly differentiated from each other, each with unique producer service specializations. Lyons and Salmon (1995) found that the three world cities were actually losing their brokering role to second tier cities. Abu-Lughod (1995, 1999) has refuted the conflation of the three economies by carefully documenting the historical, cultural and sectoral differences among the three.

Using our occupational data, we look closely at the three metros to see the extent to which the occupations identified as clustering in the world city group are present in each. We find, generally, that size does not dictate occupational structure and that the competitive, or specialization, view fits the set best.

The MSAs of New York, Chicago and Los Angeles each supported more than 4 million covered jobs in 2000.[6] For the hypothesized world city functions, i.e. those in which the world city total exhibits a location quotient above average, none but office and administrative services occupations show relative convergence (Table 7). Of the five occupational groups in which the three cities together exceed the national norm by 20%, New York in every case exceeds the world city norm substantially. Los Angeles meets the benchmark only in the arts, law and protective services, while Chicago meets it only in business and financial operations. Size, in other words, does not dictate specialization, even at this highly aggregated occupational level.

The three mega-metros are most alike in their relative deficiencies, as shown in the occupations towards the bottom of the table. Even here, though, it is dangerous to

generalize. Although New York shows very low levels of production and transportation occupations, Los Angeles outpaces the nation and all metros in transportation, while both Los Angeles and Chicago post high concentrations in production occupations.

At finer levels of occupational specification, the non-correspondence among members of the world city peer group is even more striking (Table 8). In the seventeen detailed occupations with a world city location quotient above 2.0 and where the OES contains data for all three metros,[7] very few show any degree of comparability across the three metros. Multi-media artists come closest, followed by parking lot attendants and flight attendants. For most of the others, the degree of variation from the world city norm is quite substantial. Thus these metro's specializations cannot be easily predicted from the norm for the set. Los Angeles' specializations in acting and make-up art, garment work, aerospace engineering, and certain other skilled blue collar jobs are uncontested and yet could not be predicted with any certainty by its presence in the 4 million plus size class (Authors, 2003).

Conclusion

In this paper we have explored whether the distribution of functional activities across urban economies exhibits tendencies toward hierarchy, specialization, or both. We find little evidence for nested hierarchies in which additional functions are added monotonically with size. The three largest metro areas failed to dominate across-the-

board and were especially notable for ceding high tech functions to the set of second tier metros. Production occupations favored the smallest metros, while nine additional occupations were either proportionally distributed without regard for size or modestly favored one or more intermediate size group. Only law, business and finance, and the arts/sports/media occupations uniformly increase their over-representation with as metro size increases. When we lump the three world cities with the second tier set, we find that the science, engineering and computing occupations also exhibit hierarchical clustering. This, then, is evidence for hierarchy within a modest though important segment of economic functions.

However, when we look at deviations within each size group, we find considerable evidence of specialization. With the exception of the business and finance group, these deviations are largest for the same occupations that appear to exhibit hierarchy. We infer from this that within size groups, metros are competing vigorously for various functions, as firms choose where to locate and workers decide where to live and work. For the world cities of New York, Chicago, and Los Angeles, substantial differences in their occupational profiles defy attempts to predict the occupational (and thus functional) composition of each based on its size and "global" status alone. Furthermore, when we disaggregate the occupational groups into more fine-grained occupations (engineering into civil, electrical, petroleum, mechanical, aerospace etc. engineers), patterns of hierarchy become even more complex and unpredictable, with many occupational titles exhibiting idiosyncratic or anti-hierarchical patterns.

This work does not address explicitly how the process of urban occupational specialization takes place or how urban planners and public policy makers might influence their region's occupational mix. These questions represent areas of future inquiry. Our findings on the limited ability of pure size to account for occupational composition and on the pervasiveness of specialization within size groups, especially among high tech and professional occupations, suggest that metropolitan economic development planners and policymakers should not rely on generic growth strategies alone. Regions may be able to cultivate one or more specializations, such as high tech, entertainment, or finance, by targeting economic development incentives towards the creation and retention of specialized firms and the education, attraction and rooting of certain groups of skilled workers. Additional conceptual and empirical work on this process would be very welcome.

[1] Employment estimates are generally not available for all 770 detailed occupations at geographic levels due to survey limitations and confidentiality/nondisclosure requirements. This problem is more acute for smaller metropolitan areas, where estimates for approximately 200–300 occupational titles are more common.

[2] Specifically, total metropolitan employment could not be calculated for these 137 metros, preventing analysis of occupational concentration. Total metropolitan employment was not published as part of the OES data release in 2000, but could be calculated by combining totals for the 22 major occupational groups. The metro areas were excluded due to suppression of one or more occupational group totals. As mentioned, this problem was largely confined to MSAs with employment of 250,000 or less; only 3 of 95 metros larger than 250,000 are excluded from the dataset, and none larger than 1 million.

[3] The suppression of detailed occupational employment estimates is unfortunately quite common in the OES dataset, and poses a likely source of bias in estimates for the broader size classes. For example, to the degree that occupational data are published only in metros that exhibit sufficient presence of a given occupation, it will likely result in overestimates of occupational concentration. This problem is much less prevalent at the occupational group level.

[4] Relatively high location quotients for smaller city groups toward the bottom of the table may be a compositional phenomenon. Relatively high specializations in health care support and food preparation workers for the smallest group of metros may reflect the absence of other occupations in these regional economies, lowering the size of the total employment denominator for the location quotient.

[5] In another paper, we show that finer-grained occupations in some of the other groupings are also highly skewed — garment workers in Los Angeles, roustabouts in Bakersfield, CA, personal care workers in Minneapolis/St. Paul (Authors, 2003). We counsel location state and local planners to pay close attention to occupational detail in working with economic and workforce development program design.

[6] Although both New York City and Los Angeles were part of broader consolidated metropolitan statistical areas (CMSA) that employed over 7–8 million.

[7] The OES, for suppression reasons, does not publish data where only a few establishments account for the occupation. Thus a number of occupations in which one or two world cities may be highly specialized — gaming officers and investigators in Chicago (7.00), aeronautical engineers in Los Angeles (3.63), make-up artists in Los Angeles and New York — are missing from this accounting.

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Tables

Table 1. U.S. Metropolitan Areas by Size Group, 2000

Size Group	Employment Level	N	Data Available	Share of U.S. Employment
World Cities	4 million or more	3	3	9.5%
Second-Tier Cities	1–4 million	23	23	27.3%
Mid-Sized Metros	500,000–1 million	35	33	18.1%
Small Metros	250,000–500,000	34	33	8.4%
Very Small Metros	Less than 250,000	245	111	10.8%
	Totals	**340**	**203**	**74.1%**

Source: Calculated from Bureau of Labor Statistics, Occupational Employment Statistics

Table 2. Occupational Specialization by Metro Size Class, 2000

Occupational Group	All MSAs	4m+	1–4m	500k–1m	250–500k	<250k
Computer and Mathematical	1.17	1.05	**1.56**	1.06	0.84	0.75
Legal	1.15	**1.47**	**1.26**	1.06	1.02	0.84
Business and Financial Operations	1.12	**1.26**	**1.23**	1.10	0.98	0.85
Arts, Design, Entertainment, Sports, and Media	1.09	**1.87**	1.05	0.97	0.95	0.83
Architecture and Engineering	1.09	0.79	**1.36**	0.96	0.98	0.96
Life, Physical, and Social Science	1.05	0.96	**1.26**	0.95	0.89	0.92
Office and Administrative Support	1.04	**1.14**	1.04	1.06	1.01	0.95
Management	1.04	1.09	1.11	0.97	0.97	0.95
Protective Service	1.02	**1.30**	0.97	1.06	0.93	0.91
Healthcare Practitioners and Technical	1.01	0.98	0.95	0.99	**1.11**	1.10
Sales and Related	1.00	0.92	1.01	1.03	1.01	1.02
Personal Care and Service	1.00	**1.13**	0.99	0.98	0.97	1.00
Building and Grounds Cleaning, Maintenance	0.99	0.98	0.99	0.97	1.03	0.98
Community and Social Services	0.98	**1.20**	0.87	0.94	1.05	1.06
Construction and Extraction	0.97	0.74	1.01	0.98	1.01	1.05
Food Preparation and Serving Related	0.96	0.75	0.94	1.00	1.03	**1.11**
Installation, Maintenance, and Repair	0.96	0.79	0.95	1.00	1.01	1.04
Education, Training, and Library	0.96	1.01	0.92	0.90	0.96	**1.11**
Healthcare Support	0.96	1.00	0.86	0.95	1.04	**1.12**
Transportation and Material Moving	0.95	0.95	0.90	1.01	0.97	0.96
Production	0.91	0.95	0.81	0.94	0.97	1.01
Farming, Fishing, and Forestry	0.68	0.17	0.31	0.32	**1.55**	**2.02**

Significant specializations (>10 percentage points greater than average) in boldface

Source: Calculated from Bureau of Labor Statistics, Occupational Employment Statistics

Table 3. Selected Detailed Occupational Concentrations by Metro Size, 2000

Occupational Title	4m+	1–4m	500k–1m	250–500k	All MSAs
Hierarchical					
Art Directors	2.87	1.15	1.08	1.08	1.44
Multi-Media Artists and Animators	2.48	1.21	0.81	0.98	1.32
Broadcast Technicians	2.44	1.03	1.06	0.92	1.29
Medical Scientists, Except Epidemiologists	2.43	1.34	1.03	1.00	1.53
Personal Financial Advisors	2.26	1.12	1.08	0.95	1.30
Financial Analysts	2.08	1.38	1.09	0.76	1.25
Architects, Except Landscape and Naval	1.85	1.33	1.17	0.91	1.29
Favoring Second-Tier Metros					
Economists	0.76	2.52	1.38	1.31	1.80
Computer Software Engineers, Systems Software	0.86	1.91	0.83	0.54	1.27
Computer Software Engineers, Applications	1.01	1.80	0.93	0.71	1.24
Technical Writers	0.95	1.69	0.99	0.81	1.27
Electronics Engineers, Except Computer	0.67	1.67	0.95	1.02	1.24
Management Analysts	1.08	1.57	1.08	0.80	1.20
Computer Programmers	1.19	1.50	1.16	0.84	1.18
Avoiding Second-Tier Metros					
Actors	4.77	0.51	1.89	*	1.99
Sound Engineering Technicians	3.82	0.93	1.12	1.73	1.50
Musicians and Singers	2.84	0.94	1.17	1.81	1.51
Film and Video Editors	2.49	0.95	1.25	1.59	1.31
Camera Operators, Television/Video/Motion Picture	1.94	0.91	1.27	1.28	1.27
Actuaries	1.71	1.16	2.35	2.93	1.62
Anti-hierarchical					
Music Directors and Composers	1.26	1.17	1.54	7.32	1.50
Petroleum Engineers	0.90	4.11	4.14	6.89	3.94
Choreographers	0.63	1.09	1.89	2.59	1.41
Atmospheric and Space Scientists	0.48	1.77	1.53	2.34	1.44
Landscape Architects	0.42	1.16	1.38	2.00	1.27
Statisticians	0.64	1.45	1.48	1.73	1.41
Geoscientists, ex. Hydrologists and Geographers	1.17	1.33	1.31	1.66	1.36
Microbiologists	0.72	1.41	1.69	1.48	1.38

Source: Calculated from Bureau of Labor Statistics, Occupational Employment Statistics

* Data unavailable

Table 4. Standard Deviation of Occupational Group LQs, all Metropolitan Areas, 2000

Occupational Group	Standard Deviation
Computer and Mathematical	0.65
Life, Physical, and Social Science	0.54
Architecture and Engineering	0.54
Production	0.43
Legal	0.42
Personal Care and Service	0.40
Community and Social Services	0.37
Education, Training, and Library	0.33
Protective Service	0.33
Arts, Design, Entertainment, Sports, and Media	0.33
Business and Financial Operations	0.32
Construction and Extraction	0.27
Healthcare Support	0.27
Healthcare Practitioners and Technical	0.23
Transportation and Material Moving	0.22
Management	0.20
Food Preparation and Serving Related	0.20
Installation, Maintenance, and Repair	0.19
Building and Grounds Cleaning and Maintenance	0.17
Office and Administrative Support	0.12
Sales and Related	0.12
Average Standard Deviation	**0.32**

Source: Calculated from Bureau of Labor Statistics, Occupational Employment Statistics

Note: Data for farming and forestry occupations not included due to data inconsistencies.

Table 5. Standard Deviation of Selected Occupational Group LQs, by MSA size group, 2000

Occupational Group	All MSAs	4m+	1–4m	500k–1m	250–500k	<250k
Business and Financial Operations	0.32	0.16	0.26	0.26	0.28	0.31
Computer and Mathematical	0.65	0.12	0.85	0.49	0.38	0.63
Architecture and Engineering	0.54	0.22	0.68	0.28	0.32	0.59
Life, Physical, and Social Science	0.54	0.05	0.48	0.48	0.43	0.59
Legal	0.42	0.49	0.45	0.28	0.34	0.42
Arts, Design, Entertainment, Sports, and Media	0.33	0.73	0.31	0.22	0.33	0.30

Source: Calculated from Bureau of Labor Statistics, Occupational Employment Statistics

Table 6. Variation in Computer and Math Occupations among Second Tier Cities, 2000

Metropolitan area	Employment, Computer and Math Occupations	LQ	Jobs to be added (lost) to be average for size
Riverside–San Bernardino	5,660	0.25	29,984
Detroit	47,810	1.01	26,433
Nassau–Suffolk	18,110	0.66	24,486
Philadelphia	61,570	1.15	22,104
Cleveland	19,470	0.75	21,213
Pittsburgh	21,320	0.86	17,469
Houston	58,840	1.26	14,242
Tampa–St. Petersburg	28,420	1.04	14,207
Phoenix	42,200	1.17	14,181
St. Louis	32,420	1.09	13,941
Baltimore	29,570	1.06	13,828
Orange County	35,660	1.14	13,203
San Diego	36,420	1.32	6,689
Minneapolis–St. Paul	58,720	1.50	2,568
Oakland	34,930	1.49	1,764
Atlanta	76,980	1.58	(894)
Dallas	81,530	1.78	(10,028)
Denver	53,960	2.00	(11,910)
Boston	94,100	2.05	(22,456)
Seattle	76,210	2.41	(26,892)
San Francisco	72,750	2.89	(33,442)
San Jose	99,430	4.04	(60,961)
Washington, DC	165,150	2.70	(69,731)
Average, Second-Tier Cities	**54,401**	**1.56**	
		Total jobs to be transferred	**236,313**

Source: Calculated from Bureau of Labor Statistics, Occupational Employment Statistics

Table 7. Occupational Specializations, by group, US World Cities and all metros, 2000

Occupational Group	World Cities	Los Angeles	New York	Chicago	All MSAs
Arts, Design, Entertainment, Sports, and Media	1.87	2.20	2.37	1.04	1.09
Legal	1.47	1.26	2.03	1.11	1.15
Protective Service	1.30	1.29	1.72	0.88	1.02
Business and Financial Operations	1.26	1.08	1.40	1.30	1.12
Community and Social Services	1.20	1.09	1.57	0.94	0.98
Office and Administrative Support	1.14	1.15	1.20	1.07	1.04
Personal Care and Service	1.13	0.82	1.64	0.94	1.00
Management	1.09	1.00	0.99	1.26	1.04
Computer and Mathematical	1.05	0.91	1.08	1.14	1.17
Education, Training, and Library	1.01	0.94	1.27	0.84	0.96
Healthcare Support	1.00	0.80	1.49	0.70	0.96
Healthcare Practitioners and Technical	0.98	0.97	1.01	0.96	1.01
Building and Grounds Cleaning, Maintenance	0.98	0.88	1.07	1.00	0.99
Life, Physical, and Social Science	0.96	0.94	1.02	0.92	1.05
Production	0.95	1.19	0.53	1.15	0.91
Transportation and Material Moving	0.95	1.16	0.60	1.08	0.95
Sales and Related	0.92	0.89	0.92	0.93	1.00
Installation, Maintenance, and Repair	0.79	0.84	0.70	0.83	0.96
Architecture and Engineering	0.79	0.93	0.53	0.90	1.09
Food Preparation and Serving Related	0.75	0.68	0.73	0.83	0.96
Construction and Extraction	0.74	0.66	0.73	0.84	0.97
Farming, Fishing, and Forestry	0.17	0.28	0.07	0.17	0.68

Source: Calculated from Bureau of Labor Statistics, Occupational Employment Statistics

Table 8. Selected Occupational Specializations among World Cities, 2000

Occupational Title	World Cities	Los Angeles	New York	Chicago
Fashion Designers	6.78	0.81	5.94	13.59
Sewers, Hand	3.81	1.73	6.54	3.21
Brokerage Clerks	3.38	2.18	1.72	6.22
Fabric and Apparel Patternmakers	3.19	0.40	5.00	4.20
Art Directors	2.87	2.23	1.01	5.35
Musicians and Singers	2.84	2.33	1.79	4.37
Parking Lot Attendants	2.56	1.85	2.86	2.98
Flight Attendants	2.50	3.29	1.82	2.36
Multi-Media Artists and Animators	2.48	2.53	2.14	2.78
Sewing Machine Operators	2.48	0.42	4.69	2.37
Fine Artists,Inc Painters, Sculptors, Illustrators	2.46	1.67	1.36	4.32
Broadcast Technicians	2.44	1.03	2.34	3.95
Medical Scientists, Except Epidemiologists	2.43	0.62	2.13	4.52
Watch Repairers	2.30	2.26	1.59	3.05
Securities, Commodities, Financial Services Sales Agents	2.28	1.50	0.58	4.72
Personal Financial Advisors	2.26	1.34	0.72	4.70
Financial Analysts	2.08	1.81	0.92	3.50

Source: Calculated from Bureau of Labor Statistics, Occupational Employment Statistics