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The web of production: the economic geography of commercial Internet content production in the United States

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Abstract. This paper provides a description and analysis of the clustering behavior of the commercial Internet content industry in specific geographical locations within the United States. Using a data set of Internet domain name developed in the summer of 1998, I show that three regions—San Francisco, New York, and Los Angeles—are the leading centers for Internet content in the United States in terms both of absolute size and of degree of specialization. In order to understand better how the industrial structure of a region impacts the formation of the Internet content business, I provide an analysis of how the commercialization of the Internet has changed from 1993 to 1998 and explore the relationship between existing industrial sectors and the specialization in commercial domain names. Over time there appears to be a stronger connection between Internet content and information-intensive industries than between Internet content and the industries providing the computer and telecommunications technology necessary for the Internet to operate. Although it is not possible to assign a definitive causal explanation to the relationships outlined here, this paper provides a first step in theorizing about the overall commercialization process of the Internet.

Introduction

The Internet has captured the imagination of the world with its ability to distribute information quickly on a real-time basis across the globe. Although the power of this technology opens up new possibilities for long-range collaboration, it does not, as some suggest, end the importance of place in economic organization. The emerging business of Internet content creation, which is best prepared to take advantage of the space-transcending ability of the Internet, exhibits much of the traditional unevenness that has characterized urban and economic development throughout history. The fact that information and content can be easily and widely distributed is often mistaken for an indication that the organization of this business is also necessarily diffused. In fact, there is a much more complicated dynamic involving the connection of specific places to global networks, resulting in a system of production that is both place rooted and networked at the same time.

One of the greatest challenges facing any research project involving the Internet is finding reliable and practical indicators. In particular, assigning geographical locations to what takes place on the 'spaceless' Internet is especially difficult. With this problem in mind, I outline in this paper a technique for mapping the supply of Internet content and describe the current physical geography of this production system. I then turn to an analysis of some of the factors influencing the location of this activity in certain places.

Although it is not within the scope of this paper to prove why specific nodes are emerging, there is evidence that the existing industrial structure of a region plays an important role in supporting the development of commercial Internet content production. In particular, three regions—San Francisco, New York, and Los Angeles—appear as leading centers for Internet content in the United States in terms of both absolute size and degree of specialization. Moreover, it appears that there is a stronger connection between Internet content and information-intensive industries than between Internet

content and the industries providing the computer and telecommunications technology necessary for the Internet to operate.

Explanation of data

Because of the emerging and rapidly evolving nature of the Internet, it is imperative at the outset to provide a clear definition of the commercial Internet content business. In this paper I define it as enterprises involved in the creation, organization, and dissemination of informational products to a global marketplace where a significant portion of the business is conducted via the Internet. These informational products could be the sale of physical items (for example, by eBay), the sale of digital products (for example, by CD-Now), the sale and use of services (for example, by Travelocity or Home Shark), the use of a database search engine (for example, Inktomi), or convenience of portals or destination sites (for example, Yahoo, Amazon, or AOL).

This definition purposively encompasses firms from a wide array of traditional industries because the new methods for communication and distribution offered by the Internet have a wider impact than any one particular sector. In a very real sense, these firms are actively engaged with a technology that could restructure the current organization and boundaries of their respective industries. Just as Chandler (1977) argues that technologies of the railroad and telegraph enabled the transformation of traditionally small businesses into a system of corporations, I assert that the Internet has the potential to bring about a similar reorganization of business structures. Although the exact nature of this reorganization is still undetermined, it promises to have a profound effect on the spatial organization of many portions of the economy.

Because this definition of the Internet content business is primarily based on the activities of individual firms rather than of a traditional industry as a whole, it is difficult to use standard sources of sectoral and geographically based data such as the census or county business patterns. There have been numerous techniques developed for measuring data packet flows or the infrastructure of the Internet fiber optic backbone.[1] However, these studies largely illuminate the workings of the technical geography of the Internet rather than the economic geography of the people and firms using it. For example, the criteria for selecting the computer that hosts a firm's content are based on how fast data packets can flow to the rest of the Internet. Conversely, the criteria for choosing the physical place where the content is created depend upon access to skilled labor, capital, and other services. Because these two decisions can be made separately and are based on very different criteria, it is entirely possible that a firm decides to host its content on a server farm located hundreds or thousands of miles from where it is designed and created.

Given the problem of measuring infrastructure rather than economic activity, it is crucial to find alternative indicators for economic activity on the Internet. Moss and Townsend (1997) suggest one of the most useful methods in determining the site of content creation with their technique of using the registration addresses of domain names (for example, yahoo.com or wired.com) to determine a geographical location. In many ways domain names are one of the most basic building blocks of the commercial Internet. Although actual data packets are routed by computers according to IP addresses, these numbers (for example, 169.229.39.137) are hard for human beings to remember. The domain name system was developed so that users could use the Internet

[1] For example, Gorman (1998) use Internet backbone data from the Cooperative Association for Internet Data Analysis to construct a connectivity matrix for the United States, and Cheswick and Burch (1998) use trace routes to display the connections between individual networks on the Internet. To gain a better sense of efforts to map the Internet, please consult the *Atlas of Cyberspace* (Dodge, 1998) and the Matrix Information and Directory Services (www.mids.org).

address www-dcrp.ced.berkeley.edu rather than its numeric equivalent. This system, which was originally designed as a convenience for a small number of computer specialists and academics, has now become the ubiquitous means of brand identification within the Internet content business.

Although the connection between registration addresses and production of Internet content is not necessarily straightforward, clusters of registered com domain names are arguably the best available indicators of where the Internet content business is locating. This argument is based on the following assumptions:

1. registration of a com domain name indicates a higher degree of purposeful and commercial information distribution than just surfing or e-mailing friends and family;
2. there is no inherent geographic bias in the means of registering a com domain name;
3. the registration address, particularly for newly conceived Internet ventures, corresponds to the location of the site where content creation is taking place; and
4. it is a marketing and brandname necessity for Internet content firms to have their own com domain name.[2]

Although these assumptions are reasonable, they are undercut by the phenomenon of domain name speculation, that is, people who register multiple domain names in the hope of profiting from someone else who wants the name. Although there is no means to determine definitively the extent to which speculation colors the domain name data, it appears that it is probably less than 10%. In an effort to remove the bias caused by this speculation, in this analysis I removed 35 000 (about 2% of all domain names) based on observable traits such as a 'for sale' line in the registration address or more than 25 domain names registered to a post office box.

Furthermore, using just the number of domain names does not differentiate between domain names that have a substantial Internet presence versus those that are less important players in the Internet content business. This issue is resolved somewhat by the fact that serious Internet content firms generally register multiple variations of their domain name both to protect their Internet brand and to allow differentiation between various products they offer. For example, Wired Magazine has over 75 registered com domain names and Amazon has registered dozens of names such as amazonfilms.com or amazonkids.com. This gives additional weight to the most important Internet content firms and helps to counterbalance the phenomenon of smaller and less used domains.

The domain name data set for this paper is based on a tabulation I conducted during June and July 1998 and uses an Internet utility program known as whois which returns contact information for a particular domain. Included in this information is a mailing address, contact names with telephone numbers and e-mail addresses, the date the domain name was registered, the last time it was updated, and the name servers responsible for the domain. In order to build a list of all registered domain names it is necessary first to use an option contained within the whois utility to request a list of all domain names that start with a certain series of letters and numbers (for example, aaaab or deff4). This list can then be used to query each individual domain name to obtain its contact information. Because of the large number of queries involved in this process, several perl scripts were written both to automate the process and to parse the information that was returned. This included programs to standardize address information so that it could be used to aggregate to higher geographical levels and to map to street addresses with a data set obtained from the Environmental System Research Institute.

[2] The recent sale of the altavista.com domain name for $3.35 million illustrates how fundamental and valuable domain names can be to the prospects of an Internet firm (Bicknell, 1998).

Although it is important to acknowledge that there are significant shortcomings to the use of domain names as an indicator of the location of the Internet content business, these issues are not debilitating. Information on individual domain names may be inaccurate or misleading, but it is reasonable to assume that these inaccuracies will be fairly evenly distributed and the process of aggregation to the regional level will help dilute the bias introduced by any one incorrect data point.

Current geography of Internet content production

In this section of the paper I present the empirical results of the mapping of commercial (com) domain names in the United States. This provides a good overview of how the production of Internet content is clustering and which cities and regions are emerging as key nodes in this network.

Figure 1 shows the distribution of com domain names around the United States which represents 75% of all com domains registered worldwide. One immediately sees significant concentrations in Northern and Southern California, the Northwest, the Eastern Seaboard, and scattered throughout the rest of the country. In many ways this pattern follows the distribution of population, with most cities emerging as notable sites of domain name registrations. In fact, a simple linear regression at the metropolitan statistical area level with number of com domain names as the dependent variable and population as the independent variable yields an r^2 of 0.65.

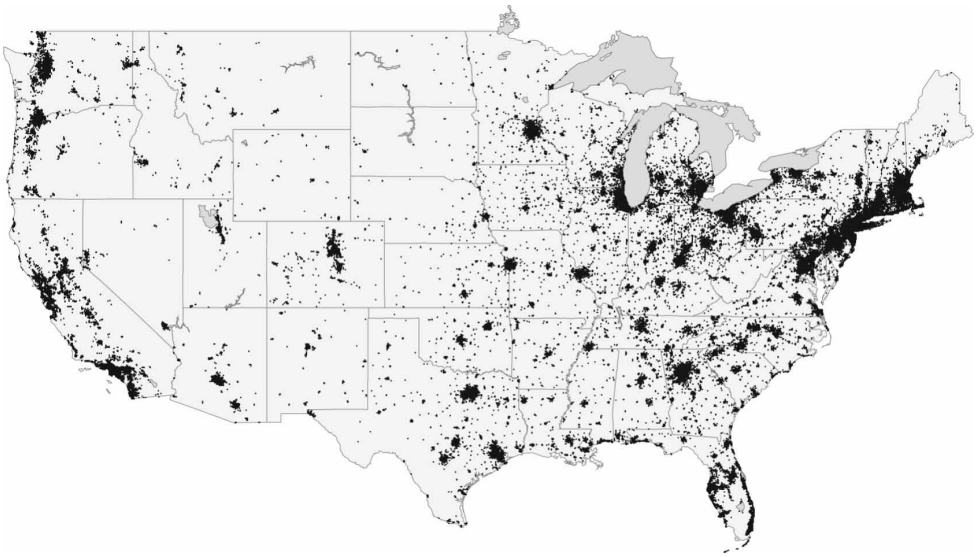


Figure 1. Distribution of commercial domain names in the United States, 1998 (source: author's survey).

However, the distribution of the Internet content business, as indicated by com domain names, is not simply a straightforward story of correlation to population. Moving from the national level to metropolitan areas it is possible to note significant differences between regions. A useful technique for comparing regions is the domain name specialization ratio which indicates the extent to which a region is specialized in domain names compared with the United States as a whole. A value greater than 1 indicates a higher specialization than the national average and a value less than 1 indicates a lack of specialization. Although any number of standardizing variables can be used (for example, population, jobs, etc), number of establishments is used because the

phenomenon under study is the process of firms creating Internet content. The formula used to calculate these specialization ratios is as follows:

$$\text{Domain name specialization ratio} = \frac{\text{no. of com domains in a region}}{\text{no. of firms in a region}} \Big/ \frac{\text{no. of com domains in the USA}}{\text{no. of firms in the USA}}.$$

Although most metropolitan areas have specialization ratios higher than the national average, the variance between these regions can be quite extreme. For example, as table 1 illustrates, the San Francisco Bay region has almost three times the number of domain names per firm as either the Chicago, Philadelphia, or Houston metropolitan regions. Also of interest is the noticeable discontinuity between the top three regions and the rest in terms of total numbers of domain names. Together, the New York, San Francisco, and Los Angeles regions have more com domain names than the next eleven largest metropolitan regions combined.

However, the geography of the Internet cannot simply be described in terms of total numbers of domains because in many ways this simply reflects size. As table 2 (see over) illustrates, one obtains a very different ordering of metropolitan regions on the basis of domain name specialization ratios—San Francisco Bay moves to the number one position and the New York region drops off the table completely. Additionally, new regions, such as Provo, UT; Portland, OR; Austin, TX; and Las Vegas, NV, appear as smaller but highly specialized areas of com domain names.

Table 1. Top fifteen concentrations of commercial domain names by census-defined metropolitan statistical area 1998 (source: domain data from author's survey; firm data from US Census 1995 Zip Code Business Patterns).

CMSA[a]	States	Comm. domains[b]	Domains per 1000 firms	Firm spec. ratio[c]
1 New York – Northern New Jersey – Long Island (C)	NY – NJ – CT – PA	142 375	274.19	1.25
2 San Francisco – Oakland – San Jose, (C)	CA	122 970	674.11	3.08
3 Los Angeles – Riverside – Orange County (C)	CA	118 000	339.17	1.55
4 Chicago-Gary-Kenosha (C)	IL – IN – WI	50 222	238.35	1.09
5 Boston – Worcester – Lawrence (C)	MA – NH – ME – CT	45 110	390.38	1.79
6 Washington (P)	DC – MD – VA – WV	38 213	421.64	1.93
7 Philadelphia – Wilmington – Atlantic City (C)	PA – DE – NJ – MD	37 296	252.78	1.16
8 Dallas – Forth Worth (C)	TX	34 064	299.50	1.37
9 Miami – Fort Lauderdale (C)	FL	32 518	290.04	1.33
10 Atlanta (M)	GA	30 285	320.22	1.47
11 Denver – Boulder – Greeley (C)	CO	29 409	434.68	1.99
12 Seattle – Tacoma – Bremerton (C)	WA	27 934	334.21	1.53
13 San Diego (M)	CA	25 903	429.98	1.97
14 Houston-Galveston-Brazoria (C)	TX	24 769	253.65	1.16
15 Minneapolis – St Paul (M)	MN – WI	22 331	304.45	1.39
National total		1 409 538	218.54	1.00

[a] C = CMSA (Consolidated Metropolitan Area); M = MSA (Metropolitan Statistical Area); P = PMSA (Primary Metropolitan Statistical Area).
[b] Commercial domains.

Table 2. Top fifteen specialized census-defined metropolitan statistical areas in commercial domain names, 1998 (source: domain data from author's survey; firm data from US Census 1995 Zip Code Business Patterns).

CMSA[a]	States	Comm. domains	Domains per 1000 firms	Firm spec. ratio
1 San Francisco – Oakland – San Jose (C)	CA	122 970	674.11	3.08
2 Provo – Orem (M)	UT	2 862	505.21	2.31
3 Denver – Boulder – Greeley (C)	CO	29 409	434.68	1.99
4 San Diego (M)	CA	25 903	429.98	1.97
5 Washington (P)	DC – MD – VA – WV	38 213	421.64	1.93
6 Austin – San Marcos (M)	TX	10 336	406.35	1.86
7 Boston – Worcester – Lawrence (C)	MA – NH – ME – CT	45 110	390.38	1.79
8 Santa Barbara – Santa Maria – Lompoc (M)	CA	3 679	362.21	1.66
9 Las Vegas (M)	NV – AZ	7 668	360.19	1.65
10 Portland – Salem (C)	OR – WA	17 791	350.61	1.60
11 Los Angeles – Riverside – Orange County (C)	CA	118 000	339.17	1.55
12 Seattle – Tacoma – Bremerton (C)	WA	27 934	334.21	1.53
13 Athens (M)	GA	1 362	333.33	1.53
14 Atlanta (M)	GA	30 285	320.22	1.47
15 Minneapolis – St Paul (M)	MN – WI	22 331	304.45	1.39
National total		1 409 538	218.54	1.00

[a] See table 1.
[b] Commercial domains.
[c] Firm specialisation ratio.

Furthermore, as one would expect, domain names are not evenly distributed within regions but are clustered in particular locations. In the largest three regions there are high concentrations of domain names in the city of San Francisco, Manhattan, around San Jose and Silicon Valley, and in the Santa Monica – Hollywood area of Los Angeles. In addition, there are numerous other smaller concentrations such as Berkeley – Emeryville, Brooklyn, and Long Beach.

Given these subregional clusters, it is useful to take the analysis to the next smallest geographical category, that is, the city.(3) Interestingly, the top three cities mirror the experience of the metropolitan regions, with New York, Los Angeles, and San Francisco containing more domain names than the next twelve cities. As one would expect, table 3 shows even more variation in specialization ratios at this finer grain of analysis. For example, the cities of Houston, Dallas, and Denver fall below the national average in terms of domain names to firms, Chicago and Phoenix are hovering close to the national average, and San Francisco again stands out as the most

(3) Unfortunately, using the city as a unit of analysis does not adequately reflect the true nature of economies that ignore municipal boundaries. For example, two key economic nodes in the Internet content industry (Silicon Valley and Southern California's entertainment complex) do not appear in table 3 at all because they cross multiple municipal boundaries which makes analysis and comparison difficult. However, if one uses Joint Venture's *1998 Index of Silicon Valley* definition of Silicon Valley one discovers that if it had been included it would have come second on the list of cities with 47 486 com domain names. The Southern California entertainment complex was more difficult to aggregate because no widely used definition was found. However, using the rough description offered by Scott (1995) in his study of the multimedia industry, an area running from Santa Monica through Hollywood to Burbank was discovered to contain approximately 30 000 domain names, making it the third largest 'city' in the US Internet system.

Table 3. Top fifteen concentrations of commercial domain names by census-defined cities, 1998 (source: domain data from author's survey; firm data from US Census 1995 Zip Code Business Patterns).

City	State	Commercial domains	Domains per 1000 firms	Firm specialization ratio
1 New York	NY	56 003	310.11	1.42
2 Los Angeles	CA	38 086	328.39	1.51
3 San Francisco	CA	20 868	668.25	3.07
4 San Diego	CA	16 590	421.57	1.94
5 Chicago	IL	14 274	225.48	1.04
6 Houston	TX	13 822	192.34	0.88
7 Dallas	TX	12 074	215.72	0.99
8 Seattle	WA	10 754	446.46	2.05
9 San Jose	CA	9 883	359.45	1.65
10 Phoenix	AZ	8 588	226.27	1.04
11 Boston	MA	8 078	377.74	1.73
12 Portland	OR	6 606	257.81	1.18
13 Washington	DC	6 000	320.67	1.47
14 Austin	TX	6 000	293.63	1.35
15 Denver	CO	5 869	170.38	0.78

Table 4. Top fifteen specialized census-defined cities in commercial domain names, 1998 (source: domain data from author's survey; firm data from Us Census 1995 Zip Code Business Patterns).

City	State	Commercial domains	Domains per 1000 firms	Firm specialization ratio
1 Los Altos	CA	1 345	1036.21	4.76
2 Foster City	CA	974	995.91	4.57
3 San Francisco	CA	20 868	668.25	3.07
4 Long Branch	NJ	479	630.26	2.89
5 Sunnyvale	CA	3 895	589.44	2.71
6 Santa Monica	CA	3 696	565.05	2.59
7 Mountain View	CA	3 401	524.68	2.41
8 Waltham	MA	1 244	497.60	2.28
9 Cambridge	MA	3 368	495.29	2.27
10 Berkeley	CA	2 544	483.93	2.22
11 Blacksburg	VA	291	474.71	2.18
12 Redmond	WA	1 333	446.87	2.05
13 Seattle	WA	10 754	446.46	2.05
14 Carson	NV	757	446.08	2.05
15 San Diego	CA	16 590	421.57	1.94

highly specialized major center of com domain names. Of course, in many ways these findings reflect the larger urban structure of these cities and regions. For example, although Denver defined as a city falls below the national average for domain names, it is the third most specialized CMSA in the country, illustrating the decentralized nature of recent urban development around Denver.

Again, because total numbers of domain names are only one side of the story, it is also important to examine how cities compare according to their specialization in domain names. Table 4 shows the top fifteen census-defined cities in the United States ranked according to specialization ratios. It is immediately obvious that many of these cities are relatively small, although San Francisco, Seattle, and San Diego make this

list. Also interesting is the geographic proximity of many of these cities: Los Altos, Foster City, San Francisco, Sunnyvale, Mountain View, and Berkeley are all in the San Francisco Bay Region; Redmond and Seattle are in the Seattle Metropolitan Area; and Cambridge and Waltham are located in the Greater Boston Area.

Figures 2 and 3 illustrate how these commercial domain names are distributed in the cities of New York and San Francisco. There are significant concentrations of domain names in the financial district of San Francisco as well as the South of Market or Soma district also known as Multimedia Gulch. The New York City Map clearly shows concentrations in domain names near the tip of Manhattan in the TriBeCa district, Soho, and Greenwich Village which generally correspond to the parts of the city referred to as Silicon Alley. One can also see a dense concentration of domain names on the East side just south of Central Park where many corporations and business headquarters are located.

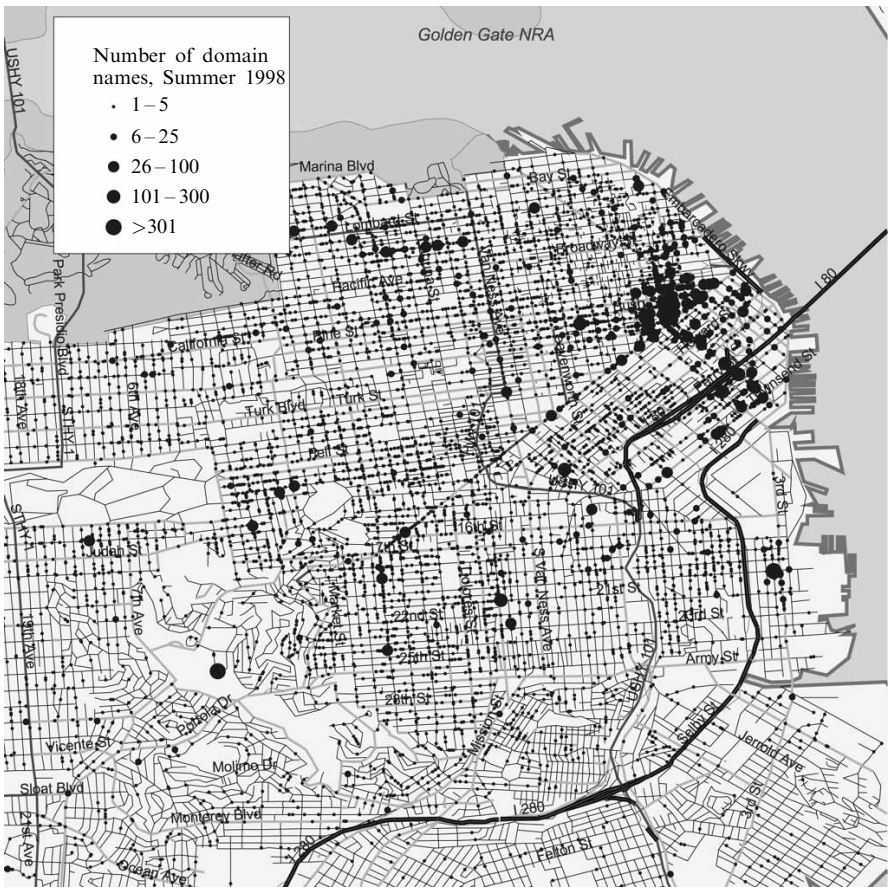


Figure 2. Location of commercial domain names in downtown San Francisco, 1998 (source: author's survey).

Implications of geography

This section demonstrates that the production of Internet content exhibits a remarkable degree of clustering despite its much ballyhooed spacelessness. Given the space-transcending nature of Internet technology it seems strange that such differences in the commercialization of the Internet should exist. Despite the possibility of every region

Figure 3. Location of commercial domain names in downtown New York, 1998 (source: author's survey).

developing its own particular brand of Internet content, it appears that in fact distinct interregional differences in domain names are occurring. Given the fact that the Internet offers enormous returns to scale in which small first-mover advantages can quickly translate into meaningful competitive advantage, the geography described here has significant implications for the future trajectory of the Internet content business.

However, one of the most interesting aspects about the three leading regions is that, although they all have a significant Internet presence, they are very dissimilar to one another in basic industrial makeup. This suggests that there are multiple pathways towards the development of an Internet content specialization. Industry analysts often point to the existing high-technology industries of Silicon Valley, the financial and publishing industries of New York, and the entertainment industry of Southern California to explain their high concentrations of Internet-related activity. In order to understand better how these differences impact the formation of the Internet content business, in the next section I provide an analysis of how the commercialization of the Internet has changed from 1993 to 1998 and explore the relationship between existing industrial sectors and the specialization in commercial domain names.

Temporal and industrial makeup analysis

Although the Internet as a system has been in existence since the 1970s, 1993 in many ways marks the birth of the commercial Internet with the introduction of the browser Mosaic and the subsequent mass interest in the World Wide Web. Because there is no readily available source of historical data on the registration locations of Internet domain names, I use the creation date of domain names to determine how the location of domain name registrations has changed over time. It must be noted that there is a degree of fallacy in using the domain name data in this manner because the registration address obtained in July 1998 is not necessarily the same address at which the domain name was initially registered. However, because speculation in domain names for resale probably consists of less than 10% of all registrations and, given that firms value the maintenance of a consistent domain name identity, these data should provide a reasonable sense of how the location of the Internet content production has shifted over time.

Figure 4 provides an overview of how the specialization ratios[4] of the ten CMSAs with the most domain names have changed over the past six years. It is interesting to note the relative drop in specialization of San Francisco, Boston, and Washington, DC over time. This can be partially attributed to their early involvement in the academic and military version of the Internet and the subsequent diffusion of the Internet content business as the World Wide Web became more widely popularized. This is also supported by the fact that many of most specialized CMSAs in 1993, such as Champaign – Urbana, IL and Colorado Springs, CO, were closely associated with universities or the Defense Department and quickly dropped in specialization as the Internet commercialized.

Equally interesting is the relatively large increase in the specializations of New York, Los Angeles, Miami, and Dallas – Forth Worth. Although it is impossible to provide a single causal factor for the increased specialization of these cities, these results illustrate an evolution of the use of the Internet from its initial role as a technological

[4] Because of data availability the domain name specialization ratios used in this section use number of jobs rather than number of firms as the standardizing variable and therefore will differ somewhat from the values in tables 2 and 3.

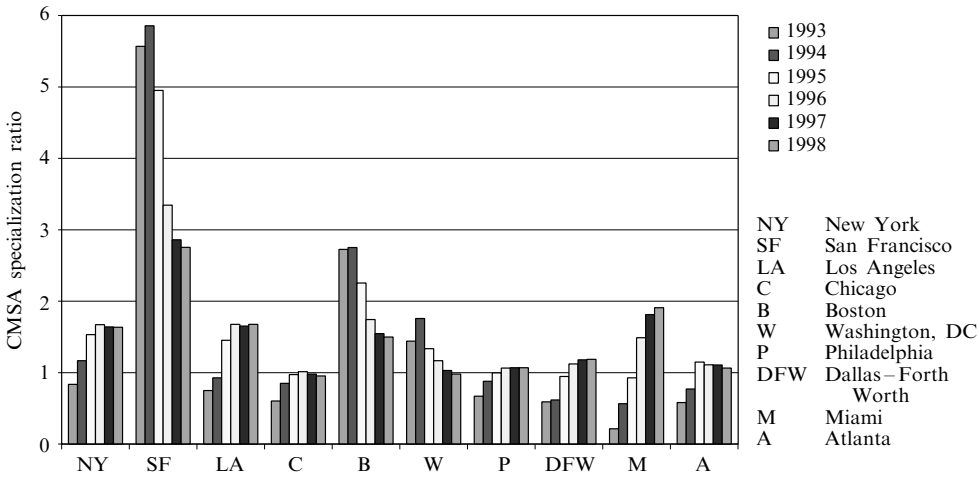


Figure 4. Top ten consolidated metropolitan statistical areas (CMSAs) by commercial domain name to jobs specialization ratio, 1993–98 (source: domain data from author's survey; employment data from US Department of Commerce).

development tool for the Defense Department, to its application for broader commercial purposes. However, although the trends illustrated in figure 4 correspond well with anecdotal stories of the development of the Internet content business, a more systematic analysis is warranted. In this vein, in the last section of this paper I explore two arguments about the underlying relationship between Internet content production and the industrial makeup of a region.

Industrial makeup and production of Internet content

The first hypothesis under consideration is that the growth of the commercial Internet is based largely on the technological abilities contained within a region. Therefore regions which have strong high-tech industries, such as San Francisco, Boston, or San Diego, have an advantage in developing firms producing Internet content. The second hypothesis is that the real competitive advantage in the Internet content business lies in the ability of a region to produce information to be distributed via the Internet. Therefore regions with large media or entertainment sectors, such as New York and Los Angeles, would be at an advantage. In an effort to provide an answer to these two hypotheses, a series of scatterplots are presented. These figures compare the relationship between domain name specialization ratios and location quotients[5] for clusters of industries that represent the key supporting industries for each hypothesis.

The first industrial cluster—Internet technology industries—is defined to include computer manufacturers, telecommunications, and software.[6] The second industrial cluster—informational industries—is made up of media and publishing, entertainment,

[5] Location quotients are a measure of the specialization of a region in employment within a particular industry in comparison with the national average. The formula for calculation of a location quotient is (employment in section *i* in region *j*/total employment in region *j*) ÷ (employment in sector *i* in the USA/total employment in the USA).

[6] This cluster is made of SIC 357—computer and office equipment; 366—communications equipment; 367—electronic components and accessories; 481—telephone communications; 482—telegraph and other message communications; 489—communications not elsewhere classified; and 737—computer and data processing services.

advertising and public relations, and advanced users.[7] Although the exact makeup of these clusters can be debated, the goal is simply to create categories that capture the theoretical underpinnings of the two hypotheses. In other words, is the growth of Internet content production more closely tied to the technological capacity brought by a specialization in technology or the supply of informational products from a specialization in informational industries? Although the formulation of this inquiry, the methodology used, and the characteristics of the data do not permit the drawing of definitive conclusions, this technique does provide some initial and valuable insights.

The first comparison undertaken is between figure 5(a) and 5(b) which contain the top hundred most domain-name specialized CMSAs or MSAs in 1993.[8] One can see that in the case of the Internet technology industries [figure 5(a)] there does not appear to be a particularly strong relationship between a specialization in this cluster and the development of Internet content. Only 9% of the top hundred Internet specialized metropolitan areas had both a specialization ratio and a location quotient greater than 1. Moreover, only half of the regions specializing in Internet technology also had an above-average specialization ratio for domain names.

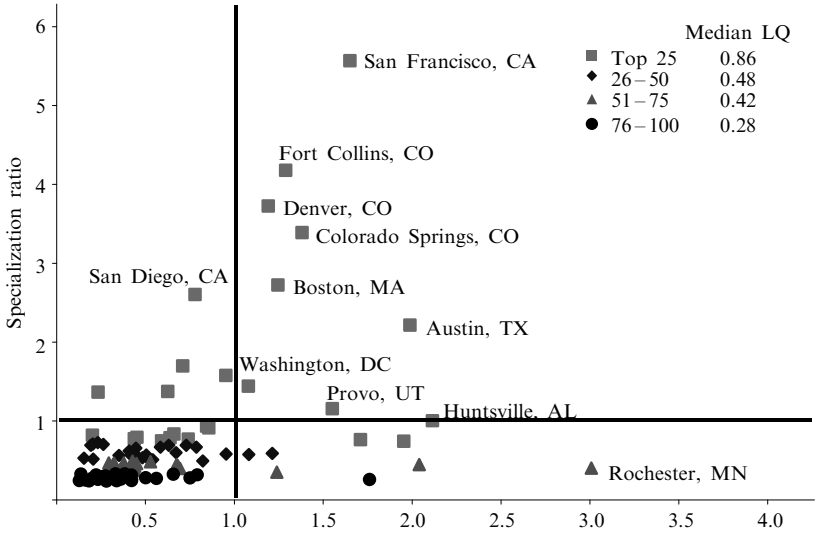
However, the informational cluster does not appear to have a particularly strong relationship with the commercialization of the Internet either. As with the Internet technology cluster, only 9% of the metropolitan areas had both a location quotient and a specialization ratio greater than 1. Additionally, one can observe that the three metropolitan areas with the highest location quotients in the informational cluster not only have lower than average specializations in domain names but are not even within the top fifty most domain-name specialized metropolitan areas.

All in all, the lack of noticeably strong relationships between these two industry clusters and domain names is not terribly surprising. At this time, the development of the Internet was driven by the logic of academic and military designs and thus the limited commercialization that had taken place was most likely the result of local connections to universities than any particular economic advantage.

The next set of figures illustrates the results of six years of commercialization and development of the Internet. Figure 6(a) (see over) and 6(b) show the location quotients and specialization ratios for 100 metropolitan areas with the highest specialization in domain names in 1998. In the case of the Internet technology cluster there is a continued weak relationship between these industries and a specialization in domain names. Only 12% of these metropolitan areas had both a location quotient and a specialization ratio greater than 1. Moreover, the median location quotient for the top twenty-five metropolitan areas actually dropped during this period from 0.86 to 0.81. Although one should not read too much into these figures, it is readily apparent that both in 1993 and in 1998 being specialized in the technology of the Internet was not sufficient to guarantee the development of a strong Internet content business.

[7] This cluster consists of media and publication (SIC 271—newspapers; 272—periodicals; 273—books; 483—radio and television broadcast stations; 484—cable and other pay television); entertainment (701—hotels; 781—motion picture production; 782—motion picture distribution; 783—motion picture theaters; 794—commercial sports; 799—miscellaneous amusement and recreational services); advertising and public relations (731—advertising; 874—management and public relations); and advanced users (621—security brokers and dealers; 622—commodity contracts brokers; 623—security and commodity exchanges; 628—security and commodity services; 738—miscellaneous business services; 871—engineering and architectural services; 872—accounting, auditing, and bookkeeping; and 873—research and testing services).

[8] Please note, a value greater than 1 in either specialization ratio or location quotient indicates that a region has more domain names or employment in the industrial cluster than the national average.



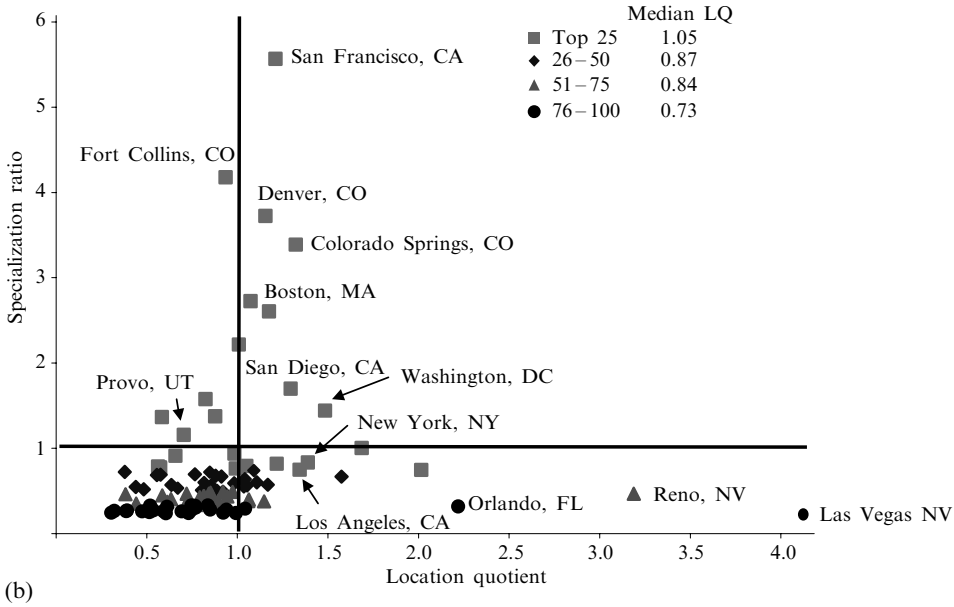


Figure 5. Scatterplot of commercial domain name to jobs specialization ratio versus the location quotient (LQ) of (a) Internet technology industries, (b) informational industries, 1993 (source: domain data from author's survey; employment data from US Department of Commerce).

Interestingly, the findings for the informational cluster suggest a different and stronger relationship. A comparison between figures 6(b) and 6(a) reveals that, unlike the Internet technology cluster, there appears to be a strong relationship between a specialization in domain names with a specialization in informational industries. Of metropolitan areas which are specialized in domain names 82% are also specialized in informational industries. This compares with only 32% of these same metropolitan areas being specialized in the Internet technology cluster. Moreover, figures 6(b) and 5(b) reveal that this relationship between specialization in informational industries and specialization in domain names has increased over time. For example, the

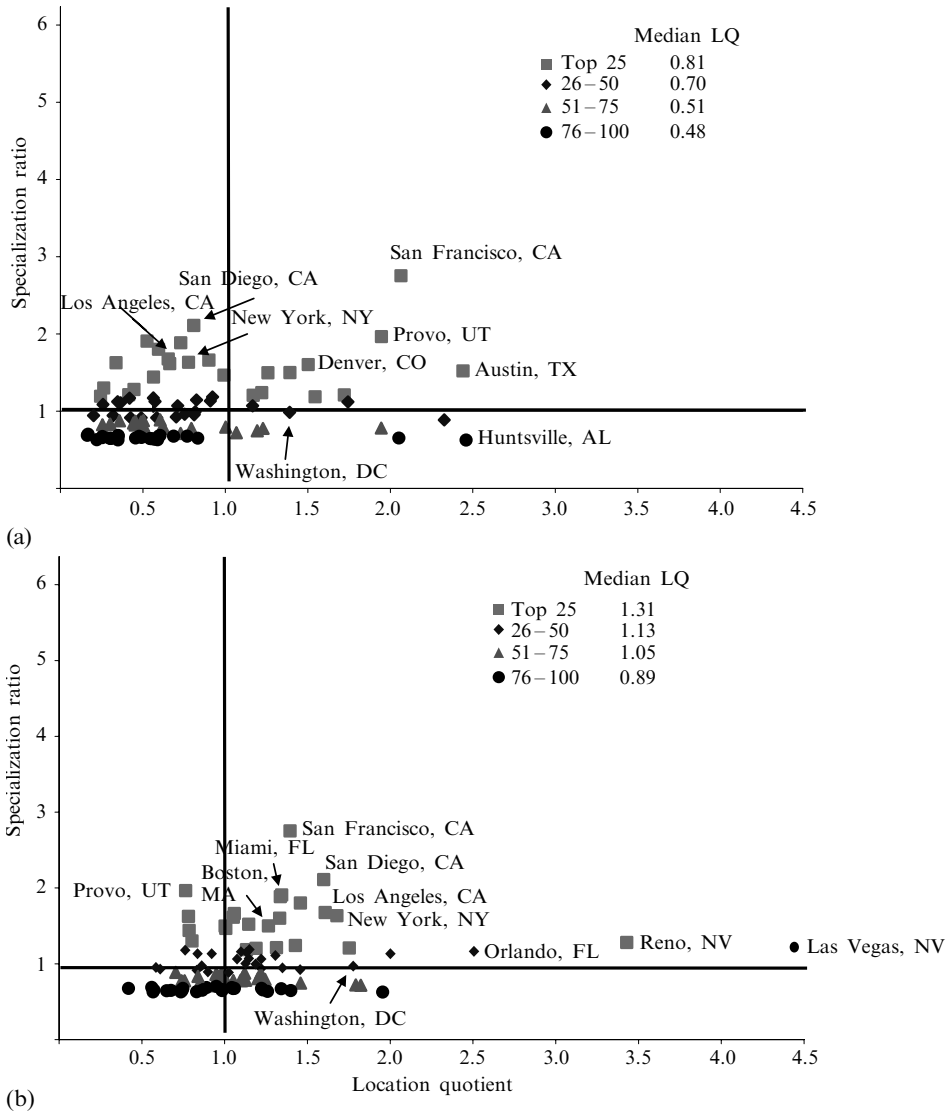


Figure 6. Scatterplot of commercial domain names to jobs specialization ratio versus the location quotient (LQ) of (a) Internet technology industries, (b) informational industries, 1998 (source: domain data from author's survey; employment data from US Department of Commerce).

median location quotient for the informational cluster of the top twenty-five industries increased from 1.05 in 1993 to 1.31 in 1998.

In addition, a simple linear regression using the specialization ratio for domain names as the dependent variable and the location quotient of informational industries as the independent variable resulted in an adjusted r^2 of 0.04 in 1993 and 0.17 in 1998. Although these correlations clearly demonstrate that specialization in informational industries cannot alone explain a specialization in the Internet content production, the increase in the correlation suggests that this industry cluster is becoming increasingly connected to the production of Internet content.

Conclusion

Because of the multiplicity of assumptions that have been made about the significance of domain names and the methods employed, it is not possible to assign a causal explanation to the relationships outlined here. This analysis has shown a relationship between information industries and the production of Internet content but cannot explain why an important informational center like Chicago is not also emerging as an equally strong and important node as New York or Los Angeles. Therefore, these findings should be seen as a suggestive first step in theorizing about the overall commercialization process of the Internet.

In many ways the first six years of the commercial Internet content business correspond well to the first stage of Vernon's (1966) product-cycle theory. Product-cycle theory argues that, in the early phase of a product innovation, production will locate in regions that are equipped with highly skilled labor with access to highly specialized information and then later move to more peripheral regions as the products become standardized. Although the drop in location quotients for cities outlined in figure 4 indicates a reduction in some of the Internet's initial concentrations it is still too early to see whether production of Internet content will ever reach a point of product standardization. After all, industries based on the manipulation of information are a recent phenomenon and researchers are still striving to understand what this means for long-term development patterns. And as the continued specialization of San Francisco and the growth of specialization of New York and Los Angeles illustrate, some cities are continuing to attract new start-ups despite the high costs associated with doing business there.

Thus, the most significant finding of this paper is that the Internet is not bringing about the wholesale elimination of place-based networks in favor of cyberspace. As Graham (1997, page 123) argues, "time and space barriers are only selectively being overcome ... Place-based and place-bound ways of living, and the social, economic, institutional, and cultural dynamics that can arise where urban propinquity does matter are still critically important in shaping how cities and localities are woven into global lattices of mobility and flow". Just as the earlier technologies of the telegraph and railroad upset the standards upon which the competitive advantage of firms and regions were based, the Internet promises a reorganization of the production systems of a wide range of industries. The challenge for future research will be understanding and analyzing the way specific regional networks and individual firms adapt to and exploit the opportunities offered by the Internet.

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