HUBS, NODES AND BY-PASSED PLACES: A TYPOLOGY OF E-COMMERCE REGIONS IN THE UNITED STATES

MATTHEW A. ZOOK

Department of Geography, University of Kentucky, Patterson Office Tower, 14th Floor, Lexington, KY 40506-0027, USA. E-mail: zook@zooknic.com

Received (in revised form): December 2001

ABSTRACT

This paper assesses US metropolitan regions in terms of the adoption of e-commerce by businesses using a combination of data from Interactive Week, Alexa Research and Hoover's Online. This analysis shows that e-commerce is providing the impetus and means to reorganise the economic and geographic space in which businesses operate. Spatial divisions in the use of e-commerce are identified in which many cities in the South and Midwest appear to be lagging behind their counterparts in other parts of the country. Thus, rather than the destruction of place and geography predicted by some, e-commerce is reorganising the economic space in which businesses operate. Although not every place will become a major e-commerce hub, all regions will be shaped by the way in which firms adapt to this new commercial medium.

Key words: E-commerce, economic development, digital divide

The end of the twentieth century was marked by dramatic changes in telecommunications as national monopolies and the plain old telephone service (POTS) gave way to increased competition, lower prices, and growing data communications and advanced services. The most visible example of this process is the growth of the packet-switched network of networks, the internet. The unlikely progeny of a Cold War defence project, the internet emerged from the cloistered confines of academia and courtesy of the user-friendly world wide web, transformed itself into an increasingly commercial environment during the last years of the twentieth century (Abbate 1999; Reid 1997).

The bursting of the dot-com bubble in April 2000 resulted in a marked decrease in rhetoric on the ability of the internet and e-commerce to completely transform the economy. Despite this decline in visibility, e-commerce continues to grow and affect the way companies conduct business. While it is no longer the stuff of instant companies and 20-year-old billionaires, it has important implications for the development trajectories of cities and regions. This paper assesses US metropolitan regions in terms of the adoption of e-commerce by businesses located within them. This analysis shows that e-commerce is not bringing about the destruction of place and space as some pundits predicted, but is providing the impetus and means to reorganise the economic space in which businesses operate. While not every place can become a major hub or global city, some regions appear to be re-making themselves while others are moving more slowly. In particular, many cities in the South and Midwest appear to be lagging behind their counterparts in other parts of the country.

THE SPATIAL IMPLICATIONS OF E-COMMERCE

One of the great paradoxes of the twenty-first century is that as telecommunications improve

Tijdschrift voor Economische en Sociale Geografie – 2002, Vol. 93, No. 5, pp. 509–521.

Published by Blackwell Publishers, 108 Cowley Road, Oxford OX4 1JF, UK and 350 Main Street, Malden MA 02148, USA

and the economy globalises, spatial proximity and cities retain their importance in economic development (Malecki 1999; Porter 1998; Markusen 1996; Florida 1995; Gertler 1995; Scott 1995). This builds on earlier arguments by Pred (1977) and Storper and Walker (1989) and reflects over a century of academic research. Despite this body of research many people, albeit largely non-geographers, predicted that the internet would loosen the ties of economic activity to localities and herald the end of cities (Gilder & Peters 1995; Cairncross 1997; Negroponte 1995, 1999).[1]

To disperse or not to disperse – While expectations of the internet 'ending geography' have been shown to be grossly exaggerated (Zook 2000; Moss & Townsend 2000; Gorman 2002), there remains considerable uncertainty surrounding the impact of e-commerce on the economy (Leinbach 2001). While it is tempting to identify a single effect of e-commerce, e.g. dispersal of jobs or industries, the dynamic geography of the economy and production is complicated, messy and defies neat categorisation (Storper & Walker 1989). Moreover, analysis of earlier rounds of related innovations in transportation and communications technologies demonstrate that while certain economic functions such as management might agglomerate, others such as production or distribution may disperse, thus constructing more complex organisational systems (Johnson 1977; Castells 1989; Leamer & Storper 2001).[2] While the effect of e-commerce on economic geography remains an empirical question, it seems likely that its introduction will create similar patterns of concentration and dispersion.

For example, new communications and transportation technologies have allowed for the fragmentation of many production processes across geographical places (Arndt & Kierzkowski 2001), but this fragmentation has not reduced the long-standing draw of agglomerations nor their ability to generate new firms and industries (Jacobs 1984). The centripetal forces at work in agglomerations are as complex and varied as the economy. Transportation costs remain an important factor for some manufacturers; reliability of access to suppliers or customers is paramount for many companies, while others are driven by cost-minimising or regulatory concerns. In the case of innovative and information-based industries, the ability to access uncodifiable knowledge via local networks has proven a powerful theoretical explanation for agglomeration in the current era (Saxenian 1994; Gertler 2001; Lo & Grote 2002). Although the exchange of uncodified knowledge need not be limited to local exchanges (Amin & Cohendet 1999; Cowan *et al.* 2000), economic history provides considerable evidence that 'handshake' interactions generally require face-to-face interaction (Leamer & Storper 2001).

Continued relevance of localities and agglomerations – Thus, for these theoretical reasons, the internet and e-commerce are arguably bringing about a revival of cities (or in the light of the office park landscape of Silicon Valley, agglomerations) rather than their end. Research on 'global' cities such as Friedmann and Wolff (1982) and Sassen (1994) and related research that documents the dominance of a few metropolitan regions in 'knowledge' industries (Pollard & Storper 1996; Audretsch 1998), provide empirical backing to the argument that agglomerations are far from irrelevant in the current era.

Nevertheless, research on the interaction of telecommunications (such as the internet) and cities has historically been relatively sparse, particularly when compared to research on urban transportation issues. Moreover, analysis of the use of telecommunications and the implications for cities is often coloured by technological determinism, utopian and dystopian, rather than by concrete analysis (Graham & Marvin 1996; Thrift 1996).

In the case of the internet there has been a growing body of literature that demonstrates that much of the development of the internet has concentrated within developed countries and/or major urban agglomerations (Hargittai 1999 Robinson & Crenshaw 2002; Jordan 2001; Townsend 2001; Dodge & Shiode 1998; Brunn & Dodge 2002; Moss & Townsend 1997; Kolko 1999; Zook 2000; Zook 2001; Malecki 2000). Equally intriguing is that a number of studies have also shown that significant disparities exist between regions' access and use of the internet (Wheeler & O'Kelley 1999; O'Kelly &

Grubesic 2001; Zook 2001; Moss & Townsend 2000). This suggests that a country and its regions are taking multiple paths towards internet adoption rather than following a single trajectory.

Aoyama's (2001) research on e-commerce in Japan provides a particularly striking example of this. Rather than following the retail e-commerce model developed in the USA, in which consumers purchase products via a website with a credit card and have it delivered to their home, Japanese retail e-commerce is centred on corner convenience stores. A combination of factors including less familiarity and history with mail-order purchases than in the USA, a low level of credit card use, and concerns with the ability to return purchases has created a remarkably different implementation of e-commerce. Although sub-national differences within a country are likely to be less than between countries, this example shows the diversity in the form and timing of e-commerce.

This review argues that far from having a static and uniform effect, the adoption of e-commerce is a dynamic process, which as the numerous bankruptcies of online retailers illustrate, can change very quickly. Even before the bursting of the dot-com bubble there was steady movement away from small entrepreneurial companies to more established 'bricks and mortar' companies. This trend, however, does not mark a return to the economic system of the pre-internet era but is simply the next phase in e-commerce. Nevertheless, as the following sections show, regions that were the early centres of dot-com companies retain their primacy in the next stage even as more mainstream companies expand their e-commerce operations.

IDENTIFYING E-COMMERCE AGGLOMERATIONS

Obtaining accurate and meaningful geographic measures of the internet and e-commerce is a difficult undertaking. A widely used study by the Center for Research in Electronic Commerce at the University of Texas (2000) as well as Department of Commerce (2001) data on e-commerce is only available at the national level. Although country business pattern data will likely prove useful in the future with its utilisation of the North American Industry Classification System (NAICS), currently its most recent data predates most of the expansion in e-commerce.

Therefore, researchers interested in e-commerce, particularly in regards to its geography, must rely on private sources of data and their own devices to find relevant data sets. This paper uses a series of databases based on directories of companies engaged in e-commerce to construct indicators of the level of internet commercial activity in metropolitan regions. Because this data comes from private sources rather than government agencies, the methodologies and criteria are not standardised and often only capture the largest cases of e-commerce. In order to reduce the bias of any one of these sources this paper uses a combination of databases to construct a typology of regions based on the size and relative specialisation of regions' e-commerce activity.

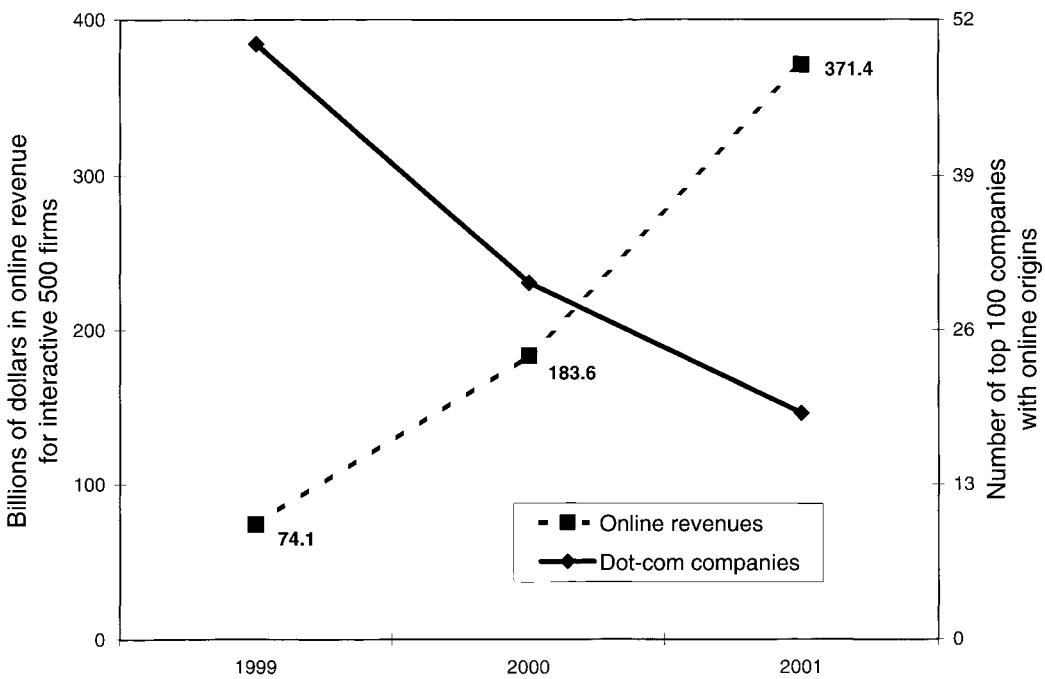
Data sources – The primary data source for this paper is a list by Interactive Week of the 500 companies, both pubic and private, with the most sales generated electronically.[3] This ranking is conducted in late summer and measures online sales for the previous 12 months, generally 1 July to 30 June. Although it likely that some companies eligible for this list are missing, it still represents the most comprehensive collection of companies engaged in e-commerce. The criteria used by Interactive Week for e-commerce is based on a Department of Commerce definition and includes the sale of all goods and services (B2C and B2B) via any electronic system, e.g., electronic data exchange, internet, extranet, etc., although payment can be made via any means. The use of this database means that this definition is also the one adopted by this paper. Because Interactive Week provides no data on the location of these companies, this information is based on the registration information for the company's domain names, which is obtained via a 'who is' query (Moss & Townsend 1997; Zook 2000).[4]

The Interactive Week ranking has been conducted in 1999, 2000 and 2001. However, concerns about the validity of longitudinal geographic analysis based on this data restricts

this paper to a static moment in time. Nevertheless, it is informative to examine the evolution of this data set particularly because it covers the period of time in which many dot-com companies went out of business. As Figure 1 illustrates, there has been considerable growth in the amount of revenue generated by the top 500 e-commerce firms. From approximately $74 bn in 1999, it grew to $183.6 bn in 2000 and to $371 bn in 2001.[5] While the figures for e-commerce are difficult to verify, Interactive Week's figures correspond well with other available data. For example, the Center for Research in Electronic Commerce (2000) found that internet commerce in the time period that corresponds with Interactive Week's 2000 data totalled $226 bn. While CREC's figure is an estimate it is relatively close to the figure from Interactive Week and the $42 bn surplus could be accounted for by the revenue of smaller companies that were not included in the top 500.

In addition, Figure 1 highlights a second trend within e-commerce, i.e. the shift from start-ups formed specifically to take advantage of the internet to established companies incorporating the internet as part of their business strategy. During the late 1990s, the prevailing wisdom was that 'brick and mortar' companies were in danger of losing significant market share to online start-ups. For example, in 1999 eToys was ranked 80th by Interactive Week and Toys'R'Us did not even make the top 500. An article that appeared in *Business Week* in late 1999 used this disparity to argue:

> When old-economy companies have tried to beat their Net rivals at the new game, it has usually been the upstarts that prevailed ... Perhaps nowhere will the contest between traditional and cyber-merchants be more intense than in toys ... Toys'R'Us Inc ... is still struggling to get its cyberfooting ... the entrenched e-tailer, eToys, will be



Source: Online revenues based on Interactive Week's Interactive 500; firms with online origins determined by author.

Figure 1. *Online revenues and number of 'dot-com' firms in top e-commerce positions, 1999–2001.*

> hard to beat. It could grab as much as $100 million in sales this year (Zellner & Anderson 1999, p. 31).

Ironically, although eToys reached $167 m in sales in Interactive Week's 2000 data it did so by taking an enormous loss. Moreover, in less than the space of two years the situation changed dramatically with eToys bankrupted and Toys'R'Us moving up the rankings for e-commerce revenues.[6]

The second data source is based on a technique first discussed by Paltridge (1997) that relies on top web site rankings. The exact methodology of these rankings systems are often proprietary but they are generally based upon variables such as pageviews – the number of times a site is accessed, unique visitors – counting individuals rather than hits, and other traffic measures. Although not all top visited sites engage in e-commerce, e.g., berkeley.edu and mit.edu are regularly among the top 500 most visited sites, there is generally a high correlation between traffic and attempts to turn these visitors into customers. This paper uses the top 1,000 sites provide by Alexa Research which are based on the aggregated traffic patterns of 500,000 web users worldwide. The location of these websites was again determined by 'who is' queries on their domain names.

The third data source used as an indicator of e-commerce is a specially constructed database of internet firms. At its heart is Hoover's Online Business Network, which contains information on approximately 14,000 public and private firms worldwide. Firms were selected from this database if they were classified by Hoover's as belonging to the internet sector or were otherwise identified by the author. These firms include both those founded explicitly to take advantage of the internet (dot-coms) and those that existed prior to the internet but were moving towards making the internet a significant part of their business. While these 815 firms certainly do not include all companies in the internet industry, they do represent a sample of the most important firms. The location of each firm was based on the information within the Hoover's database.

A common issue with all three data sources (see Table 1 for a summary) is that they provide only one location for a firm or website despite the complex spatial division of labour of the companies represented in the data. As a result these databases are biased toward urban regions that contain a large number of company headquarters since this is often the one location that is possible to determine. Although this issue cannot be completely removed, the analysis adjusts for this bias by standardising the analysis by the number of Fortune 1000 companies headquartered in a region.

Constructing a typology – The first step in constructing a typology of e-commerce regions in the USA is the creation of indexes that standardise each region's score. The calculation for each index is based on the following formula:

$$\text{Number of observations in region}_i \,/\, \text{maximum number of observations in any region} * 100$$

This creates an index of 0–100 in which the region with the largest number of observations scores 100 and a region that had 43.8% obser-

Table 1. Data Sources

Data	URL/source	Location based on	Number of observations	Date
Top e-commerce firms	Interactiveweek.com	Domain name	500	30 June 2000–30 June 2001*
Most visited websites	Alexaresearch.com	Domain name	1,000	July 2000
Top internet companies	Hoovers.com	In database	815	May 2000

* If data is not available for this time period, the four quarters closest to this date is used.

vations scores 43.8. These three index scores are summed and standardised which form the basis for the typology created in this paper.[7]

The typology is defined along two axes, the overall size of e-commerce in a region and its specialisation in e-commerce relative to the number of Fortune 1000 firms headquartered within it. Regions are placed in each category based on the standard deviations outlined in Table 2. The size categories are relatively straightforward measures of the overall amount of e-commerce in a region. The specialisation level categories capture regions' level of activity within e-commerce with those scoring well above the median designation as e-commerce regions. Potential and Lagging classification simply represent lower penetration levels within the region. While the criteria for entry in each category are soft as they are based on natural breaks within the index and are designed to provide variation to allow for useful delineation between regions.

This paper uses census defined Metropolitan Statistical Areas (MSAs) or Consolidated Metropolitan Statistical Areas (CMSAs) throughout its analysis. Because revenues vary so dramatically and it is not possible to assign revenues of multi-locational companies to each of its sites, this paper counts the number of companies in a particular region. Because of the relatively small sample sizes of all data sets, this analysis is limited to 106 metropolitan regions with observations in at least one of the three indicators.

E-COMMERCE HUBS, NODES AND PLACES

As Table 3 outlines, there is considerable variation among the 15 regions that score highest in the summed index. The seven hubs at the top of this typology are identical to the largest metropolitan areas in the USA with the exception of Seattle and the exclusion of Philadelphia. The rankings, however, do not mirror the size of these regions, as the San Francisco Bay outstrips all other regions in all categories and Chicago ranks lower than expected based on its size. This results in only four of the top seven hubs emerging as specialised in e-commerce, with New York and Washington DC achieving potential status and Chicago emerging as a laggard. This demonstrates that the development of e-commerce is not simply a matter of major business centres adopting its use. Rather, the unique dynamics and histories in regions shape the timing and form of e-commerce use.

This trend is mirrored in the smaller concentrations in Table 3, i.e. nodes and places, which again run the gamut from e-commerce to lagging classifications. While it is not surprising that Austin, given the presence of Dell Computers, or San Diego, given its concentration of many telecommunications companies, achieve an e-commerce specialisation, the emergence of Miami as an e-commerce node is less intuitive. Identified by Zook (2000) as containing a large concentration of domain

Table 2. *Outline of typology.*

	Criteria for entry in category
Size	
Hub	Summed index > 1 std. dev. above median
Node	Summed index > 0.5 std. dev. above median
Place	Summed index > median
Specialisation level	
E-commerce	Standardised summed index > 1 std. dev. above median
Potential	Standardised summed index > 0.4 std. dev. above median
Lagging	Standardised summed index < 0.4 std. dev. above median
Example	
E-commerce hub	Summed index > 1 std. dev. above median & standardised Summed index > 1 std. dev. above median

Table 3. *Summary of 15 regions with the highest summed indexes.*

MSA/CMSA description	Alexa index	Hoover's index	Interactive Week index	Summed index	Standardised summed index*	Category
San Francisco–Oakland–San Jose, CA CMSA	100.0	100.0	100.0	300.0	6.4	E-commerce–hub
New York–Northern New Jersey–Long Island, NY–NJ–CT–PA CMSA	64.2	85.8	78.0	228.1	1.6	Potential–hub
Los Angeles–Riverside–Orange County, CA CMSA	43.8	29.7	45.1	118.6	2.6	E-commerce–hub
Boston–Worcester–Lawrence, MA–NH–ME-CT CMSA	20.4	34.5	30.5	85.4	3.3	E-commerce–hub
Seattle–Tacoma–Bremerton, WA CMSA	32.8	28.4	23.2	84.4	6.0	E-commerce–hub
Washington–Baltimore, DC–MD–VA–WV CMSA	17.5	24.3	28.0	69.9	2.1	Potential–hub
Chicago–Gary–Kenosha, IL–IN–WI CMSA	12.4	19.6	31.7	63.7	1.0	Lagging–hub
Atlanta GA	9.5	13.5	15.9	38.9	1.7	Potential–node
Dallas–Fort Worth, TX CMSA	7.3	10.1	17.1	34.5	1.0	Lagging–node
San Diego CA	8.8	11.5	8.5	28.8	5.8	E-commerce–node
Philadelphia–Wilmington–Atlantic City, PA–NJ–DE–MD CMSA	6.6	7.4	14.6	28.6	0.7	Lagging–node
Miami–Fort Lauderdale, FL CMSA	8.8	8.8	8.5	26.1	3.3	E-commerce–node
Minneapolis–St Paul MN–WI	5.1	10.1	9.8	25.0	0.8	Lagging–node
Denver–Boulder–Greeley, CO CMSA	3.6	14.2	6.1	23.9	1.6	Potential–node
Austin–San Marcos TX	3.6	8.1	6.1	17.9	8.9	E-commerce–place
Median	0.7	0.7	1.2	2.4	1.0	
Standard Deviation	12.7	13.8	13.8	40.0	1.6	

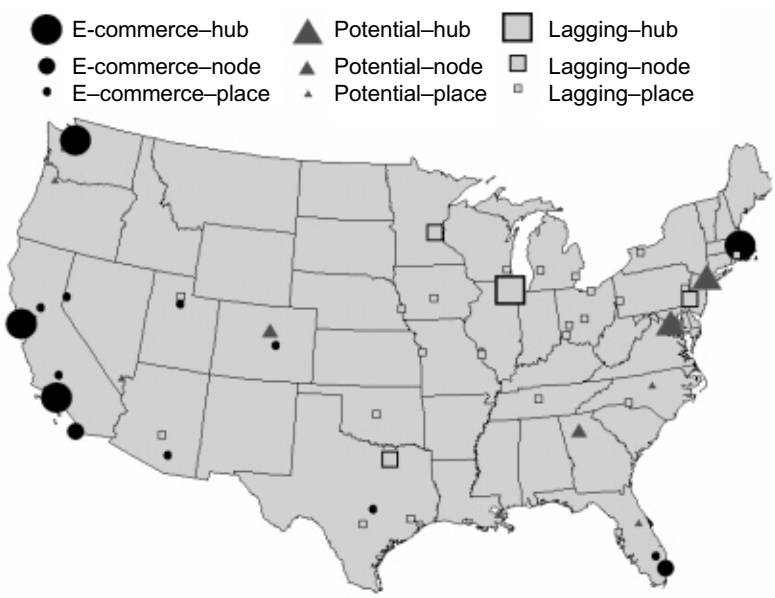
*Standardisation is based on number of Fortune 1000 companies headquartered in region.

names, and as a location for e-business activity by Gorman (2002), Miami is emerging as an example of how e-commerce allows some regions to leverage their existing strengths in the internet era. Although space considerations do not allow this paper to go into more detail on this point, it appears that Miami is emerging as the internet hub for Latin America. Telegeography (2001) documents that it is the primarily gateway for internet traffic from Latin America to the USA and the rest of the world.

The regions that have relatively little e-commerce activity given the size of their economies include Chicago, Dallas, Philadelphia and Minneapolis. While there are any number of reasons for this low level of penetration this mirrors the pattern identified for the adoption of commercial internet use identified by Moss and Townsend (1997), Zook (2000) and Moss and Townsend (2000). This lack of specialisation remains even when the analysis is just based on Interactive Week data. These differences between regions illustrate that important spatial differences exist in the adoption and use of e-commerce.

This spatial division is even more evident when mapped. As Figure 2 illustrates, the bulk of e-commerce regions are concentrated in the Western and Pacific regions of the USA. In addition to those listed in Table 3, these regions include Santa Barbara CA, Sacramento CA, Bakersfield CA, Provo UT, Reno NV, Colorado Springs CO, Tucson AZ and West Palm Beach FL. In contrast, the majority of regions that have low e-commerce use relative to their existing economy, i.e. lagging, are concentrated in the Midwest and Great Plains including Detroit MI, Cincinnati OH, Milwaukee WI, Cleveland OH, Pittsburgh PA and Omaha NE. Although regions placed in the Potential category are more evenly distributed throughout the USA, the spatial divide between e-commerce and lagging regions is striking.

This concentration illustrates a continuing spatial divide between regions of the USA between regions that were early adopters of the internet and e-commerce and those that



Note: The 51 out of 106 metropolitan regions represented here are those that scored above the median in terms of size of e-commerce activity.

Figure 2. *Distribution and level of e-commerce in the USA, 2000.*

have been slower to take this step. It also suggests a sectoral division between regional economies, with larger concentrations in traditional manufacturing and agriculture industries resulting in slower adoption of e-commerce. This spatial divide is resistant to sensitivity testing and remains even when the standardisation method is based on the total number of firms within a region rather than Fortune 1000 firms.

Although this typology is preliminary, it demonstrates the continued relevance of agglomerations during the emergence of e-commerce in the USA. However, it suggests that the way in which regions adopt and participate in e-commerce is not uniform but based on the history and conditions of a region. While much of this is unique to particular regions there also appears to be larger and spatially relevant trends influencing the adoption of e-commerce and resulting in a spatial division of e-commerce regions.

BY-PASSED PLACES

The nature of the data used in previous analysis, i.e. its small sample size and focus on the largest companies, confounds attempts to study smaller regions and cities with lower levels of internet use and penetration. For example, because all three data sources assign all data to a single headquarters location they overlook smaller e-commerce activities based in the multiple locations by firms. This includes the Amazon.com warehouse in Lexington, Kentucky, the emergence of specialised distribution centres for e-commerce, e.g. Reno, Nevada, and the concentration of internet infrastructure in co-location facilities (Malecki & McIntee 2001).

In an effort to understand e-commerce in smaller agglomerations this analysis uses the number of registered dot-com domain names per establishment in a region during July 1998 and January 2001. Regions with less than the median number of dot-com domains per establishment in both time periods (117 MSAs) were identified. MSAs with less than the median number of dot-com names per establishment from this subset in both time periods (37 MSAs) are classified as by-passed places with sustained and significantly lower commercial usage of the internet than the USA as a whole.

As Figure 3 illustrates, these by-passed places are scattered throughout the USA, although there is a large concentration in the South. Over 70% of by-passed regions are located

Figure 3. *By-passed places.*

in the census defined southern region, with 30% in the South Atlantic Division, i.e. Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia and West Virginia. Another 27% are located in the West South Central division, consisting of Arkansas, Louisiana, Oklahoma and Texas.

This distribution suggests a further refinement of the spatial division of e-commerce identified in Figure 2 in which the Southern part of the USA has a disproportional number of by-passed places. It appears that firms within smaller regions in the USA and these 'by-passed places' are less likely to engage in e-commerce. It is not clear from this analysis what barriers may be preventing firms in these regions from adopting e-commerce and what an appropriate response would be. However, the type of e-commerce activity in these smaller regions is likely to differ significantly from what takes place in the e-commerce hubs. Although officials in many regions are eager to cast themselves as the next Silicon Valley or e-commerce centre, a more likely scenario would take the form of call centres (Richardson & Gillespie 2000).

CONCLUSION

The typology of e-commerce regions developed in this paper tells an important story of how a technology that was reputed to 'render geography and cities meaningless' has developed a distinct and often urban geography. There are a few key urban agglomerations that have emerged as hubs for e-commerce. While in some ways these cities correspond closely to existing city hierarchies there are also significant discontinuities from previous patterns. For example, Chicago and Philadelphia have a relatively small e-commerce component to their economy and other regions such as Austin, TX and Miami are emerging as important new nodes.

While telecommunications technologies have increased the ability for isolated businesses or individuals to access (and be accessed by) the rest of the world, it also strengthens the ability of large companies and early movers to extend the scope and reach of their markets. Given the disparate experience of regions shown in this paper, it is clear that the impact of e-commerce is far from uniform. Nevertheless, two conclusions can be made based on this analysis.

Shift from dot-coms – The first conclusion is that e-commerce is continuing to shift away from the entrepreneurial start-up prevalent at the end of the 1990s to more established or 'bricks and mortar' companies. At the height of the dot-com bomb in 1999 big companies and corporations were increasingly concerned with internet-based competition as a seemingly endless supply of venture capital and IPOs were creating companies and attracting talent. The 'new economy' magazine *Business 2.0* characterised the dilemma facing old-line business:

> An increasingly annoying question – *What's your Internet strategy?* – keeps getting asked, but not really answered. You thought the focus group nipped that in the bud when you launched a Website a couple of years ago. (You even had the URL printed on everyone's business cards.) Problem is, your big dot-com is now dismissed as advanced brochureware, and two online startups launched last quarter with the sole mission of bumping you off the face of the earth. More red flags: Resignation letters from key executives in logistics and distribution – who took jobs they couldn't turn down at Net startups – are trickling in (Davis, 1999, p. 72).

The souring of the public markets, the subsequent drop in venture capital investing, and the numerous bankruptcies of dot-com business during 2000 and 2001 has reduced this particular worry for companies.[8] Nevertheless, considerable challenges remain for companies and regions in adopting e-commerce in business and development strategies. While the recent bankruptcy filing by Interactive Week's leading e-commerce company, Enron, may be a unique case, it highlights that even longer company histories do not ensure success.

Variety of place experience – This paper's second conclusion is that the adoption of e-commerce by businesses and regions is far

from a uniform process. Some sectors, e.g. high technology, financial and business services were quick to adopt the internet and introduce e-commerce capabilities into their business models. The dearth of e-commerce specialised regions in the Midwest and the concentration of by-passed places in the South suggests that there is a significant spatial divide within the adoption of e-commerce.

However, the limitations of the data sets used in this paper have necessarily focused on the largest cities and admittedly provide a less than satisfactory analysis of how e-commerce has been adopted in smaller regions and rural areas. One of the most remarkable achievements within e-commerce is the increased ability for individuals and small businesses to access large markets of other individuals through websites such as eBay and Paypal. The agglomeration of these small transactions into national and international marketplaces enables people to sell and buy products from other individuals on a scale hitherto unknown. The time and monetary costs of contacting all the sellers or buyers in a market would have been prohibitive and served to keep many of these exchanges local and constrained. Although this will wait on future research it is likely that this type of engagement will provide yet another example of the variety of e-commerce adoption.

Thus, rather than the destruction of place and geography predicted by some, e-commerce is reorganising the economic space in which businesses operate. This reorganisation of economic space is reflected in the fortunes of specific regions and contains significant variation between regions. Although not every place will become a major e-commerce hub all regions will be shaped by the way in which firms adapt to this new commercial medium.

Notes

1. It is enlightening to note that during the nineteenth century pundits made related predictions about how the introduction of the telephone would affect economic and social life (Fischer 1992).
2. Economic history is replete with instances in which existing skills, production processes, industries and locations were rendered obsolete by a new innovation which at the same time offered the opportunity for new agglomerations and the reorganisation of existing ones. As Walker (1995, p. 196) argues, 'The amazing process of industrialization – has repeatedly knocked the props out from under established social arrangements and posed new puzzles for humanity to solve. How this unwinds is very much an open, experimental process, even though the contours of the prevailing social relations channel the movements in certain ways.'
3. This list is available at http://www.interactiveweek.com/
4. While this means that determining geographic location is by no means infallible, Zook (2001) has shown a high correlation between the headquarter locations of companies and the registration information contained within domain names.
5. The figure for 2001 is somewhat questionable given that more than a quarter of the total is generated by Enron, which with $97.5 bn of online sales, far surpasses its closest competitor, IBM with $26 bn. As the investigation surrounding Enron's recent bankruptcy has revealed, much of these profits were illusionary.
6. In general there has been a steady drop in the rankings of top 'dot-com' firms in Interactive Week's list and a corresponding rise in established corporations. For example from 1999 to 2001, Amazon dropped from 12th to 21st, Travelocity from 17th to 82nd, E*trade from 18th to 26th, Buy.com from 20th to 44th, and Yahoo! from 21st to 40th. In contrast, Enron which was not rated in 1999 was ranked 1st in 2001, General Electric moved from not rated to 8th, and General Motors moved from not rated to 10th.
7. Although the algorithm used in this paper is one of many indexing techniques, sensitivity analysis shows that similar classifications result when other formulas based on medians or means rather than the maximum value are used. Moreover, the exclusion of datasets in the summed index produces relatively few changes in the categories in which regions are placed. For example, when only the Interactive Week dataset is used, regions that are better known for their role in the dot-com boom, such as Seattle and Los Angeles, drop from hubs to nodes and Chicago moves from a node to a hub. However, despite this movement, the regions retain

their respective specialisation classifications, e.g. e-commerce or lagging.

8. Moreover, while dot-com companies received much of the attention during the 1990s and included some major success stories it is uncertain how much of the internet economy consists of these types of firms. For example, the CREC (2000) argues, 'While "dot-com" companies have often been the face of the internet economy, interestingly they make up a very small part of it. Only 9.6% of the firms studied can be classified as "dot coms" with 95% or more of their revenue from the internet. [Based on 2000 data]'

REFERENCES

ABBATE, J. (1999), *Inventing the Internet*. Cambridge MA: MIT Press.

AMIN, A. & P. COHENDET (1999), Learning and Adaptation in Decentralised Business Networks. *Environment and Planning D-Society & Space* 17(1), pp. 87–104.

AOYAMA, Y. (2001), The Information Society, Japanese Style: Corner Stores as Hubs for E-Commerce Access. *In*: T.R. LEINBACH & S.D. BRUNN, eds., *Worlds of E-Commerce: Economic, Geographical and Social Dimensions*. Chichester, New York: Wiley.

ARNDT, S. & H. KIERZKOWSKI (2001), *Fragmentation: New Production Patterns in the World Economy*. Oxford: Oxford University Press.

AUDRETSCH, D.B. (1998), Agglomeration and the Location of Innovative Activity. *Oxford Review of Economic Policy*, Summer.

BRUNN, S.D. & M. DODGE (2001), Mapping the 'Worlds' of the World Wide Web. *American Behavioral Scientist*, June, pp. 1717–1739.

CAIRNCROSS, F. (1997), *The Death of Distance: How the Communications Revolution Will Change Our Lives*. Boston MA: Harvard Business School Press.

CASTELLS, M. (1989), *The Informational City: Information Technology, Economic Restructuring, and the Urban-Regional Process*. Oxford, Cambridge MA: Blackwell.

CENTER FOR RESEARCH IN ELECTRONIC COMMERCE (CREC) (2000), *The Internet Economy Indicators*. Austin: Graduate School of Business, University of Texas at Austin. Available from http://www.internet indicators.com/.

COWAN, R., P. DAVID & D. FORRAY (2000), The Explicit Economies of Knowledge Codifcation and Tacitness. *Industrial and Corporate Change* 9, pp. 211–253.

DAVIS, J. (1999), Eating the Fortune 500 for Launch. *Business 2.0*, July, pp. 72–78.

DEPARTMENT OF COMMERCE (2001), Electronic Commerce Homepage. Available from http://home.doc.gov/Electronic_Commerce/.

DODGE, M. & N. SHIODE (1998), Where on Earth is the Internet? An Empirical Investigation of the Spatial Patterns of Internet Real-Estate in Relation to Geospace in the United Kingdom. Paper read at Telecommunications and the City, Athens GA.

FISCHER, C.S. (1992), *America Calling: A Social History of the Telephone to 1940*. Berkeley CA: University of California Press.

FLORIDA, R. (1995), Toward the Learning Region. *Futures* 10.

FRIEDMANN, J. & G. WOLFF (1982), World City Formation: An Agenda for Research and Action. *International Journal of Urban and Regional Research* 6(30), pp. 309–344.

GERTLER, M.S. (1995), 'Being There': Proximity, Organization, and Culture in the Development and Adoption of Advanced Manufacturing Technologies. *Economic Geography* 26.

GERTLER, M.S. (2001), Tacit Knowledge and the Economic Geography of Context. Paper read at Nelson and Winter DRUID Conference, 12–15 June, at Aalborg, Denmark.

GILDER, G. & T. PETERS (1995), City vs. Country. *Forbes ASAP*, pp. 56–61.

GORMAN, S. (2002), Where are the Web Factories: The Urban Bias of E-Business Location. *Tijdschrift voor Economische en Sociale Geografie*, this issue.

GRAHAM, S. & S. MARVIN (1996), *Telecommunications and the City: Electronic Spaces, Urban Places*. London, New York: Routledge.

HARGITTAI, E. (1999), Weaving the Western Web: Explaining Differences in Internet Connectivity Among OECD Countries. *Telecommunications Policy*, Nov–Dec.

JACOBS, J. (1984), *Cities and the Wealth of Nations*. New York NY: Random House.

JOHNSON, C. (1977), *The Visible Hand*. Cambridge MA: Belknap Press.

JORDAN, T. (2001), Measuring the Internet: Host Counts Versus Business Plans. *Information, Communication & Society* 4(1), pp. 34–53.

KOLKO, J. (1999), The Death of Cities? The Death of Distance? Evidence from the Geography of Commercial Internet Usage. Paper read at Cities in the Global Information Society: An International Perspective, November, at Newcastle upon Tyne, UK.

LEAMER, E. & M. STORPER (2001), The Economic Geography of the Internet Age. NBER Working Paper 8450. Cambridge MA.

LEINBACH, T. (2001), Emergence of the Digital Economy and E-Commerce *In*: T.R. LEINBACH & S.D. BRUNN, eds., *Worlds of E-Commerce: Economic, Geographical and Social Dimensions*. Chichester, New York: Wiley.

LO, V. & M. GROTE (2002), Where Traders Go When Stock Exchanges Go Virtual – Concentration, Dissemination or Persistence? *In*: A. MULLINEUX, M. BALLING & F. LIEBMAN, eds., *Technology and Finance: Challenges for Financial Markets, Business Strategies and Policy Makers*. London: Routledge.

MALECKI, E. (1999), Knowledge and Regional Competitiveness. Paper read at The International Symposium: Knowledge, Education and Space, at Heidelberg, Germany.

MALECKI, E. (2000), The Internet: Its Economic Geography and Policy Implications. Paper read at Global Conference on Economic Geography, at Singapore.

MALECKI, E. & A. MCINTEE (2001), Making the Connections: Interconnecting the Networks of the Internet. Paper read at Digital Communities 2001 at Chicago IL.

MARKUSEN, A. (1996), Sticky Places in Slippery Space: A Typology of Industrial Districts. *Economic Geography* 72(3), pp. 293–314.

MOSS, M.L. & A. TOWNSEND (1997), Tracking the Net: Using Domain Names to Measure the Growth of the Internet in US Cities. *Journal of Urban Technology* 4(3), pp. 47–60.

MOSS, M.L. & A. TOWNSEND (2000), The Internet Backbone and the American Metropolis. *Information Society* 16(1), pp. 35–47.

NEGROPONTE, N. (1995), *Being Digital*. New York NY: Knopf.

NEGROPONTE, N. (1999), Being Rural. *Wired Magazine* 94.

O'KELLY, M.E. & T. GRUBESIC, (2002), Backbone Topology, Access and the Commercial Internet, 1997–2000. *Environment and Planning B* 29(4), pp. 533–552.

PALTRIDGE, S. (1997), *Internet Domain Names: Allocation Policies*. Paris: OECD Publications.

POLLARD, J. & M. STORPER (1996), A Tale of Twelve Cities: Metropolitan Employment Change in Dynamic Industries in the 1980s. *Economic Geography* 72, pp. 1–22.

PORTER, M.E. (1998), Clusters and Competition: New Agendas for Companies, Governments, and Institutions. *In*: M.E. PORTER, ed., *On Competition*. Boston MA: Harvard Businesss School Publishing.

PRED, A. (1977), *City Systems in Advanced Economics: Past Growth, Present Processes, and Future Development Options*. New York NY: Wiley.

REID, R. (1997), *Architects of the Web: 1,000 Days that Built the Future of Business*. New York NY: Wiley.

RICHARDSON, R. & A. GILLESPIE (2000), The Economic Development of Peripheral Rural Areas in the Information Age. *In*: M.I. WILSON & K.E. COREY, eds., *Information Techtonics*. Chichester: Wiley.

ROBINSON, K. & E. CRENSHAW (2002), Post-Industrial Transformations and Cyber-Space: A Cross-National Analysis of Internet Development. *Social Science Research* forthcoming.

SASSEN, S. (1994), *World Cities in a Gobal Economy*. Thousand Oaks CA: Pine Forge Press.

SAXENIAN, A. (1994), *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Cambridge MA: Harvard University Press.

SCOTT, A. (1995), The Geographic Foundations of Industrial Performance. *Competition and Change* 1(1), pp. 51–66.

STORPER, M. & R. WALKER (1989), *The Capitalist Imperative: Territory, Technology, and Industrial Growth*. Oxford, New York NY: Blackwell.

TELEGEOGRAPHY (2001), *Packet Geography 2002*. Washington DC: Telegeography Inc.

THRIFT, N. (1996), New Urban Eras and Old Technological Fears: Reconfiguring the Goodwill of Electronic Things. *Urban Studies* 33.

TOWNSEND, A. (2001), The Internet and the Rise of the New Network Cities, 1969–1999. *Environment and Planning B-Planning & Design* 28(1), pp. 39–58.

WALKER, R. (1995), Regulation and Flexible Specialization as Theories of Capitalist Development. *In*: H. LIGGET & D. PERRY, eds., *Spatial Practices: Critical Explorations in Social/Spatial Theory*. Thousand Oaks: Sage.

WHEELER, D. & M. O'KELLEY (1999), Network Topology and City Accessibility of the Commercial Internet. *Professional Geographer* 51(3), pp. 327–339.

ZELLNER, W. & ANDERSON, S. (1999), The Big Guys Go Online. *Business Week* September 6, pp. 30–32.

ZOOK, M. (2000), The Web of Production: The Economic Geography of Commercial Internet Content Production in the United States. *Environment & Planning A* 32, pp. 411–426.

ZOOK, M. (2001), Old Hierarchies or New Networks of Centrality? The Global Geography of the Internet Content Market. *American Behavioral Scientist*, June, pp. 1679–1696.