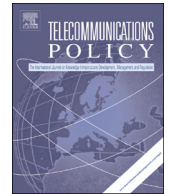


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# Telecommunications Policy

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## An econometric approach for evaluating the linkages between broadband and knowledge intensive firms



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### ABSTRACT

In addition to highlighting improvements in the availability and speed of broadband as a national priority, the National Broadband Plan also includes several recommendations for improving access and use of broadband by small businesses. The plan also recommends economic development officials include broadband in their local development strategies. While these are certainly import goals, more research is needed to evaluate how broadband impacts the regional business environment, and regional capacity to retain and attract businesses in particular industries. In order to further our understanding about the linkages between broadband and businesses, and the ability of places to retain and attract businesses in particular industries, this study will develop and estimate econometric models to better understand the linkages between broadband and firms in the knowledge intensive sector. Specifically, 54 metropolitan area specific models will be developed to examine regional variations in the linkages between broadband and firms in the knowledge intensive sector in 2004. Model results highlight the importance of broadband to knowledge firms in all but five metropolitan areas across the U.S. They also reveal variations in the impact of broadband on knowledge firm presence related to metropolitan area size and industrial legacy.

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### 1. Introduction

Since the privatization of the Internet in 1995 (Abbate, 1999) the number of users and also the means with which people and businesses access data over the Internet has evolved dramatically. Around 1995, users accessed the Internet at dial-up speeds of just 14.4 kilobits per second (Kbps) to 28.8 kbps (Atkinson, 2008). In 2000, 8 million Americans used the Internet compared to 200 million Americans in 2009 (FCC, 2010). Today, over 65% of Americans use residential broadband Internet connections (FCC, 2010) and people can access the Internet at broadband speeds of 4 megabits per second downstream (Mbps) and 1 Mbps upstream on fixed and wireless connections (FCC, 2012). In Kansas City, Google recently rolled out its 1 Gbps home Internet network at a cost to subscribers of \$70 per month (Farivar, 2012). Mobile devices are also used increasingly to access the web at 4 G LTE speeds with average download speeds around 6.5 Mbps and average upload speeds as fast as 5.0 Mbps (Sullivan, 2011).

While these advances in Internet access are impressive, the pace at which these improvements take place complicates researchers' ability to understand the impact of these technologies on businesses and individuals. In terms of individuals, our understanding of the factors driving adoption and use of the Internet is comparatively more complete than those driving business adoption and use. For example, we know that individual adoption of the Internet is impacted by income, race, age,

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and geographic location (Chakraborty & Bosman, 2005; FCC, 2010; Gabel & Kwan, 2001; Grubestic, 2004; Grubestic & Murray, 2004; Hoffman & Novak, 1999; Hu & Prieger, 2007; LaRose, Gregg, Strover, Straubhaar, & Carpenter, 2007; Mossberger, Tolbert, & McNeal 2006; Norris, 2001).

A lot of work has also been devoted to mapping and understanding the distribution of the Internet through space and time, and the data that are required to perform these tasks. Combined, distribution studies highlight the spatially uneven rollout of Internet infrastructure in the hands of private companies (Grubestic & Murray, 2002, 2004; Moss & Townsend, 2000). This body of work also demonstrates that the unevenness of broadband availability favors large urban centers compared to smaller cities and rural areas (Grubestic & Murray, 2004; Strover, 2001). Similarly, much work has been devoted to the impact of broadband on economic growth (Czernich, Falck, Kretschmer, & Woessmann, 2011; Holt & Jamison, 2009; Koutroumpis, 2009). Taken together, the research about the distribution, adoption and use, and impacts of the Internet is indeed voluminous. However, several challenges remain for researchers and policymakers, particularly as regards the faster Internet speeds of broadband on businesses. Open questions for research on business access and use include:

- How did the spatially uneven rollout of broadband infrastructure impact business adoption and use of the Internet?
- Does the linkage between broadband and businesses vary by industry?
- What are adoption barriers to more efficient uses of broadband in day-to-day business operations?
- Did the spatially uneven rollout of broadband impact business location?
- Does the spatially uneven geography of broadband availability impact the location of businesses in particular industry and local area capacity for cluster development?

In addition to highlighting improvements in the availability and speed of broadband as a national priority, the National Broadband Plan also includes several recommendations for improving access and use of broadband by small businesses (FCC, 2010). The plan also recommends economic development officials include broadband in their local development strategies (FCC, 2010). While these are important goals, more research is needed to evaluate how broadband impacts the regional business environment, and regional capacity to retain and attract businesses in particular industries.

The present study proposes to provide more information about the linkages between broadband and firms in the knowledge intensive sector using historical data from the Form 477 database of the Federal Communications Commission (FCC). This historical approach is important to understanding the impact of the *initial availability* of broadband on business climates when access and usage were less widespread than at present. Cross-sectional spatial econometric models are specified and estimated for 54 metropolitan areas across the U.S. to examine regional variations in the linkage between broadband and firms in the knowledge intensive sector in 2004. Model results highlight the importance of broadband to knowledge firms in all but five metropolitan areas across the U.S. They also reveal variations in the impact of broadband on knowledge firm presence related to metropolitan area size and industrial legacy.

## 2. Businesses and ICTs

Research examining the linkages between broadband and businesses is comparatively sparse relative to research examining business adoption and use of information and communications technologies (ICTs). From this perspective, the body of research examining the impact of ICTs on businesses can offer some insights about potential broadband impacts and items that merit additional inquiry. For example, a common perception of impacts is the reduced importance of geography given the space-time compressing ability of the Internet (Cairncross, 1997). However, studies assert the Internet does not eliminate the importance of place and the agglomerative benefits of cities (Graham, 1999; Leamer & Storper, 2001; Zook, 2002).

Instead, studies suggest a more nuanced relationship between ICTs and firm location (Atkinson, 1998; Audirac, 2005; Sohn, Kim, & Hewings, 2002, 2003; Warf, 1989). These studies suggest heterogeneities in this relationship that are related to the distribution of infrastructure (Sohn et al., 2002, 2003), firm industry membership (Forman, 2005; Forman, Goldfarb, & Greenstein, 2003), firm size (Gibbs, 2001; Gibbs & Tanner, 1997; Karshenas & Stoneman, 1993), and the skill level of workers (Capello, 1994; Peitchinis, 1992; Warf, 1989). For example, it is suggested that the geographic concentration of industry is related to the uneven distribution of infrastructure (Sohn et al., 2002, 2003) and that ICTs will only facilitate dispersion when the underlying infrastructure also becomes more evenly distributed (Sohn, 2004).

In terms of industry specific impacts, the results of a Hackler (2003) study examining linkages between high-tech industry growth and telecommunications capacity imply that the quality of telecommunications in cities may impact their ability to attract businesses in specific sectors. Several other studies examining adoption of dial-up Internet connections also reveal some important industry variations in adoption propensity (Forman et al., 2003; Forman, Goldfarb, & Greenstein, 2005a, 2005b, 2005c). These variations in adoption rates are likely related to four key industry characteristics: history of ICT use, labor cost, industry growth, and geographic proximity (Forman et al., 2005b).

A 2003 study by Forman et al. for example, found that the historical computing intensity of firms helped explain industrial variations in the adoption of dial-up for advanced uses such as e-commerce. In particular, they found that businesses in the information sector (NAICS 51) and management of companies and enterprises (NAICS 55) had the highest adoption rates of advanced Internet uses followed by finance and insurance businesses (NAICS 52) and businesses offering

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