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Industry variations in the broadband business nexus

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ABSTRACT

Although broadband Internet infrastructure is acknowledged as a key ingredient to competitiveness, an unfortunate aspect of current work is the dominant focus on households. Given the need for more research on the multidimensional relationship between broadband and businesses, or the broadband-business nexus, this study estimates econometric models to evaluate the impact of early broadband availability on future levels of business activity. Model results suggest regions with an early advantage in broadband provision had more business growth than other regions. Model results also highlight long-lasting spatial effects on business activity stemming from broadband spillovers from core hubs to neighboring areas.

1. Introduction

Technological change continues to be a fundamental driver of economic growth [36]. A landmark achievement in recent decades is high-speed broadband Internet connections, which have opened the door to unprecedented economic opportunity associated with a large number of innovations in products and services [5]. Due to the importance of Internet connectivity to job creation [38] and the economic development of regional and national economies [33], considerable attention has been dedicated to understanding the social and economic implications of uneven access to this critical infrastructure. Studies to this point have emphasized the socio-economic and demographic drivers of the demand for and supply of broadband [24]. Geographic perspectives on the distribution of the physical infrastructure necessary to access the Internet have highlighted uneven Internet access between and within metropolitan areas [18].

While early evaluations of uneven access divided people and regions into the haves and have-nots, this binary perspective on broadband infrastructure has evolved into a much more nuanced and complex issue related to variations in cost, platform choice, provider choice, and infrastructure reliability and performance [15]. Recognizing these inequalities, the case is being made that broadband provision functions like a utility and is as vital as electricity a century ago; thus emphasizing the importance of municipal broadband initiatives in filling service gaps [14]. The recent subsidy plan initiated by the Federal Communications Commission (FCC) to help provide low-income households with Internet access [23] only highlights the continued relevance of Internet infrastructure in a networked and technologically advanced digital economy.

Although broadband infrastructure is acknowledged as a key ingredient to competitiveness, an unfortunate aspect of current work is the dominant focus on households. This emphasis ignores business adoption and use, which account for a large proportion of the economic impacts associated with this infrastructure in terms of jobs, productivity impacts and GDP growth [25]. While recent work on broadband provision and business activity has uncovered industrial [22] and geographic [29,32] variations in this relationship, more research is needed on the multi-dimensional relationship between broadband access and business activity. The findings of prior work suggest that locales without broadband or poor quality broadband infrastructure, may be at a disadvantage in retaining and attracting businesses [30,32]. If true, this disadvantage impacts the ability of economic development entities to pursue cluster-oriented development strategies (i.e., high technology). To complicate matters, urban locales that were a point of initial broadband deployment efforts may have derived a first-mover advantage in retaining and attracting businesses due to the

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inertia behind infrastructure upgrades, which follow initial deployment locations because they represent the most favorable demand conditions and highest chances of recouping upgrade costs [3]. This suggests further limitations of places outside of core broadband deployment areas to overcome setbacks in business retention and attraction efforts stemming from initial disparities in Internet access.

Given the amount of money spent on deploying Internet infrastructure by the federal government, and the dearth of information about the linkages between broadband availability and businesses (the broadband business nexus), the goal of this study is to evaluate the impacts of early levels of broadband availability on future levels of business activity. In this regard, the goals of this paper are a) to investigate industrial variations in the long-term impact of early levels of broadband availability on business activity; and b) to examine the utility of various instruments to econometrically model this relationship. To examine industrial variations in this relationship, a national county-level dataset is used to construct econometric models to examine the impact of early levels of broadband availability on future levels of business activity. Results highlight long-lasting impacts of broadband market dynamics on neighboring areas of initial hubs of broadband availability. These long-lasting impacts are also specific to particular industries. While revealing, this look at one aspect of the broadband business nexus suggests new paths for research. In this regard, a research agenda is outlined at the close of the paper to highlight key areas for new research to better understand the dimensionality of this relationship and encourage more widespread participation across research disciplines.

2. Information and communication technologies (ICTs) and economic activity

Investments in telecommunications are positively linked to economic growth [6], and the development trajectory of regional economies [9]. More recently, studies have found similar positive linkages between broadband enabled telecommunications technologies and economic activity including gross domestic product [33] and employment [38]. Taken together, this research suggests that broadband is a part of nations' telecommunications infrastructure [13].

While research specific to broadband finds positive impacts on economic activity, studies suggest the need to consider nuances in the size of these impacts stemming from subtle industrial characteristics of the workforce and the quality of human capital at the individual and regional level [12], [4]; [31]. For example, Yilmaz, Haynes, and Dinc [40] uncovered that telecommunications infrastructure investments had the strongest impact on the wholesale trade, finance, insurance and real estate (FIRE) and services sectors. Kolko [26] found stronger impacts of broadband on economic growth for information intensive industries. In addition to industry-based variations in the economic impacts of broadband; studies of the quality of human capital and ICTs find evidence of skills-biased technological change related to computer-based technologies [12] and broadband presence at the regional level [31].

3. Evolutionary dynamics of ICTs

The evidence of skills biased technological change suggests that the provision of infrastructure alone is an insufficient solution for economic advancement [29]. Along these lines, several studies have suggested that telecommunications be one of many investments in regional economies. Dholakia and Harlam [9] for example, recommend that telecommunications be one of many economic development investments amongst other types of physical infrastructure (i.e. roads) as well as education and training. While investments in telecommunications alone are insufficient to the achievement of positive economic development outcomes, particularly in rural areas with a plethora of development issues [20,30], the provision of infrastructure is an essential precondition to achieving positive outcomes in non-rural locales. Broadband Internet connections are considered a general-purpose technology (GPT), which means that they provide opportunities for downstream innovational complementarities in other economic sectors besides telecommunications [5]. Further, Internet technologies have network effects [33], which means that the amount of economic benefits depend upon the number of users; the greater the number of users, the greater the economic benefits.

Unfortunately, the distribution of this infrastructure remains uneven in terms of basic geographic availability as well as the skills needed to unravel the economic benefits associated with broadband connections. This divide in basic availability and use is also known as the “digital divide” which refers generically to differences in access and use of information and communications technologies (ICTs). The dynamism associated with ICTs suggests that the phrase “digital divide” be viewed from an evolutionary perspective. This dynamism is related to technological change and the latest technologies that are considered ICTs. While fax machines and telephones were classified as ICTs in the 1970's, this definition has rapidly evolved to embody a new set of technologies that represent the convergence of telephone-oriented and computer-oriented technologies in smartphones and tablet-based access devices. As regards the diffusion of ICTs, studies find that the adoption rates of new ICTs are accelerating [7]. A recent study found it took just thirty-one years for one-quarter of the U.S. population to adopt the radio, which became commercially available in 1897, as compared to just seven years for the Internet, which became commercially available in 1991 [7]. The speeds at which people access the Internet have also increased tremendously since its initial years of commercial availability, from dial-up speeds between 14.4 and 28.8kbps [2], to 4G LTE speeds with download speeds of 6.5 Mbps and upload speeds of 5.0 Mbps [37].

4. The broadband-business nexus (BBN)

The importance of these speed increases, as well as many other facets of broadband adoption and use specific to businesses, remains largely unstudied. As mentioned previously, the volume of research about business adoption and use of broadband pales in comparison to the research about households. Given this lack of attention to the business side of Internet research, a conceptual framework for understanding this relationship or the Broadband Business Nexus (BBN) has been proposed. The BBN is defined as the reciprocal relationship between broadband availability and businesses [16]. Fig. 1 outlines the four dimensions of this nexus. The

Business to Business Interactions	Business to Telecommunications Interactions
Telecommunications to Business Interactions	Telecommunications to Telecommunications Interactions

Fig. 1. Dimensions of the broadband business nexus (BBN).
Source: Grubesic and Mack [16].

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