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Does closeness in virtual space complement urban space?

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ABSTRACT

The rapid growth of the internet poses a challenge for understanding how cities will grow in the future. An advantage of the internet is that groups can be close, in terms of interactions, without being close in physical space. Thus the internet may substitute for urban areas. Or the internet may increase the extent and scope of interactions so that the internet complements physical closeness. We compare the two possibilities, and using data from US states show that urban areas increase the per-capita demand for internet access, suggesting a complementary relation. The complementarity emanates more from consumers than producers.

1. Introduction[1]

Over about the last decade or so, the study of cities has accelerated because of the growing appreciation for the benefits of social interaction fostered in urban agglomerations (for example, see Refs. [2,8,14]. However, the prevalence of the internet poses an interesting challenge for thinking about the vitality of urban areas because it allows individuals to interact without being in the same local space. Further, an advantage of online interactions is the avoidance of the congestion that occurs in physical space. Therefore, it is reasonable to conclude that residents from rural areas will have a higher demand for internet connections relative to urban dwellers because they can substitute living in congested urban areas to make face to face interactions with creating interactions in virtual space. This research empirically finds, despite the possibility of substitution, that urban areas have a higher demand for internet connectivity. This result suggests that online interactions are complements, rather than substitutes, to offline interactions.

The empirical finding reported in this paper is evidence concerning an equally likely alternative process. By allowing communication without necessarily facing congestion costs, the internet might make it possible to use a city more fully. That is, if virtual communication is a complement to inter-personal interaction, the internet may serve to heighten the benefits while reducing the otherwise associated congestion costs. In this case, the internet will be a complement to urban areas, and the value of physical space will be enhanced by the availability of virtual space. People who study urban areas have been aware of the challenge posed by the internet at least since [11]. From this perspective, one of the great academic achievements has been to integrate the complexities of physical space into the academic understanding of cities. Now, an additional step will be required to integrate cyber-space into our understanding of cities.

We pose an interesting empirical question, which is whether there is a higher per-capita demand for the internet from urban areas, or from non-urban environments. Because urban agglomerations are rather fixed for a period of time while internet demand is much more variable, we focus our examination on how various aspects of the urban environment affect internet demand. Furthermore, by examining aggregate U.S. states rather than individual behavior, we can capture the combination of internet demand that comes from firms as well as individuals. The key features we examine include not only the level of urbanization within each state, but also whether the largest city in a state creates extra demand. Also, since one of the key features of urban environments is the creation of innovation, we include two variables in our empirical strategy to capture this important aspect. Specifically, we include state level patents and state level research and development expenditures (R&D) from all sources including firms.

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[1] This research benefitted from the face-to-face interaction fostered by Peter Nijkamp, who provided an excellent creative forum in the conference organized along with Karima Kourtit at the Tinbergen Institute Workshop, Amsterdam, May 19–20, 2014, “Real People in Virtual Space”.

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It can be argued that urban residents should have the least interest relative to rural dwellers in the internet because urban residents are already in such close proximity to both consumption choices, and contacts for productive requirements. Similarly, since rural residents are generally far from consumption opportunities as well as both complements and customers in production, rural dwellers should have a much higher demand compared to urban residents. Conversely, if being in a city generates demand for contact with people throughout the world, we might expect that urban dwellers have the higher relative demand for internet connections. Similarly, it may be that those with a high demand for consumption variety will explore variety across the globe as well as within their physical environment, while those with low demand for variety need it neither in their physical space nor their virtual space.

A similar trade-off exists for firms, especially those that rely on innovation to maintain their presence in markets. Higher R&D expenditures, as well as patent activity, may be stimulated by greater use of virtual space as these institutions will reach out anywhere to find an innovative edge. Conversely, it may be that physical contact and personal interaction are the methods by which innovation is best fostered.

To answer our question of the relative demand by urban dwellers for virtual space compared to physical proximity, we examine the aggregate internet subscription behavior of residents and firms across 50 U.S. states from 2000 to 2011. Specifically, consistent with the discussion above, this empirical research seeks to find whether residents and firms of urban areas are more or less likely to desire high speed internet access than those in non-urban areas. Further, in addition to a panel analysis of whether urbanization leads to more internet access, we separately examine whether larger cities have more or less internet access. Our hypothesis is that if city dwellers have sufficient personal interactions, there will be reduced demand for high speed internet access compared to rural residents, since rural residents will be looking for lower cost alternatives to an urban location. If the internet is an effective substitute for urban locations, those in rural locations will have very high internet demand. Conversely, it is possible that urban residency increases the demand for internet access, since it is possible that online activity enhances the urban experience.

One potential deficiency in our results is that internet access may alter the degree of urbanization. While we do not find this particularly likely, we, nonetheless, re-estimate our model using an instrumental variable (IV) regression model to account for this possibility. The model uses three instrumental variables; the first is federal aid to internet system based on income; the second is federal aid to internet system providers based on high provision costs typically associated with rural areas; the third is the percentage of public sector workers that are unionized. The empirical results from the IV model generally support our empirical conclusion that virtual space is not a substitute for urban space, but rather it complements urban activities.

We discuss the theoretical possibilities briefly in section 2 of this paper. Section 3 presents the annual data by state, as well as the specification of the empirical model. Section 4 shows the empirical results that cities and the internet work together with the internet even more important for larger cities. Interestingly, we find that urban populations are more important than R&D expenditures at generating internet demand. A final section concludes by discussing how our empirical work is consistent with the bulk of the literature that addresses this question.

2. Model discussion

Our discussion has been to consider the very real possibility that the internet could reduce the trend toward urbanization. Specifically, if the internet can create agglomeration benefits without physical contact, the necessity to co-locate may be much reduced. In such a case, the internet could substitute for cities and result in profound changes in the way people live as the tendency to disperse increases, consistent with the warning by Gilder in 1995 as to the potential "death of cities" if internet communications were substitutes for face-to-face communications.[2] In this case, that the internet could substitute for cities may cause profound changes in the way that people live as the tendency to disperse increases. We discuss some research findings below that suggest some of the dimensions about which the internet substitutes for cities. Conversely, the alternative is that internet connectivity increases the benefits of being located within cities. Such benefits could occur because agglomeration benefits that result from physical proximity can be achieved more efficiently. Alternatively, a different pathway might be that the internet helps to mitigate congestion costs, thus reducing the costs of being in a city. We do not explore the pathway through which either increased benefits or reduced costs might occur, but we present below some research that speaks to these issues. Following the discussion that suggests both process may occur, we present some statistical evidence on whether urban living increases the share of the population using high speed internet connections. The reduced form results of the empirical test reinforces the suspicion raised by our review of the literature, which is that the net benefits of urban location may be increased by the internet, in which case the internet may accelerate the propensity for urban living.

2.1. The internet as a substitute for urban locations

One of the conundrums in urban economic research has been isolating the sources of agglomeration economies [6,24]. Part of the discussion has been whether it is the interaction between firms which creates benefits, whether it is the interaction between people, or whether it is the joint interaction. For example, one reason that the internet may create a substitute for cities is potentially discussed by Ref. [18]. They discuss that what is important for creativity and innovation is creative occupations, rather than creative industries. In this context, it is easy to see that the internet may be effective at creating networks of professionals that do not necessarily live in proximity to each other. This is therefore the type of process by which the internet could substitute for urban proximity.

Another dimension by which the internet could substitute for cities depends on the process by which cities create innovation. For example, in a recent paper [22] discusses whether relationships depend on homophily or proximity. This distinction may be inadequate to fully describe whether the internet can substitute for cities, depending on in which dimensions it is that homophily matters. For example, if people desire sameness depending on physical characteristics, these can generally only be observed by proximity.[3] On the other hand, if homophily is determined by intellectual characteristics, then the internet may be a perfect substitute for proximity.

2.2. Reasons why the internet May enhance cities

Despite the validity of the processes discussed above, there are several strong reasons to believe the internet is not yet sufficiently

[2] George Gilder comment from, Forbes ASAP, February 27, 1995, quoted in Ref. [20]. Another popular phrase the "death of distance" was probably first used by Frances Cairncross, a writer for the *Economist*, who later published a book with the same title in 1997 and revised it in Ref. [3].

[3] Although perhaps as video conferencing technologies improve even this dimension could be replaced by virtual space.

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