Jeffrey Boase

THE CONSEQUENCES OF PERSONAL NETWORKS FOR INTERNET USE IN RURAL AREAS[1]

Why are there fewer Internet users in rural areas than in urban areas? Researchers addressing this question typically focus on the lack of Internet infrastructure and demographic factors in rural areas. Rural areas often lack affordable Internet connectivity and contain relatively high numbers of people who are unlikely to adopt Internet connections at home—specifically the elderly and those without a postsecondary education.Although infrastructure and demographics are undoubtedly important factors, equalizing Internet adoption in rural and urban areas may require more than simply providing infrastructure that is affordable to a population of the right demographic composition. Drawing on the personal network approach and the concept of direct network externality, the author argues that the composition of personal networks in rural areas may hamper general levels of Internet adoption and high-speed Internet connection at home. To examine the empirical validity of this argument, the author conducted descriptive and multivariate analyses on data collected from a random-digit dial survey of 2,200 American adults.

Keywords social networks, externality, rural, Internet, digital divide

Internet Use in Rural Areas

The Pew Internet & American Life Project's 2003 national sample survey of internet use in rural areas provides some of the most current and comprehensive findings publicly available regarding internet use in rural America. Findings from this survey show that although internet use is becoming an increasingly popular activity in rural America, it is still less prevalent than in urban and suburban America (Bell, Reddy & Rainie, 2004). For example, urban and suburban residents have a nearly 15 to 14 percent lead over rural residents in terms of internet use. Although broadband is growing in urban, suburban, and rural areas, broadband users make up a larger percentage of urban and suburban users than rural users. This study also finds that rural residents are more likely than urban

---

[1] The citation for this paper is:
Jeffrey Boase (2010) 'The Consequences of Personal Networks for Internet Use in Rural Areas', American Behavioral Scientist, 53:9, 1257-1267.

The final published version of this paper is available at:
http://abs.sagepub.com/cgi/reprint/53/9/1257

and suburban residents to depend on having an internet connection outside of the home. The report in which these results are published points both to lack of internet infrastructure and demographic factors -- especially age and income -- to explain these disparities in levels of internet use.

Using more recent tracking survey data, a data memo published by the Pew Internet & American Life Project in 2006 showed that although high-speed internet penetration is increasing throughout all parts of America, rural communities continue to lag behind (Horrigan & Murray, 2006). As of late 2005, 24 percent of Americans living in rural areas had high-speed internet connections, while 39 percent of urban and suburban residents had high-speed internet connections. As in the 2003 Pew report, lack of internet availability and demographic differences between rural and non-rural residents are cited as factors contributing to this gap.

The Influence of Personal Networks

In addition to demographics and internet infrastructure, personal networks may partially account for the relatively low levels of internet adoption in rural areas. Broadly defined, a personal network consists of all those relationships deemed significant by a given individual. The personal network approach stems from the social networks paradigm, which posits that social relationships strongly influence behavior, ideas, beliefs, and flows of information.

Those using the personal network approach sometimes explain the significance of personal networks through the use of economic analogies. For example, personal networks have been called 'social capital' to the extent that they yield information or resources (Lin, 2001). DiMaggio and Cohen (2003) also draw on economic theory to consider the influence of network externalities on the adoption patterns of television and the internet. They distinguish between *direct* network externality, whereby the value of adopting the internet varies directly with the number of people with whom one can interact online (e.g., by way of e-mail, file sharing programs, or online auction websites such as E-Bay), and *indirect* network externality, whereby the greater number of people using the internet increases the availability of services, products, information, and entertainment online. By virtue of having a direct connection to an individual, personal network composition may affect the direct network externality of using the internet.

In this paper I focus on the direct network externality of personal networks and examine if this type of externality further helps to explain the relatively low level of internet adoption in rural settings. However, unlike DiMaggio and Cohen who consider the direct network externality that includes all potential online interaction partners, I focus solely on the direct network externality that is created through personal networks. This means that I do not consider direct network externality

that occurs with those outside of an individual's personal network, such as strangers on file sharing networks or anonymous sellers on Amazon.com.

I focus on personal networks related to direct network externality for two reasons. First, following the social networks paradigm, I assume that personal network members are generally more influential than those outside of an individual's network, and will therefore have a greater impact on internet adoption. Second, using a limited definition of direct network externality allows for the use of specific personal network measures that can be directly linked to internet use. Note that examining the influence of direct personal network externality on rural internet adoption does not dispute the influence of infrastructure and demographics on internet adoption in rural areas. I consider personal network externality to be a previously unexamined factor that may also contribute to the relatively low level of internet use in rural areas.

Personal networks may be particularly influential in the decision to adopt the internet given the popularity of e-mail. This paper takes the direct network externality generated by way of e-mail as the main mechanism for explaining differential levels of internet adoption in rural and urban areas for two reasons. Although other socially oriented internet activities -- for example, the use of websites such as *Friendster* or more recently MySpace -- have rapidly gained and lost popularity, e-mail remains the most popular of internet activities (Pew, 2009). In fact, e-mail's popularity is explained in large part because it helps people maintain contact with their personal networks (Boase et al., 2006). While evidence generally suggests that it rarely replaces other forms of communication, it is clear that e-mail serves an important role as a part of a larger personal communication system that individuals use to stay connected to their personal networks (Boase, 2006). Although misunderstandings occur through e-mail due to a lack of synchronous auditory or visual feedback, individuals find ways of overcoming these issues (Menchick & Tian, 2008). Given its popularity, it is reasonable to infer that e-mail is a significant means through which direct network externality is generated. Moreover, although only a few years old, the data on which this paper is based were collected shortly before the rapid adoption of social networking sites and mobile phone based e-mail. Therefore, this focus on e-mail is particularly reasonable given the data at hand.

Although I have argued that knowing network members who have internet connections may be particularly influential for adoption because it allows for communication by way of e-mail, this argument is not particularly about e-mail. Rather, in broader terms, it is about how a personal network can influence the adoption of a new technology insofar as that technology allows or 'affords' communication with personal network members who themselves have access to the same

technology. For this reason, even though new platforms for internet based communication will continue to be widely adopted and may eventually dwarf the use of e-mail, that the adoption of internet based tools by personal network members will play a significant role in the decision to use the internet remains an important issue.

Few studies have examined the nature of rural personal networks in America using a nationally representative sample with standardized measures. For this reason it is difficult to say with certainty that rural personal networks differ from non-rural personal networks. Nevertheless, rural populations tend to differ demographically from non-rural populations, and this necessarily affects the demographic traits of individuals that are available for activities that build and maintain personal networks. Nationally representative surveys have shown that people living in rural areas tend to be somewhat older, less educated, and working in lower status occupations than people in non-rural areas (e.g. Bell, Reddy & Rainie, 2004; Horrigan & Murray, 2006). This implies that rural networks will tend to include larger numbers of people who share these demographic traits. Given that people who are older in age, lack college education, and work in low status occupations tend to be among the lowest adopters of the internet, it is likely that rural personal networks have high numbers of people who are unlikely to have internet access.

Given what has been said so far, I pose the following two hypotheses:

> Hypothesis 1: The negative relationship between rurality and Internet access will decrease when controlling for age, education, and occupation.
>
> Hypothesis 2: The negative relationship between rurality and Internet access will further decrease when controlling for the occupational diversity of per- sonal network members.

The age of personal network members is not considered because the data used for this analysis does not contain this information. I also do not consider the impact of internet infrastructure in rural areas on the negative relationship between rurality and internet access for the same reason.

As discussed above, people living in rural areas are less likely to have high-speed connections at home than people living elsewhere. For this reason, I further examine the influence that personal networks have on obtaining high-speed internet access at home. There are mixed reasons to consider the impact of personal networks on obtaining this kind of access, as opposed to internet access more generally. On the one hand, personal networks may act as only a weak network externality for obtaining high-speed internet access at home because personal networks are most likely to impact e-mail use, which requires minimum bandwidth and can be carried out with only

minimal time spent online. Unlike web surfing, that requires a constant internet connection, it is possible to compose e-mail offline and connect for only short periods of time online to send and receive e-mail. On the other hand, the burden of sending and receiving e-mail is significantly reduced by using a high-speed internet connection, and so direct personal network externality may add enough value that an individual feels inclined to adopt a high-speed connection at home. Considering the possible influence of personal networks on obtaining a high-speed internet connection at home, I hypothesize:

Hypothesis 3: The negative relationship between rurality and having high- speed Internet at home will decrease when controlling for age, education, and occupation.

Hypothesis 4: The negative relationship between rurality and having high-speed Internet at home will further decrease when controlling for the occupational diversity of personal network members.

Data and Method

The findings presented here are based on data collected from the Pew Internet & American Life Project's Social Ties Survey, a random digit dial telephone survey of 2,200 adults living in the continental USA. Interviews were conducted from February 17 to March 17, 2004, and lasted an average of 19 minutes per individual. All adults sampled had landline telephones (telephones that use physical outlets connected in one place) in their households, and all interviews were conducted in English. The response rate was 35%, and approximately 96% of those individuals who began the survey completed it in full. A comparison of sex, age, race, employment, and education variables from the Social Ties Survey with the same variables in the US Census Bureau's 2003 American Communities Survey indicates that the Social Ties sample is similar to the general American population in its demographic composition (Boase, 2006).

To measure the occupational diversity of personal networks, the Social Ties Survey used a variation of Lin's (2001) position generator method. Although Lin's original method asks respondents if they know anyone in occupations of varying prestige, this variation asks respondents if they know active ties in occupations of varying prestige. Active ties include kin, neighbors, workmates, and other ties that are more than just casual acquaintances. The survey is structured such that respondents are primed with this definition of active ties, and are then asked if they know any active ties in ten occupations of varying prestige. The occupations where chosen at roughly equal intervals from a list of occupations ranked on a prestige scale of 0 - 100 (prestige scores from Ganzeboom & Treiman, 1996).

In this paper this data on occupation diversity is analyzed somewhat differently than Lin. While Lin adds the results of these questions together to give a single scale indicating network diversity, this analysis adds together the results to give two scales: one indicating the diversity of ties in high prestige occupations, and the other indicating the diversity of ties in low prestige occupations. This scale is broken into two scales because I have argued that diversity is associated with e-mail use, such that people in high prestige occupations are more likely to have e-mail access than those in low prestige occupations. Social diversity can only matter for the use of e-mail if the diverse ties that an individual would like to communicate with have e-mail access. Given that the prestige scale from which the occupations were selected varies from 0 - 100 at roughly equal intervals, network members in occupations with prestige scores higher than 50 points are considered to be of high prestige, and network members with a score of 50 points or less are considered to be working in low prestige occupations.

In the Social Ties survey internet access is measured simply as going online. Having high-speed internet access at home is measured as having any type of internet connection at home other than a dial-up connection.

Rurality is coded using the 2003 Rural-Urban Continuum Codes (Beale Codes) which defines degree of rurality through a combination of county population and adjacency to metro areas (see United States Department of Agriculture, 2009). Although the Rural-Urban Continuum Codes originally used eight categories to indicate degree of rurality, several categories contained less than five percent of respondents. To ensure stronger statistical results, rurality was recoded into five categories, with each category containing at least ten percent of the respondents. The categories "urban fringe" and "city rural fringe" were collapsed into a single category, as were the categories "small urban fringe," "small city rural fringe," "rural fringe," and "rural".

Analysis and Results

This analysis starts with a bivariate correlation to confirm that rurality is negatively associated with internet access, in general, and high-speed access at home in particular. The existence of these relationships in the Pew Social Ties data is critical to the analysis that follows since they are assumed by all four research hypotheses. The existence of such relationships also indicates external validity of these measures in the Social Ties survey, since such relationships have been found in surveys discussed in the literature review section of this paper. Using Pearson correlation, these relationships in the Pew Social Ties data are confirmed -- there is a significant ($p < 0.001$) correlation of -0.11 between rurality and having any type of internet access, and a significant ($p <$

0.001) correlation of -0.11 between rurality and having high-speed internet access at home (Table 1).

Pearson correlations also confirm the negative association between rurality and having a college education (-0.12, $p < 0.001$) and working in a professional occupation (-0.09, $p < 0.001$). There is also a positive association between rurality and age (0.06, $p < 0.05$). As discussed above, Pearson correlations generally confirm that rurality is negatively associated with knowing people in high prestige occupations (-0.16, $p < 0.05$), and positively associated with knowing people in low prestige occupations (0.12, $p < 0.001$).

Correlation - Rurality

	Rurality
Any Internet Access	-0.11 **
High Speed at Home	-0.16 **
College +	-0.12 **
Professional	-0.09 **
Age	0.06 **
Ties in High Prestige Occupations	-0.06 **
Ties in Low Prestige Occupations	0.12 **

* $p < 0.05$, ** $p < 0.001$

Logit Regression - Any Internet Access

	Coef.	Z	Coef.	Z	Coef.	Z
Rurality	-0.17	-5.18 **	-0.11	-2.68 **	-0.09	-2.21 *
College +			1.65	10.78 **	1.43	9.05 **
Professional			0.98	5.46 **	0.89	4.90 **
Age			-0.21	-6.55 **	-0.20	-6.14 **
Age Sqrt			2.09	4.85 **	1.94	4.39 **
Ties in High Prestige Occupations					0.31	7.57 **
Ties in Low Prestige Occupations					-0.12	-3.51 **
Constant	1.00	16.19 **	-3.69	-2.61 **	-3.24	-2.24 *
Pseudo R-Squared		0.01		0.25		0.28

* $p < 0.05$, ** $p < 0.001$

The first hypothesis states that the negative relationship between rurality and internet access will decrease when controlling for age, education and occupation. Logit regression analysis is used

to examine this hypothesis because it implies the use of multivariate analysis and that the dependent variable (internet access) is dichotomous (Table 2). This analysis supports the hypothesis, showing a marked decrease in the size of the coefficient for rurality and internet access when age, education and occupation type are added. The size of the unstandardized negative coefficient decreases by more than a third, from -0.17 to -0.11, when controlling for age, education and occupation type. However, despite this substantial change in the size of this coefficient, it remains significant at the 0.001 level.

The second hypothesis states that the negative relationship between rurality and internet access will further decrease when controlling for occupational diversity of personal network members. This hypothesis is generally confirmed when controlling for the occupational diversity among active, core and significant ties. When controlling for the occupational diversity of active ties, the negative coefficient for rurality and internet access decreases from -0.11 to -0.09. Although this is not an extremely large decline in the size of the coefficient, the significance level of this coefficient drops from $p < 0.001$ to $p < 0.05$. This means that the addition of active tie occupational diversity decreases the statistical significance relationship between rurality and internet access to a threshold that is substantially lower.

Logit Regression - High-Speed Internet Access at Home

	Coef.	Z	Coef.	Z	Coef.	Z
Rurality	-0.30	-7.29 **	-0.25	-5.83 **	-0.23	-5.30 **
College +			0.62	5.39 **	0.39	3.22 **
Professional			0.51	4.19 **	0.43	3.46 **
Age			-0.12	-3.57 **	-0.11	-3.18 **
Age Sqrt			1.24	2.73 **	1.06	2.30 *
Ties in High Prestige Occupations					0.23	7.15 **
Ties in Low Prestige Occupations					-0.10	-3.10 **
Constant	-0.77	-12.56 **	-3.76	-2.62 **	-3.27	-2.24 *
Pseudo R-Squared		0.02		0.10		0.12

* $p < 0.05$, ** $p < 0.001$

The third hypothesis states that the negative relationship between rurality and having high-speed internet at home will decrease when controlling for age, education and occupation. Logit regression analysis shows minor support for this hypothesis, indicating a decrease of approximately 17 percent, from -0.30 to -0.25, in the unstandardized coefficient for rurality and high-speed internet access at home when controlling for age, education and occupation type (Table 3).

The fourth hypothesis states that the negative relationship between rurality and having high-speed internet access at home will further decrease when controlling for occupational diversity of personal network members. Adding active tie occupational diversity to the analysis shows little support for this hypothesis -- the coefficient for rurality and high-speed internet at home decreases only slightly when controlling for active tie occupational diversity (from -0.25 to -0.23). Moreover, the significance level of the association between rurality and high-speed internet at home remains at the same threshold ($p < 0.001$) after adding the occupational diversity control variable.

Discussion and Conclusion

The results of this analysis show modest support for the argument that internet adoption is lower in rural areas due to relatively low levels of direct network externality. At least in regard to the adoption of the internet, considering the occupational prestige of personal networks in addition to demographic characteristics helps to explain why people in rural areas are less likely to have internet access than people living in more urban areas. This suggests that although improving internet infrastructure in rural areas will certainly reduce inequality in access, direct network externality may work somewhat against internet adoption in these areas because the network ties with whom individuals would like to communicate with online may not have internet access.

Although this analysis indicates that direct network externality helps to explain why general internet access is relatively low in rural areas, it does not help to explain why people living in rural areas are less likely than those living in non-rural areas to have high-speed internet access at home. There are at least two possible explanations for this finding. First, it is possible that since high-speed internet infrastructure is generally lacking more in rural areas and urban areas, direct network externality has less opportunity to influence the adoption of these services in rural areas. Nevertheless, this explanation seems less plausible when considering that demographic control variables had a significant role in explaining the relatively low adoption of high-speed internet at home in rural areas. If these results were completely due to a lack of high-speed infrastructure in rural areas, these demographic variables should not have had an impact on the relationship between rurality and high-speed internet access at home.

Second, it is possible that because e-mail is the most popular internet activity for maintaining personal networks (Boase, 2006) and it is less demanding of a high-speed connection than other internet activities, direct network externality has little influence on the decision to adopt high-speed internet at home. As argued above, the data that was used as the basis of this analysis was collected before the explosion in the number of users adopting bandwidth intense social media

websites, such as Flicker or Facebook. It is possible that the direct network externality of these socially oriented websites has meant an increase in the value of broadband connections in recent years.

Even though the personal network measures employed here are robust and directly associated with the highly common and intrinsically social activity of sending and receiving e-mail, future studies would do well to consider the impact of other kinds of personal network properties on a variety internet activities. The influence of having strong ties with individuals who are highly internet savvy, or perhaps numerous weak ties with people who use social network websites, such as Facebook, might also influence the decision to adopt high-speed internet at home. Considering these kinds of ties may be particularly important given that they may be less likely to exist in rural communities than in other places. Future researchers would also do well to consider the role of direct network externality on the dis-adoption (versus continued use) of the internet in rural areas, since it has been shown that significant numbers of people who adopt the internet eventually stop using it all together (Katz & Aspden, 1997; DiMaggio & Celeste, 2004). It is possible that network externality may play a significant role in the decision to stop using the internet in rural areas, which may also be contributing to the relatively low levels of internet use in these areas.

Although direct network externality influences internet adoption in rural areas, there may be other types of asocial internet activities that motivate internet adoption as well. In this issue Collins & Wellman show that people living in a Canadian rural community value the asocial web services that provide them with information about health, finances, and shopping. Moreover, they show that direct network externality does not need to be local, as people living in this community were especially interested in connecting with geographically distance friends and kin. Accordingly, future research should consider how both direct network externality and asocial internet activities influence internet adoption and continued use in rural areas.

This paper has been among the first to examine the influence of personal networks on internet use in rural areas. It has provided some evidence that direct network externality may be a previously unexplored factor that contributes to the lower levels of internet use in rural areas than in urban areas. As argued above, although e-mail was likely the key type of internet activity that generated direct network externality when the data for this survey was collected, the implications of this study are not limited to this particular type of internet use or this point in time. More broadly the findings indicate that personal networks can make a difference in the decision to adopt and use the internet. This implies that simply making infrastructure more available in rural areas may not completely erase these differences. Nevertheless, although not a sufficient condition, the continued

development of internet infrastructure in rural areas is an necessary condition of greater equality in internet access.

References

Bell, P., Reddy, P., & Rainie, L. (2004). Rural Areas and the Internet. Pew Internet & American Life Project. Washington, D.C.

Boase, J. (2008). Personal Networks and the Personal Communication System: Using Multiple Media to Connect. Information, Communication & Society, 11(4), 490.

Boase, J., Horrigan, J. B., Wellman, B., & Rainie, L. (2006). The Strength of Internet Ties. Washington, D.C.: Pew Internet & American Life Project.

DiMaggio, P., & Celeste, C. E. (2004). Technological Careers: Adoption, Deepening and Dropping Out in a Panel of Internet Users. In Conference Paper presented at the annual meetings of the Eastern Sociological Society, February (pp. 19-21).

DiMaggio, P., & Cohen, J. (2004). Information Inequality and Network Externalities: A Comparative Study of the Diffusion of Television and the Internet. The Economic Sociology of Capitalism.

Ganzeboom, H. B., & Treiman, D. J. (1996). Internationally Comparable Measures of Occupational Status for the 1988 International Standard Classification of Occupations. Social Science Research, 25, 201-239.

Horrigan, J., & Murray, K. (2006). Rural Broadband Internet Use - Data Memo. Washington, D.C.: Pew Internet & American Life Project.

Katz, J., & Aspden, P. (1997). Motives, Hurdles, and Dropouts. Communications of the ACM, 40 (4), 97-102.

Lin, N. (2001). Social Capital: A Theory of Social Structure and Action. Cambridge: Cambridge University Press.

Menchik, D. A., & Tian, X. (2008). Putting Social Context into Text: The Semiotics of E-mail Interaction. American Journal of Sociology, 114(2), 332-370.

Pew. (2009). Usage Over Time. Pew Internet & American Life Project. Retrieved from http://www.pewinternet.org/Data-Tools/Download-Data/~/media/Infographics/Trend%20Data/January%202009%20updates/UsageOverTime_Mar_11_2009%20-%20Read%20Only.zip.

United States Department of Agriculture. (2009). Measuring Rurality: Rural-Urban Continuum Codes. Retrieved from http://www.ers.usda.gov/Briefing/Rurality/RuralUrbCon/.