Measuring Change in Internet Use and Broadband Adoption:

Comparing BTOP Smart Communities and Other Chicago Neighborhoods

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EXECUTIVE SUMMARY

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This report examines change in Chicago neighborhoods that received federal stimulus funding to encourage broadband adoption. Using data from 2008 and 2011 to measure change, do the neighborhoods that participated in the program look different from other Chicago community areas? Have they experienced a higher rate of change in Internet use, broadband adoption at home, or activities online than other similar neighborhoods that did not receive the program? Our findings indicate that there is a significant difference in Internet use for the neighborhoods participating in the Smart Communities program – a 15 percentage point higher rate of change than in other similar community areas.

The City of Chicago Smart Communities program received $7 million of federal funding in 2010 to deliver a number of training and outreach initiatives in 9 low and moderate-income neighborhoods. This program continued some initial efforts in the same neighborhoods, the Digital Excellence Demonstration Communities, which were begun in 2009 with the support of the John D. and Catherine T. MacArthur Foundation.

What are the Smart Communities? The City has worked with the Chicago Local Initiative Support Corporation (LISC) and a number of community organizations to provide basic Internet training in English and Spanish, digital summer jobs, training and technical assistance for small businesses, and classes for neighborhood groups researching services and issues online. Digital media programs for youth have been offered by the Digital Youth Network and the Chicago Public Library. Centers also provide some public access. Outreach has encouraged broadband adoption (whether or not neighborhood residents participated in programs) and has been conducted through Tech Organizers, neighborhood portals, and advertising on buses and transit shelters. Additionally, program partners hope that community organizations and word-of-mouth among neighborhood residents will further encourage Internet use and broadband adoption at home.

One of the aims of the Smart Communities is to create a culture of digital excellence, or information technology use, throughout the participating neighborhoods. To evaluate the effectiveness of the program, we measure change in Internet access, use and online activities across the Smart Communities, comparing them to other neighborhoods in Chicago.

Using unique neighborhood-level data from two citywide studies of Internet use in Chicago that were conducted in 2008 and 2011, we are able to track these changes for the official community areas of Chicago. Each of the citywide studies estimated Internet use, broadband adoption, and activities online for the 77 community areas, based on citywide surveys and multilevel statistical models. Changes in these estimates for all community areas were then compared across both time periods, controlling for other factors, such as changes in the poverty, educational attainment, race, ethnicity, and age of the population in the community areas.

- The analysis shows that between 2008 and 2011, the Smart Communities had a statistically significant 15 percentage-point increase in Internet use, compared to other Chicago community areas, and controlling for demographic change (such as gentrification).
- This increase was for residents who used the Internet in any location, including many who do not have broadband at home. It included Internet users who are able to use the Internet only on smartphones, or at libraries, community centers, coffee shops, the homes of friends and relatives, and other places outside the home.
- Home broadband adoption and activities online (for job search, health information, education, or government services) were not significantly different in the Smart Communities compared to other Chicago neighborhoods.
- While it is impossible to rule out all explanations for this change other than the Smart Communities programs, the 15 percentage-point difference in Internet use is substantively large and indicates that changes for these community areas are indeed different than for other Chicago neighborhoods with similar populations. That is, such a large change would not have occurred by chance.
- Given that the treatment (or program) consisted of training and outreach rather than lower cost broadband, it could be expected to influence Internet use in any location to a greater extent than home broadband subscriptions. While outreach and training may create greater awareness of the benefits of broadband use and offer residents the skills needed to go online, home broadband adoption may still be difficult for those who cannot afford the monthly bill or a computer.
- Although the higher increase in residents who are Internet users within the Smart Communities is an important first step toward greater broadband use, research shows that individuals who have broadband at home are more likely to engage in activities online that are related to health, education, government services and more. They are also more likely to have the skills to use the Internet, including skills that are valuable for jobs (Mossberger, Tolbert and Hamilton 2012; DiMaggio and Bonikowski 2008).
- Prior research on barriers to broadband adoption in Chicago indicates that the cost of broadband is a problem for low-income residents, and that for those who live in high-poverty communities, the problem of affordability is even more pronounced (Mossberger, Tolbert, Bowen and Jimenez 2012; Mossberger, Tolbert and Franko 2012).

These findings suggest that the cost of broadband at home is still a barrier for many residents in the Smart Communities. One of the issues for public policy going forward is whether or how to address the affordability of broadband. The Smart Communities initiatives were funded by the Broadband Technology Opportunities Program (BTOP), which invested over $7 billion in federal stimulus funding to increase broadband adoption in communities around the nation. In urban areas, however, the BTOP program mostly funded training and outreach. The Comcast Internet Essentials program, which began in Fall 2009, offers discounted broadband at $9.95 a month to households with children enrolled in the free or reduced-price school lunch program. This is an important resource, but not all households in need are eligible for Internet Essentials. The Federal Communications Commission is considering reforms to the Universal Service Fund that would subsidize broadband access for low-income individuals (rather than subsidizing phone service, as the current program does). Some experts have called for greater competition in the broadband market in order to lower prices overall, and to make broadband more affordable (Crawford 2013, Berkman Center 2010). The recent Federal Communications Commission proposal for powerful and free public wireless networks would be an important step in addressing the cost barrier for broadband connectivity (Kang 2013).

This study is part of a continuing effort to evaluate the Smart Communities and to track broadband use in Chicago over time. The citywide survey is being repeated in 2013 and will provide more information about trends over time. For example, the survey used in the 2011 study was conducted in summer 2011, prior to the introduction of the Internet Essential program. The 2013 survey will provide an opportunity to examine whether broadband adoption at home increased in the Smart Communities, or whether activities online related to jobs, health, education, and government services increased as new Internet users gained more experience. In 2013, a program evaluation of the participants in the Smart Communities training programs will also provide more information about the direct effects of these programs.

The methods and findings discussed in this report have, we believe, wider significance for the evaluation of federal broadband programs undertaken as part of the stimulus efforts, and for methods to evaluate community-level impacts. Policy interventions are often place-based, and geographic measures of change offer community residents and policymakers useful data for targeting and investing scarce resources going forward. Inequalities in technology use affect the potential for community development and vitality, as well as the opportunities for residents to be digital citizens who are able to participate fully in society online, with access to critical information and services (Mossberger, Tolbert and McNeal 2008).

We thank Partnership for a Connected Illinois (PCI) for funding the 2011 citywide survey and analysis used here, as well as the forthcoming 2013 survey and analysis. The 2008 citywide study was funded by the John D. and Catherine T. MacArthur Foundation and the Illinois Department of Commerce and Economic Opportunity. This study would not have been possible without the support of these funders, but the analysis and conclusions drawn here are the sole responsibility of the authors.

The Broadband Technology Opportunities Program (BTOP) invested over $7 billion in federal stimulus funding to increase broadband adoption in communities around the nation, and as the interventions are ending in 2012 and 2013, there is a need to examine what change has occurred, and whether federally funded programs to increase high-speed Internet use have been effective.

One such program is Chicago's Smart Communities initiative, which received a $7 million Sustainable Broadband Adoption (SBA) grant as part of BTOP. Chicago's Smart Communities program brings together a number of training and outreach efforts in 9 low and moderate-income neighborhoods, with the aim of creating a culture of digital excellence, or information technology use throughout the communities.

In the Smart Communities, the City of Chicago has worked with the Chicago Local Initiative Support Corporation (LISC) and a number of community organizations to provide basic Internet training in English and Spanish, digital summer jobs, training and technical assistance for small businesses, and classes for neighborhood groups researching services and issues online. Digital media programs for youth have been offered by the Digital Youth Network and the Chicago Public Library. The programs also provided some public access. Outreach has encouraged broadband adoption and has been conducted through Tech Organizers, neighborhood portals, and advertising on buses and transit shelters. Additionally, community organizations and word-of-mouth among neighborhood residents may further encourage Internet use and broadband adoption at home.

To evaluate the effectiveness of this program, we measure change in Internet access, use and online activities across the Smart Communities and other neighborhoods in Chicago.

The analysis shows that between 2008 and 2011, the Smart Communities had a statistically significant 15 percentage-point increase in Internet use, compared to other Chicago community areas, and controlling for demographic change (such as gentrification). This means there was an increase in Internet users, including those who do not have broadband at home, but use the Internet on smartphones or who use public access sites like libraries, the homes of friends and relatives, or other Internet connections at places outside the home. Home broadband adoption and activities online were not significantly different in the Smart Communities compared to other Chicago neighborhoods. While it is impossible to rule out all explanations for this change other than the Smart Communities efforts, the 15 percentage-point difference is substantively large and is unlikely to have occurred by chance. Given that the treatment was training and outreach rather than lower cost broadband, it could be expected to influence Internet use in any location to a greater extent than home broadband subscriptions.

Why measure broadband use geographically? As discussed below, the role of place is important for research and policy addressing the "digital divide" and broadband use. Inequalities in technology use affect the potential for community development and vitality, as well as the opportunities for residents to be digital citizens who are able to participate fully in society online, with access to critical information and services (Mossberger, Tolbert and McNeal 2008).

Internet use (and the access to information and services it allows) affords benefits to the individual user. This can be measured by participant surveys in an evaluation study. But the benefits spreading through networks of individuals and the surrounding community may be many times larger. Measuring access by place provides a way to aggregate impacts for individual residents and to suggest potential spillover benefits for neighborhoods. The Smart Communities are part of a larger neighborhood-revitalization effort called the New Communities Program, and technology use is intended to support more general change in community outcomes.

The methods and findings discussed in this report have, we believe, wider significance for the evaluation of federal broadband programs undertaken as part of the stimulus efforts, and for methods to evaluate community-level impacts. Policy interventions are often place-based, and geographic measures of change offer community residents and policymakers useful data for understanding whether programs are effective and how to target and invest scarce resources going forward.

The next section of this report discusses the importance of place for evaluating broadband impacts, especially in the context of urban neighborhoods. It briefly describes the goals and activities of the Smart Communities program, some challenges for measuring community-level change, and the advantages of the unique data presented here. The balance of the report discusses in more detail the methods used in the study, a comparison of the 2008 and 2011 estimates, and the results of a statistical analysis. The conclusion discusses the policy implications of these findings as well as questions for further research, especially when Smart Communities participant surveys and additional citywide survey findings will be available in 2013.

RESEARCH ON NEIGHBORHOODS AND INTERNET USE

How does Internet use matter for neighborhoods? Given the significance of the Internet for so many social and economic activities, patterns of technology use across neighborhoods may ameliorate or exacerbate spatial disadvantage. Among the effects attributed to the concentration of poverty are disparities in health (Currie 2011), education (Jacob and Ludwig 2011; Jargowsky and El Komi 2011), labor markets (Wilson 1987; Granovetter 1973; Bayer, Ross, and Topa 2008), collective efficacy (Sampson, Raudenbush, and Earls 1997), and political participation (Alex-Assensoh 1997). While there are multiple individual-level and community-level factors that affect these outcomes, access to the information and communication opportunities online represent potential resources for addressing needs in many of these policy areas. Broadband use can provide information capital for community development and human capital for neighborhood economic development.

Low-income communities have high rates of chronic disease (Currie 2011), and Internet use may provide new resources for healthy neighborhoods. Limited options for safe exercise, poverty-induced stress, and “food deserts” lacking in fresh produce contribute to health disparities. Improved access to health information online may offer strategies for coping with environmental constraints such as “food deserts” or for prevention and control of illnesses that are common in some low-income communities, such as diabetes and high blood pressure.

Disparities in Internet access affect the more general educational environment for neighborhood schools, beyond the burdens they create for individual students. In communities where many families lack home broadband, educators may feel constrained in assigning homework or research outside the classroom. Home broadband also enables parents to connect to schools and follow their children's progress through school portals.

Residents of poor neighborhoods are often isolated from better paying jobs because they lack sufficient information about opportunities in their informal information networks (Granovetter 1973). To a greater extent than most, residents of high-poverty neighborhoods rely upon strong ties for job referrals; they are less likely to have the weak ties outside their closest circle of friends and relative to provide links to better jobs (Elliott 1999; Kleit 2001). The Internet can possibly supplement the personal networks of individuals in poor neighborhoods, overcoming some of the constraints of the immediate environment.

Local civic engagement and efficacy may be encouraged by broadband use. Collective efficacy in a neighborhood is based on social cohesion and community enforcement of social norms (Hampton 2010). Policy experiments have indicated that communication through the Internet on neighborhood listservs may have positive effects for organizing low-income communities for collective efficacy (ibid.) Similarly, residence in an area of concentrated poverty is associated with low rates of political participation (Alex-Assensoh 1997). The Internet can connect residents with online news, e-government websites, blogs, and social media, supplementing the information available in neighborhood networks. There are already substantial disparities in political participation based on education and income (Schlozman, Verba and Brady 2010). To the extent that more information, discussion, and communication are moving online, residents of high-poverty neighborhoods will be further excluded from democratic engagement and representation.

Neighborhood characteristics such as concentrated poverty are related to Internet use as well. Community income matters for Internet access and use across racial and ethnic groups, according to one national study that used multilevel models to control for both neighborhood and individual characteristics (Mossberger, Tolbert and Gilbert 2006). In fact, it is neighborhood factors that explain the gap in technology use between African Americans and whites – it is poor African Americans living in high-poverty communities that are affected by technology disparities rather than African Americans as a whole. For Latinos, place effects are significant, but do not entirely explain the inequalities (Mossberger, Tolbert and Gilbert 2006).

An analysis of the 2008 Chicago data used as the baseline for this study provides information about the most important barriers to home broadband adoption in Chicago's neighborhoods. Residents who are low-income are most likely to cite affordability as an issue, and Latinos emerge as the group most sensitive to cost. Residence in high-minority neighborhoods increases barriers for home Internet access for African Americans and Latinos: cost and lack of skill for African Americans, and cost, skill and lack of interest for Latinos (Mossberger, Tolbert, Bowen and Jimenez 2012).

But, there is also the possibility that programs supporting broadband access and use can overcome these barriers and create more connected communities through spillovers beyond the trainees involved directly in programs. An individual's purchase of a home computer is more likely in geographic areas where a high proportion of households already own computers (Goolsbee and Klenow 2000). Local spillovers and learning from others also could be expected for broadband adoption. This may be especially true in low-income communities, where there is high Internet use outside the home, including at the homes of friends and relatives (Mossberger, Kaplan and Gilbert 2008; Mossberger, Tolbert and Stansbury 2003). To the extent that outreach and advertising are present in technology initiatives, these activities may promote awareness and adoption as well, beyond the trainees.

SMART COMMUNITIES PROGRAM

The federal Sustainable Broadband Adoption program that funded the Smart Communities had a goal of increasing broadband subscribership in underserved communities. This is therefore an important goal for the Smart Communities as well, although not the only one. The program's plan envisions the creation of digital excellence community-wide as a means of achieving other community development goals (LISC 2009). In keeping with the idea of promoting broad, community-level change, the Smart Communities program embraced a number of activities reaching multiple constituencies, including training and technology programs for residents, businesses, community organizations and youth. Cross-cutting outreach and awareness activities by Tech Organizers connected these different initiatives, and community portals served as vehicles to promote information technology use within the neighborhoods.

The program components that addressed affordability were modest, partly because the original plans called for low-cost fiber to the home networks that were part of an infrastructure BTOP grant that was not funded. Computers were distributed to 1,500 residents and businesses. Financial counseling was available to assist participants in budgeting for broadband services. Smart Communities organizers referred eligible residents to the Internet Essentials program, which provided discounted broadband to households with children participating in free or reduced lunch programs. The survey used in this study, however, was conducted before the start of the Internet Essentials program in Fall 2011, and so for the period under study here there was little that directly addressed the monthly cost of broadband connections.

The roll-out of the Smart Communities BTOP program began in 9 community areas in October 2010. In 2009, however, these communities also were part of the Digital Excellence Demonstration Communities (DEDC), which were funded by the John D. and Catherine T. MacArthur Foundation. The DEDC initiative provided staff to organize outreach and to coordinate programs in each community, but the training did not begin until the BTOP investments. The target neighborhoods are majority African-American and Latino (see Mossberger, Tolbert and Franko 2012, 197 for the 5 lead agency community areas). Although activities throughout the community and social networks are expected to contribute to broader awareness and use of technology, the goal of reaching 11,000 residents with information or training is still modest in comparison with the number of residents without broadband, which are estimated to range from more than 15,000 in Englewood to more than 34,000 in Auburn Gresham (Mossberger 2012; Mossberger, Tolbert and Franko 2012).

Our research question is whether the Smart Communities program, or treatment, made any difference?

Evaluations of local programs to provide Internet access or skills tend to rely on surveys of participants. While valuable, these are not random sample surveys that can be used to predict behavior for populations. Panel surveys where respondents are repeatedly interviewed can measure change over time, but these surveys are very costly, difficult to conduct, and don't allow a measure of the spillover benefits of technology use for communities. In this research we measure what percent of the population has access and uses the technology for online activities at the community level in one major U.S. city, Chicago, and how this has changed over time. This quantity of interest is unknown, and must be estimated. We measure Internet use geographically, which allows a measure of the broader spillover effects of Internet use and digital citizenship.

METHODS

How do we estimate access and use for communities? Our estimates are based on citywide surveys conducted in 2008 (3500 respondents) and 2011 (2500 respondents) to measure Internet access and digital citizenship in Chicago. The surveys are conducted by the Eagleton Institute at Rutgers University. The random sample telephone surveys are based on a unique geographic sampling frame, where respondents were drawn from each of Chicago's 77 community areas (stratified sample). To increase the probability of interviewing low-income respondents, the samples include cell phone and landlines, congruent with the population use at the time, as reported by the CDC. The interviews were conducted in Spanish and English. Similar questions on Internet access and activities online were asked in both years, allowing a comparison over time. While obtaining citywide estimates of Internet use from such surveys is fairly straightforward, how do we obtain estimates of access for smaller geographic areas, such as neighborhoods?

There are problems using simple disaggregation from typical surveys to create geographic estimates, since most surveys have a small number of cases in any one area. To overcome this problem, we use multilevel statistical modeling (hierarchical linear modeling) to estimate Internet access and use for Chicago neighborhoods.

Respondents in the two surveys were asked to identify their cross-streets. This information was used to geocode each respondent and place them in a census tract. The survey data was merged with aggregate level census tract information from the U.S. Census measuring the percent of the population in poverty, educational attainment (percent high school graduates), percent black, Latino and Asian American and percent over 65 years of age (see Appendix Table 1A). The statistical models are based on data that combines individual and aggregate variables. We leverage the neighborhood-level data to provide more accurate and representative estimates than could be obtained from the individual-level data alone.

We use random intercept multilevel statistical modeling with post-stratification weights (and simulations) to generate geographic estimates of broadband access and online activities (see Lax and Phillips 2009 for a related methodology). This method creates geographic estimates of critical outcome variables, but leverages the neighborhood-level socioeconomic data to improve estimates based on individual-level data. This method has been shown to work well with a small number of cases in each geographic area (Lax and Phillips 2009; Raudenbush and Bryk 2002;

Snijders and Bosker 2011; Steenbergen and Jones 2002). The results are point estimates or predictions of Internet access and use for various online activities for each of Chicago's 77 community areas for 2008 and 2011 (see Appendix Table 2A).

Our null hypothesis is that the designation as a Smart Community made no difference in terms of Internet use and digital citizenship, compared to other Chicago communities. The alternative hypothesis is that the Smart Communities have higher rates of Internet use and broadband adoption than areas not targeted for the program. This hypothesis is tested with empirical data.

The Smart Communities initiative began in 2010 following the DEDC in 2009, so our data covers a period of about two years of initiatives, with the training primarily in the last 9 months, and some planning and organizing prior to that. We use the estimates of Internet access and use in Chicago neighborhoods in 2008 and 2011 to measure change over this time period. We test whether change in Internet use is higher in the nine community areas designed as Smart Communities than in other Chicago neighborhoods without this program. Table 1 lists the nine Smart Communities and the estimate of the percentage of the population with home broadband access in 2008 and 2011, and the change over this time period. The second column lists the estimates for Internet use anywhere for the two years, and the change. Some neighborhoods, such West Englewood, Auburn Gresham and the Lower West Side saw increases in Internet use of more than 20% during this three year period. That equates to 1 in 5 neighborhood residents coming online during this three year window.

Table 1. Access to the Internet, Smart Communities Estimates, 2008 and 2011

	Broadband at Home			**Internet Use Anywhere**		
Community	**2008**	**2011**	**Change**	**2008**	**2011**	**Change**
Humboldt Park	0.43	0.48	0.05	0.68	0.74	0.06
Lower West Side	0.389	0.5	0.11	0.62	0.79	0.18
Englewood	0.561	0.56	0.00	0.80	0.8	0.01
West Englewood	0.3507	0.63	0.28	0.59	0.86	0.27
Auburn Gresham	0.384	0.56	0.18	0.60	0.82	0.22
Chicago Lawn	0.515	0.66	0.15	0.75	0.85	0.10
West Lawn	0.561	0.5	-0.06	0.77	0.77	0.00
Gage Park	0.379	0.54	0.16	0.59	0.79	0.20
West Elsdon	0.624	0.59	-0.03	0.83	0.81	-0.02

NOTE: Estimates are based on multilevel statistical models and random Chicago residents conducted in 2008 and 2011. The statistical models adjust for small survey sample sizes within Chicago Community Areas. These numbers can be read like percentages, but are probability estimates based on statistical models.

Table 2. Access to the Internet (Smart Communities Compared to All Other Community Areas)

	Broadband at Home			Internet Use Anywhere		
Community	2008	2011	Change	2008	2011	Change
Smart Communities Estimates	.47	.56	.09	.69	.80	.11
All Other Community Area Estimates	.64	.70	.06	.83	.88	.05
Citywide Average (percentages)	.62	.69	.07	.81	.87	.06
DIFF Treatment (Smart Communities) - Other Community Areas			.03			.06

NOTE: Estimates are based on multilevel statistical models and random Chicago residents conducted in 2008 and 2011. The statistical models adjust for small survey sample sizes within Chicago Community Areas. These numbers can be read like percentages, but are probability estimates based on statistical models.

Table 2 reports a simple frequency table of the average rate of change in home broadband access (columns 1-3), or Internet use anywhere (columns 4-6) for the Smart Communities neighborhoods (row 1) compared to all other community areas in the city (row 2), and compared to citywide averages (row 3). Using a quasi-experimental design, our key comparison is the rate of change in Internet use among the treatment group (Smart Communities neighborhoods) compared to the control cases (all other non-treated community areas). The final row reports the difference in the rate of change between the treatment group (Smart Communities neighborhoods) and the control group (all other community areas).

Over this three year period, among Smart Communities neighborhoods, the percentage of the population with broadband at home increased by 9 percent. In other neighborhoods of the city, home broadband rates also increased, but at a slower rate (6 percent increase). The difference between the treatment and control neighborhoods was 3 percent. Internet use in any location includes public access and Internet access on mobile devices. Over the three year period, among Smart Communities neighborhoods, the percentage of the population using the Internet anywhere increased by 11 percent. In all other neighborhoods of the city, Internet use at any location increased by 5 percent; this resulted in a 6 percentage point higher rate of change in Internet use at any location in the Smart Communities than in other areas of the city. Appendix Tables A3 provides similar data for other online activities, including use of the Internet for work, job search, health, for political information, e-government, etc.

Although we notice change at the community level, we don't know whether it is because of the intervention. It may be that there has been gentrification of the neighborhood and that is why there is improvement. During this period, some neighborhoods might have become more affluent or gained younger, more educated populations. We thus estimate a multivariate regression model using statistical controls. The model controls for change at the neighborhood level in racial and ethnic composition, socio-economic factors, such as wealth and education and age in predicting changing rates of Internet use across Chicago neighborhoods. Because of these statistical controls, we also address potential issues such as the increase of smartphones in all low-income communities or "catching up" more generally in poor neighborhoods. This allows us to test whether the differences between the Smart Communities neighborhoods and other Chicago community areas are statistically significant. The unit of analysis is the neighborhood.

In the multivariate regression models reported in Tables 3-5 the outcome or dependent variables are created by taking the difference in our estimates from 2011 minus 2008. The outcome variables measure change in Internet use or online activities over the three year period. A binary predictor variable measures whether the neighborhood had Smart Community programs or not. Other independent variables measure change in the percent of the population in poverty, earning a high school degree, demographic populations, and age of the population from the 2008 and 2011 5-year American Community Survey, provided by the U.S. Census Bureau. The data were downloaded from the Census website at the census tract level and then aggregated upwards to create the 77 community level aggregates, weighted by community area population size. As with the dependent variables, the independent variables used in this analysis are the differences between the 2008 and 2011 aggregate values (see Appendix Table A1).

Table 3, column 1 predicts change Internet use at any location, while column 2 predicts the change in home broadband access. Controlling for changing demographic and economic conditions in the neighborhoods, residents of Smart Communities neighborhoods had a higher rate of increase in Internet use in any location than other areas of the city. And this difference is statistically significant with a 94 percent confidence interval. This result provides some empirical evidence that the treatment (policy) was effective. In column 2 the coefficient for the treatment (Chicago Smart Communities) is positive, but it is not statistically significant. There is no evidence that home broadband access increased in the Smart Communities neighborhoods compared to other areas of the city. This may be expected, as the program did not address affordability or the cost associated with home broadband use; its focus was outreach and training. We would expect Internet use at any location to increase more.

The analysis shown in Tables 4 and 5 shows that residing in a Smart Communities neighborhood was not associated with a statistically higher rate of change in other online activities, including searching for a job online, using online information about public transportation, health, politics or government. In almost every case the coefficient for the treatment is positive, but fails to reach statistical significance. An exception is change in use of the Internet at work; with a directional hypothesis test (one-tailed significance), individuals residing in Smart Community neighborhoods had a higher rate of change in Internet use at work than other Chicago neighborhoods. A one-tailed significance test is a lower threshold (or level of confidence) than the two-tailed tests reported in Tables 3-5.

What we can be fairly confident about is that Internet use in general appears to have increased more quickly in the communities with federal program dollars for outreach and training (Table 1, column 1). Designation as a Smart Community was not randomly assigned (and was a quasi-experiment, but still compares a treated case to a non-treated case). The statistical controls help us measure change in access in the neighborhoods. Figure 1 graphs the predicted absolute rate of change in Internet use at any location in the Smart Communities compared to other community areas. Holding change in all other demographic and economic factors constant, Internet use increased by 5 percent in non-treatment communities and 11 percent in the Smart Communities on a scale with a maximum increase of 38%. Figure 2 graphs these same data as a percentage point increase in Internet use. *Over the three year period, Internet use increased by 12 percentage points in non-treated areas and 27 percent in the Smart Communities, resulting in a 15 percentage point difference. In Chicago, the effect of the program appears to be a 15 percent boost in Internet use.*

CONCLUSION

Using unique community-level data drawn from surveys and estimates from multilevel models, we measure change in the Smart Communities BTOP program, compared to other Chicago community areas. The Smart Communities had a 15 percentage-point increase in Internet use, compared to other Chicago community areas, and controlling for demographic change. Home broadband adoption and activities online were not significantly different in the Smart Communities compared to other Chicago neighborhoods. While the percentage of residents who are Internet users has risen, Smart Communities residents who are new Internet users may be using the Internet at public access sites, on smartphones, at the homes of friends and relatives, or in other places outside the home.

Most information on broadband at the neighborhood level is based on data from providers showing where service is available to purchase (http://www.broadbandmap.gov). Infrastructure is one part of the access puzzle, but it doesn't tell us how the technology is being used. Factors such as affordability, a lack of technology skills or a lack of interest may prevent use even where broadband connections are available. In contrast, this study measures the percentage of the population using the Internet in communities, including broadband adoption at home, and activities online such as job search, use of e-government, and health information search.

The substantial increase in Internet use is a step toward creating the culture of digital excellence that is the goal of the Smart Communities. However, it falls short of full access and participation in society online. Home broadband adoption is associated with more activities online and higher levels of information technology skill, compared with smartphone use or other access outside the home. Those who have broadband connections at home are more likely to use the Internet for information on health, education, government services, and more (Mossberger, Tolbert and Hamilton 2012). Individuals with home Internet access are more likely to earn more on the job (DiMaggio and Bonikowski 2008), and Internet use at work offers higher incomes for non-college-educated workers as well (Mossberger, Tolbert and McNeal 2008). The goal of home broadband adoption embedded in the BTOP programs is important for full access, and it is worth pursuing further.

Training programs, however, may not be enough to support home broadband adoption for many low-income residents. As analysis of the Chicago 2008 study showed, affordability is problem for many Chicago residents, and along with other barriers, it increases with neighborhood segregation and concentrated poverty. Greater affordability of broadband could be accomplished through public policies such as subsidies through the Universal Service Fund reforms, through municipal broadband partnerships, or through greater competition. The recent

Federal Communications Commission proposal for public wireless networks would be a major step toward addressing the cost barrier for broadband connectivity.

Discounted broadband through Internet Essentials may help one portion of the population that is currently offline because of costs – households with children participating in free or reduced-price school lunch programs. The Internet Essentials program had not been implemented at the time of the 2011 survey. This will be an area of interest in the analysis of the 2013 citywide survey, when change can also be analyzed over a longer period, from 2008 to 2013.

While it is impossible to rule out all explanations for the change in Internet use other than the Smart Communities efforts, the statistical controls used here are useful for eliminating known challenges such as demographic change. The community-level comparisons discussed here can be triangulated with other evidence, including the surveys of program participants in the Smart Communities evaluation supported by the MacArthur Foundation. Questions are asked about where and how participants access the Internet and whether they experience continued barriers to use. Respondents are also being asked about whether they share their Internet connections or help others, to explore the idea of burgeoning networks of use in the target neighborhoods. Along with outreach by Tech Organizers and the advertising campaign that began after this survey in Fall 2011, resource sharing may have helped to create some spillovers within these communities.

Measuring change at the community level also implies that it is important to track activities online over time. While there were no significant differences between the Smart Communities and other neighborhoods by 2011, the 2013 survey could possibly tell a different story. Inexperienced Internet users do less online, and are especially engaged in entertainment and less information-intensive uses (DiMaggio et al. 2001). As residents gain experience, will we see significantly higher levels of search for information on health, jobs, and government in 2013? There is a need for further study as well, looking at changes in outcomes such as employment in these communities. Will changes in Internet use be associated with increases in outcomes such as employment, for example? Will differences in Internet use be related to higher graduation rates or other educational improvements at the scale of the community? More needs to be known, overall, whether or how Internet use matters for the collective fortunes of the participating communities.

Table 3: Probability of Smart Community Designation & Neighborhood Internet Use

	Change in Internet Use		Change in Broadband Use	
	b/(s.e)	P	b/(s.e)	p
Treatment (Chicago Smart Community)	**0.058**	**0.061**	0.046	0.205
	(0.030)		(0.036)	
Change in Poverty Rate	0.299	0.307	0.090	0.793
	(0.291)		(0.341)	
Change in % HS degree	0.461	0.027	0.561	0.022
	(0.204)		(0.239)	
Change in % Black	-0.228	0.354	-0.297	0.304
	(0.245)		(0.287)	
Change in % Latino	0.111	0.472	-0.092	0.607
	(0.153)		(0.179)	
Change in % Asian	-0.081	0.778	0.226	0.501
	(0.285)		(0.334)	
Change in % over 65 years	0.810	0.096	0.138	0.807
	(0.480)		(0.562)	
Constant	0.004	0.870	0.016	0.534
	(0.022)		(0.026)	
Observations	75	75	75	75
R-squared	0.178	0.178	0.188	0.188

Unstandardized ordinary least square regression coefficients, with robust standard errors in parentheses. Probabilities based on two tailed tests. Two of Chicago's community areas (non-treated areas) lacked data for either 2008 or 2011, reducing N to 75.

Table 4: Probability of Smart Community Designation & Neighborhood Internet Use for Economic Activities, Training and Transportation

	Change in Internet Use at Work		Change in Searching for a Job Online		Change in Taking an Online Class		Change in Searching for Information on Public Transportation	
	b/(s.e)	p	b/(s.e)	p	b/(s.e)	p	b/(s.e)	p
Treatment (Chicago Smart Community)	0.073 (0.048)	0.133	0.021 (0.043)	0.635	-0.016 (0.024)	0.507	0.028 (0.032)	0.395
Change in Poverty Rate	-0.455 (0.460)	0.326	0.118 (0.415)	0.777	0.074 (0.230)	0.751	0.330 (0.310)	0.290
Change in % HS Degree	0.819 (0.322)	0.013	0.292 (0.291)	0.320	-0.022 (0.162)	0.894	0.495 (0.217)	0.026
Change in % black	-0.083 (0.387)	0.831	-0.401 (0.349)	0.255	-0.390 (0.194)	0.048	-0.433 (0.261)	0.101
Change in % Latino	0.369 (0.241)	0.131	0.054 (0.218)	0.806	-0.043 (0.121)	0.725	-0.019 (0.162)	0.907
Change in % Asian	-0.443 (0.450)	0.328	-0.253 (0.406)	0.535	0.271 (0.225)	0.233	-0.216 (0.303)	0.477
Change in % over 65 years	-0.675 (0.758)	0.376	0.617 (0.685)	0.371	0.333 (0.380)	0.384	-0.003 (0.511)	0.995
Constant	0.033 (0.035)	0.344	-0.030 (0.032)	0.343	-0.000 (0.018)	0.980	-0.049 (0.024)	0.042
Observations	75	75	75	75	75	75	75	75
R-squared	0.228	0.228	0.066	0.066	0.170	0.170	0.139	0.139

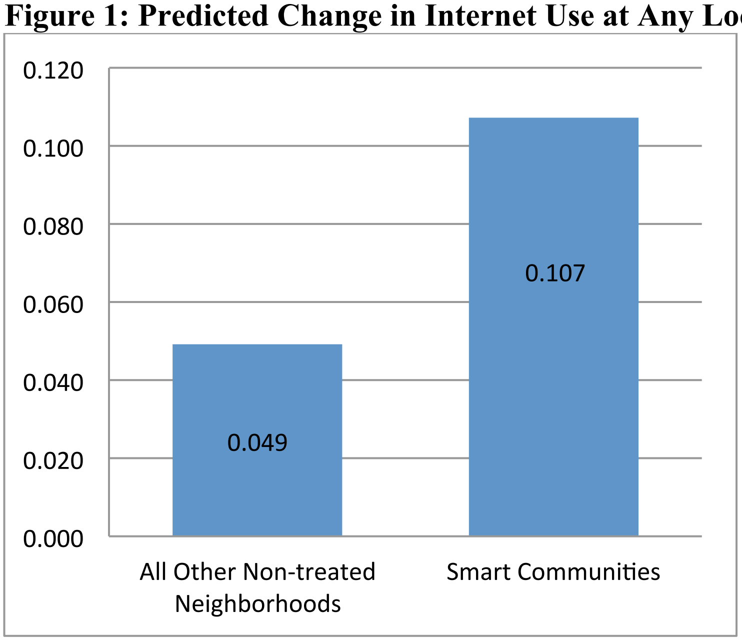
Unstandardized ordinary least square regression coefficients, with robust standard errors in parentheses. Probabilities based on two tailed tests. Two of Chicago's community areas (non-treated areas) lacked data for either 2008 or 2011, reducing N to 75.

Table 5: Probability of Smart Community Designation & Neighborhood Internet Use for E-government, Health and Politics

	Change in Using Chicago City Website		Change in Finding Health Information Online		Change in Finding Information About Politics Online		Change in Finding Information about Government Online	
	b/(s.e)	p	b/(s.e)	p	b/(s.e)	p	b/(s.e)	p
Treatment (Chicago Smart Community)	0.025 (0.029)	0.399	0.027 (0.032)	0.403	0.018 (0.033)	0.580	0.022 (0.030)	0.478
Change in Poverty Rate	0.436 (0.277)	0.120	0.375 (0.304)	0.222	-0.075 (0.315)	0.812	-0.142 (0.291)	0.626
Change in % HS degree	0.420 (0.194)	0.034	0.487 (0.213)	0.026	0.482 (0.221)	0.033	0.358 (0.204)	0.083
Change in % black	-0.376 (0.233)	0.112	-0.379 (0.256)	0.144	-0.228 (0.265)	0.393	-0.256 (0.245)	0.298
Change in % Latino	-0.082 (0.145)	0.573	-0.002 (0.160)	0.991	-0.020 (0.165)	0.902	-0.156 (0.152)	0.311
Change in % Asian	0.418 (0.271)	0.127	0.268 (0.298)	0.372	0.407 (0.308)	0.191	0.432 (0.284)	0.134
Change in % over 65 years	-0.294 (0.457)	0.522	0.307 (0.502)	0.543	-0.566 (0.520)	0.280	-0.380 (0.479)	0.430
Constant	-0.051 (0.021)	0.018	-0.020 (0.023)	0.404	-0.022 (0.024)	0.359	-0.036 (0.022)	0.113
Observations	75	75	75	75	75	75	75	75
R-squared	0.184	0.184	0.158	0.158	0.210	0.210	0.252	0.252

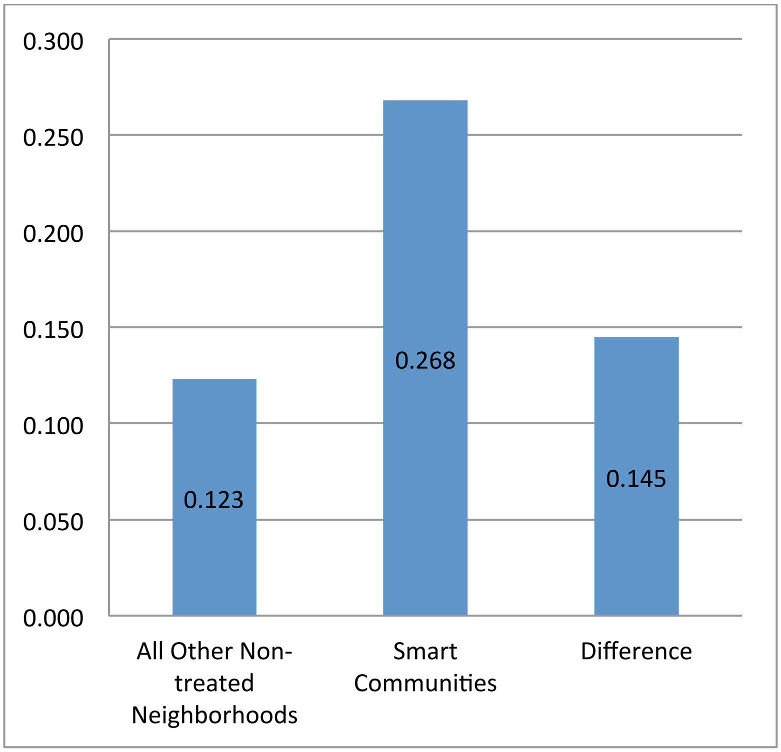
Unstandardized ordinary least square regression coefficients, with robust standard errors in parentheses. Probabilities based on two tailed tests. Two of Chicago's community areas (non-treated areas) lacked data for either 2008 or 2011, reducing N to 75.

Figure 1: Predicted Change in Internet Use at Any Location (Absolute) on .38 point scale



Predicted values, estimated holding other variables in the regression model in Table 3, column 1, constant at mean values.

Figure 2: Predicted Change in Internet Use in Any Location (Percentage Point Increase)



Predicted values, estimated holding other variables in the regression model in Table 3, column 1, constant at mean values.

Appendix Tables

Table A1: Summary Statistics for Outcome and Explanatory Variables

Variable (Change 2008-2011	No. of observations	Mean	Std. Deviation	Minimum	Maximum	Actual 2008	Actual 2011
Use Internet	75	0.056	0.083	-0.134	0.274	0.813	0.869
Use Broadband at Home	75	0.068	0.098	-0.150	0.332	0.618	0.686
Find Health Information	75	0.032	0.086	-0.144	0.257	0.652	0.684
Look For a Job Online	75	0.000	0.111	-0.309	0.279	0.476	0.476
Take an Online Class	75	0.000	0.066	-0.115	0.274	0.259	0.258
Find Information about Politics	75	0.021	0.092	-0.213	0.331	0.484	0.505
Find Information about Transportation	75	0.000	0.086	-0.182	0.254	0.528	0.528
Find Information about Government	75	-0.007	0.087	-0.241	0.283	0.546	0.538
Use Chicago City Website	75	-0.006	0.079	-0.275	0.256	0.462	0.457
Use Internet at Work	75	0.109	0.136	-0.229	0.527	0.481	0.591

Explanatory Variables

Variable (Change 2000-2010)	**No. of observations**	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**	**Actual 2008**	**Actual 2011**
Percent Poverty	75	0.016	0.049	-0.227	0.112	0.194	0.210
Percent High School Degree	75	0.079	0.054	-0.013	0.216	0.707	0.786
Percent black population	75	-0.006	0.055	-0.310	0.095	0.390	0.384
Percent Latino population	75	0.032	0.084	-0.156	0.312	0.225	0.257
Percent Asian population	75	0.006	0.035	-0.192	0.131	0.046	0.052
Percent over 65 years old	75	0.000	0.024	-0.045	0.065	0.115	0.115

Table A2: Probability of Internet use for Chicago Community Areas (*denotes Smart Communities)

CCA	CCA NAME	Internet Use Average 2008	Internet Use Average 2011	Broadband Home Average 2008	Broadband Home Average2011
1	ROGERS PARK	0.94	0.95	0.80	0.83
2	WEST RIDGE	0.94	0.96	0.79	0.82
3	UPTOWN	0.93	0.97	0.77	0.87
4	LINCOLN SQUARE	0.95	0.98	0.82	0.89
5	NORTH CENTER	0.96	0.98	0.85	0.94
6	LAKE VIEW	0.97	0.98	0.86	0.93
7	LINCOLN PARK	0.98	0.98	0.90	0.93
8	NEAR NORTH SIDE	0.96	0.96	0.85	0.86
9	EDISON PARK	0.89	0.92	0.73	0.78
10	NORWOOD PARK	0.89	0.93	0.71	0.77
11	JEFFERSON PARK	0.84	0.79	0.65	0.6
12	FOREST GLEN	0.94	0.96	0.80	0.86
13	NORTH PARK	0.89	0.95	0.71	0.77
14	ALBANY PARK	0.86	0.94	0.67	0.78
15	PORTAGE PARK	0.86	0.93	0.67	0.79
16	IRVING PARK	0.92	0.95	0.77	0.84
17	DUNNING	0.89	0.85	0.70	0.63
18	MONTCLARE	0.88	0.76	0.67	0.56
19	BELMONT CRAGIN	0.71	0.80	0.47	0.56
20	HERMOSA	0.60	0.57	0.36	0.36
21	AVONDALE	0.85	0.93	0.64	0.78
22	LOGAN SQUARE	0.88	0.88	0.67	0.71
*23	HUMBOLDT PARK	0.68	0.74	0.43	0.48
24	WEST TOWN	0.93	0.96	0.75	0.88
25	AUSTIN	0.78	0.89	0.56	0.65
26	WEST GARFIELD PARK	0.80	0.90	0.56	0.66
27	EAST GARFIELD PARK	0.70	0.57	0.42	0.36
28	NEAR WEST SIDE	0.95	0.96	0.81	0.87
29	NORTH LAWNDALE	0.71	0.77	0.44	0.54
30	SOUTH LAWNDALE	0.44	0.64	0.25	0.44

*31	LOWER WEST SIDE	0.61	0.79	0.39	0.5
32	LOOP	0.97	0.98	0.87	0.92
33	NEAR SOUTH SIDE	0.82	0.99	0.60	0.93
34	ARMOUR SQUARE	0.92	0.97	0.82	0.78
35	DOUGLAS	0.92	0.94	0.73	0.79
36	OAKLAND	0.80	0.95	0.52	0.83
**37	FULLER PARK	0.28	-	0.15	-
38	GRAND BOULEVARD	0.59	0.86	0.35	0.63
39	KENWOOD	0.93	0.95	0.80	0.83
40	WASHINGTON PARK	0.82	0.91	0.56	0.71
41	HYDE PARK	0.96	0.95	0.84	0.85
42	WOODLAWN	0.86	0.83	0.65	0.6
43	SOUTH SHORE	0.80	0.85	0.56	0.63
44	CHATHAM	0.74	0.82	0.54	0.57
45	AVALON PARK	0.78	0.97	0.60	0.81
46	SOUTH CHICAGO	0.77	0.77	0.50	0.49
**47	BURNSIDE	-	0.86	-	0.61
48	CALUMET HEIGHTS	0.82	0.83	0.63	0.48
49	ROSELAND	0.72	0.84	0.51	0.57
50	PULLMAN	0.85	0.89	0.64	0.68
51	SOUTH DEERING	0.63	0.72	0.43	0.49
52	EAST SIDE	0.75	0.70	0.55	0.48
53	WEST PULLMAN	0.79	0.85	0.55	0.61
54	RIVERDALE	0.73	0.91	0.45	0.72
55	HEGEWISCH	0.84	0.86	0.62	0.64
56	GARFIELD RIDGE	0.77	0.89	0.57	0.69
57	ARCHER HEIGHTS	0.67	0.78	0.48	0.47
58	BRIGHTON PARK	0.74	0.81	0.51	0.53
59	MCKINLEY PARK	0.77	0.97	0.56	0.85
60	BRIDGEPORT	0.89	0.94	0.72	0.78
61	NEW CITY	0.65	0.74	0.40	0.52
*62	WEST ELSDON	0.83	0.81	0.62	0.59
*63	GAGE PARK	0.59	0.79	0.38	0.54
64	CLEARING	0.79	0.77	0.56	0.57
*65	WEST LAWN	0.77	0.77	0.56	0.5
*66	CHICAGO LAWN	0.75	0.85	0.51	0.66
*67	WEST ENGLEWOOD	0.59	0.86	0.35	0.63
*68	ENGLEWOOD	0.79	0.80	0.56	0.56
69	GREATER GRAND CROSSING	0.78	0.72	0.51	0.44
70	ASHBURN	0.82	0.93	0.61	0.75
*71	AUBURN GRESHAM	0.60	0.82	0.38	0.56
72	BEVERLY	0.95	0.96	0.83	0.88

73	WASHINGTON HEIGHTS	0.63	0.84	0.42	0.54
74	MOUNT GREENWOOD	0.94	0.95	0.78	0.85
75	MORGAN PARK	0.90	0.93	0.76	0.79
76	OHARE	0.91	0.83	0.76	0.65
77	EDGEWATER	0.92	0.96	0.76	0.82

* Smart Communities
** CCAs not used in estimation because of few too cases from survey.

Table A3. Internet Activities (Smart Communities Compared to All Other Community Areas)

Community	Find Health Information			Apply for a Job		
	2008	2011	Change	2008	2011	Change
Smart Communities Estimates	0.5	0.56	0.06	0.44	0.46	0.02
All Other Community Area Estimates	0.67	0.7	0.03	0.48	0.48	0
Citywide Average (avg across cca)	0.65	0.68	0.03	0.47	0.48	0.01
DIFF Treatment (Smart Community) – non-treated areas			0.03			0.02

Table A3 Cont. Internet Activities (Smart Communities Compared to All Other Community Areas)

Community	Take Online Classes			Information About Politics		
	2008	2011	Change	2008	2011	Change
Smart Communities Estimates	0.21	0.19	-0.02	0.33	0.34	0.01
All Other Community Area Estimates	0.27	0.27	0	0.51	0.53	0.02
Citywide Average (avg across cca)	0.26	0.26	0	0.48	0.51	0.03
DIFF Treatment (Smart Community) – non-treated areas			-0.02			-0.01

Community	Information on Transportation			Information on Government		
	2008	2011	Change	2008	2011	Change
Smart Communities Estimates	0.4	0.42	0.02	0.42	0.41	-0.01
All Other Community Area Estimates	0.55	0.54	-0.01	0.56	0.56	0
Citywide Average (avg across cca)	0.53	0.53	0	0.55	0.54	-0.01
DIFF Treatment (Smart Community) – non-treated areas			0.03			-0.01

Community	Use Chicago Website			Use Internet at Work		
	2008	2011	Change	2008	2011	Change
Smart Communities Estimates	0.4	0.41	0.01	0.35	0.5	0.15
All Other Community Area Estimates	0.47	0.46	-0.01	0.5	0.6	0.1
Citywide Average (avg across cca)	0.46	0.46	0	0.48	0.59	0.11
DIFF Treatment (Smart Community) – non-treated areas			0.02			0.05

REFERENCES

Alex-Assensoh, Y. 1997. "Race, Concentrated Poverty, Social Isolation, and Political Behavior." *Urban Affairs Review* 33(2): 209–227.

Bayer, P., S.L. Ross, and G. Topa. 2008. "Place of Work and Place of Residence: Informal Hiring Networks and Labor Market Outcomes." *Journal of Political Economy* 116(6): 1150-1196.

Berkman Center. 2010. *Next Generation Connectivity: A Review of Broadband Internet Transitions and Policy from Around the World.* The Berkman Center for the Internet and Society at Harvard University. http://cyber.law.harvard.edu

Crawford, S. 2013. "How to Get High-Speed Internet to All Americans." *New York Times,* January 23. *http://www.nytimes.com/2013/01/24/opinion/how-to-get-high-speed-internet-to-all-americans.html?emc=eta1&_r=0*

Currie, J. 2011. "Health and Residential Location." *Neighborhood and Life Chances: How Place Matters in Modern American*. Ed. H. B. Newburger, E. L. Birch, and S. M. Wachter. Philadelphia: University of Pennsylvania Press, 3–17.

DiMaggio, P. and B. Bonikowski. 2008. "Make Money Surfing the Web? The Impact of Internet Use on the Earnings of U.S. Workers." *American Sociological Review* 73(2): 227-250.

DiMaggio, P., E. Hargittai, et al. 2001. "Social Implications of the Internet." *Annual Review of Sociology* 27(1): 307–336.

Elliott, J.R. 1999. "Social Isolation and Labor Market Insulation: Network and Neighborhood Effects on Less-Educated Urban Workers." *The Sociological Quarterly* 40(2): 199-216.

Goolsbee, A., and Peter J. Klenow. 2002. "Evidence on Learning and Network Externalities in the Diffusion of Home Computers." *Journal of Law and Economics* 45(2): 317–343.

Granovetter, M. S. 1973. “The Strength of Weak Ties.” *American Journal of Sociology* 78(6): 1360–1380.

Hampton, K. N. 2010. “Internet Use and the Concentration of Disadvantage: Glocalization and the Urban Underclass.” *American Behavioral Scientist* 53(8): 1111–1132.

Jacob, B. A., and J. Ludwig. 2011. “Educational Interventions: Their Effects on the Achievement of Poor Children.” *Neighborhood and Life Chances: How Place Matters in Modern America*. Ed. H. B. Newburger, E. L. Birch, and S. M. Wachter. Philadelphia: University of Pennsylvania Press, 37–49.

Jargowsky, P. A., and M. El Komi. 2011. “Before or after the Bell? School Context and Neighborhood Effects on Student Achievement.” *Neighborhood and Life Chances: How Place Matters in Modern America*. Ed. H. B. Newburger, E. L. Birch, and S. M. Wachter. Philadelphia: University of Pennsylvania Press, 50–72.

Kang, C. 2013. “Tech, Telecom Giants Take Sides as FCC Proposes Large Public WiFi Networks.” *Washington Post,* February 3. http://www.washingtonpost.com/business/technology/tech-telecom-giants-take-sides-as-fcc-proposes-large-public-wifi-networks/2013/02/03/eb27d3e0-698b-11e2-ada3-d86a4806d5ee_story.html

Kleit, R.G. 2001. “The Role of Neighborhood Social Networks in Scattered-Site Public Housing Resident’s Search for Jobs.” *Housing Policy Debate* 12 (3): 541-573.

Lax, J.R. and J. Phillips. 2009. “How Should We Estimate Public Opinion in The States?” *American Journal of Political Science* 53(1): 207-121.

LISC/Chicago. 2009. “A Platform for Participation and Innovation.” Chicago: LISC/Chicago.

Mossberger, K. 2012. *Smart Communities – Formative Evaluation.* http://www.smartchicagocollaborative.org/smart-communities-formative-evaluation-report/

Mossberger, K., D. Kaplan, and M. Gilbert. 2008. "Going Online without Easy Access: A Tale of Three Cities." *Journal of Urban Affairs* 30(5): 469–488.

Mossberger, K., C. Tolbert, D. Bowen and B. Jimenez. 2012. "Unraveling Different Barriers to Technology Use: Urban Residents and Neighborhood Effects." Urban Affairs Review 48: 771-810.

Mossberger, K., C.J. Tolbert, and W.W. Franko. 2012. *Digital Cities: The Internet and the Geography of Opportunity.* New York: Oxford University Press.

Mossberger, K., C. J. Tolbert, and M. Gilbert. 2006. "Race, Place, and Information Technology." *Urban Affairs Review* 41(5): 583–620.

Mossberger, K., C.J. Tolbert, and A. Hamilton. 2012. "Measuring Digital Citizenship: Mobile Access and Broadband." International Journal of Communication 6. Available [online]: http://ijoc.org/ojs/index.php/ijoc.

Mossberger, K., C. J. Tolbert, and R. McNeal. 2008. *Digital Citizenship: The Internet, Society, and Participation*. Cambridge: MIT Press.

Mossberger, K., C. J. Tolbert, and M. Stansbury. 2003. *Virtual Inequality: Beyond the Digital Divide*. Washington, D.C.: Georgetown University Press.

Raudenbush, S. W. and Bryk, A. S. 2002. Hierarchical Linear Models: Applications and Data Analysis Methods. Thousand Oaks, CA: Sage Publications.

Sampson, R.J., J.D. Morenoff, and T. Gannon-Rowley. 2002. "Assessing 'Neighborhood Effects': Social Processes and New Directions in Research." *Annual Review of Sociology* 28(1): 443-478.

Schlozman, K.L., S. Verba, and H.E. Brady. 2010. "Weapon of the Strong? Participatory Inequality and the Internet." *Perspectives on Politics* 8(2): 487-509.

Snijders, Tom and Roel Bosker. 2011. Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling. Sage Publications.

Steenbergen, M. and Jones, B. 2002. "Modeling Multilevel Data Structures." American Journal of Political Science, 41, 218–37.

Wilson, W.J. 1987. *The Truly Disadvantaged: The Inner City, the Underclass, and Public Policy.* Chicago: University of Chicago Press.