MEASURING CHANGE IN INTERNET USE AND BROADBAND ADOPTION:

Comparing BTOP Smart Communities and Other Chicago Neighborhoods [Updated 2014]

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Smart Communities
CHICAGO DIGITAL EXCELLENCE INITIATIVE

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EXECUTIVE SUMMARY

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 policy interventions ended in 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 in increasing Internet access among disadvantaged populations at the local level.

One such program is Chicago's Smart Communities initiative, which received a $7 million Sustainable Broadband Adoption (SBA) grant as part of BTOP, with the aim of creating a culture of digital excellence, or information technology use throughout the target communities.

The 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. The Smart Communities program is the only BTOP initiative for which there is data on neighborhood change in information technology use.

The Smart Communities program brings together a number of training and outreach efforts in 9 predominantly African-American and Latino, low and moderate-income neighborhoods. The grantee, the City of Chicago, has worked with the Chicago Local Initiatives 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 (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 technology use by community organizations and word-of-mouth among neighborhood residents will further encourage Internet use and broadband adoption at home.

To evaluate the possible effects of this program, we measure change in Internet access, use and online activities across the 9 Smart Community neighborhoods, comparing them with other neighborhoods in Chicago. Measuring neighborhood-level change is important given the emphasis on creating a culture of digital excellence in the Smart Communities (LISC Chicago 2009).[1]

[1] Other reports provide a more in-depth view of outcomes for specific programs within the Smart Communities, the basic digital skills training in the FamilyNet Centers (Mossberger, Li and Feeney 2014) and the Civic 2.0 training for neighborhood organizations (Mossberger, Benoit Bryan and Brown 2014). See http://cpi.asu.edu.

The neighborhood-level data presented here is unique, and the approach of examining change at the community level is distinctive for evaluating digital inclusion efforts. The neighborhood-level data used here does not exist for other BTOP programs around the nation, and was gathered through city-wide random-sample landline and cell phone surveys collected in 2008, 2011, and 2013. Multilevel statistical modeling was used in order to provide neighborhood-level estimates of Internet use, and to examine change over time in the Smart Communities vs. other neighborhoods, controlling for other factors. While neighborhood-level change has been examined in other areas, such as economic development initiatives, this is the first study of this kind that we are aware of for a digital inclusion program.

Summary of Main Findings

Internet Use Anywhere:

The analysis shows that between 2008 and 2013, the Smart Communities had a statistically significant 13 percentage-point increase in Internet use in any location, compared to other Chicago community areas, which had only a 4.5 percentage point rate of change, controlling for demographic change (such as gentrification). **This means there was a 9 percentage point higher increase in Internet use in the Smart Communities than in similar Chicago neighborhoods**. This change includes Internet use by those who do not have broadband at home, but use the Internet on smartphones or at public access sites like libraries, the homes of friends and relatives, or at other places outside the home.

Broadband Adoption at Home:

During the five year period of 2008-2013 the Smart Communities had a 9 percentage-point higher increase in home broadband adoption compared to other Chicago community areas, and controlling for demographic change. Broadband adoption rose by an estimated 15 percentage points in the Smart Communities, while in other Chicago community areas it increased only by 6 percentage points. This difference over the five year period is substantively large and is unlikely to have occurred by chance.

This change in broadband adoption is due to increases between 2011 and 2013. In a similar analysis comparing 2008-2011 (Tolbert, Mossberger and Anderson 2013), there higher increases in Internet use in any location, but there were no significant differences in home broadband use in the Smart Community neighborhoods compared to other Chicago neighborhoods.

Given that the treatment was training and outreach rather than lower-cost broadband, the program could be expected to have more influence on Internet use in any location than on home adoption. **But the initial increases in Internet use anywere were followed by significantly higher increases in home broadband subscriptions as well by 2013.** Why were the results different in 2013 than in 2011? One explanation may be that as people gain experience, they are more likely to adopt broadband at home. It is also possible that households receiving discounts on broadband through Comcast's Internet Essentials program (promoted by the Smart Communities) may have contributed to this change in 2013. Internet Essentials was introduced in Fall 2011, just after the 2011 survey was completed. Internet Essentials, however, only covers households with children receiving free or reduced-price school lunch. Financial counseling was also offered by the Smart Communities, to help participants to budget for broadband purchases.

Activities Online:

We also see statistically significantly differences in online activities, comparing change in the Smart Communities and other Chicago neighborhoods from 2008-2013. The difference in the rate of increase for **online job search was 11 percentage points higher in the Smart Communities** than other Chicago neighborhoods. **Change in using the Internet for health information was also 11 percentage points higher.** Similarly, **the difference in the increase in using the Internet for transportation information was more than 10 percentage points**, comparing the treated and non-treated neighborhoods.

As with home broadband, from 2008-2011 the Smart Communities did not have statistically significant differences in activities online, compared to other Chicago neighborhoods. **It was only later, when analyzing the five- year window from 2008-13, that differences in online activities emerged.** Internet users perform more activities online as they gain experience, according to prior research (DiMaggio et al. 2001), and this may have been the case in the Smart Communities. Other activities that were measured were not significantly different in the Smart Communities, such as use of the Internet for taking a course, or the use of political information online.

These results suggest that the Smart Communities program appears to have a measurable effect not only in increasing Internet access and home use, but in several online activities that are important for individual and community opportunity and wellness. While it is not possible to know with certainty whether this program or other factors caused the change in these neighborhoods, the differences are substantively large and not likely to have occurred by chance. The Smart Communities included outreach by tech organizers and advertising campaigns beyond the training programs, and surveys of participants show that those who received training often reported helping others in their neighborhoods to use the Internet (Mossberger, Li and Feeney 2014). It is possible that these activities helped to create more general change for neighborhood residents, as well as to assist those who received training.

INTRODUCTION

This is one of three reports evaluating the Chicago Smart Communities program, which received a $7 million federal Sustainable Broadband Adoption (SBA) grant.[2] The grant was part of the Broadband Technology Opportunities Program (BTOP), which invested over $7 billion in federal stimulus funding to increase broadband adoption in communities around the nation. The federal funding supported programs between 2010 and the end of 2012, and **this report examines whether there has been an increase in high-speed (broadband) Internet adoption at home and Internet use in general in the target neighborhoods after the grant period.**

The Smart Communities program had the aim of creating a culture of digital excellence, or information technology use, throughout the participating communities. To achieve this goal, the program brought together a number of training and outreach efforts in 9 predominantly African-American and Latino, low and moderate-income neighborhoods. The grantee, the City of Chicago, worked with the Chicago Local Initiatives Support Corporation (LISC) and a number of community organizations to provide 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 were offered by the Digital Youth Network and the Chicago Public Library. The programs also provided some public access. Outreach encouraged broadband adoption (whether or not neighborhood residents participated in programs) and was conducted through Tech Organizers, neighborhood portals, and advertising on buses and transit shelters. Additionally, program partners hoped that community organizations and word-of-mouth among neighborhood residents would further encourage Internet use and broadband adoption at home (LISC Chicago 2009). The 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.

The Smart Communities did not provide Internet access. But, in Fall 2011, midway through the program, Comcast began to offer discounted broadband to households in Chicago with children who were receiving free or discounted school lunch. Residents had to apply for the Internet Essentials program and meet additional critieria. The Smart Communities organizations assisted residents with applications for Internet Essentials when they were eligible. They also offered financial counseling at the FamilyNet Centers to help residents budget for broadband adoption.

To evaluate the possible effects of this program, we measure change in Internet access, use and online activities across the 9 neighborhoods participating in the Smart Communities, comparing them with other neighborhoods in Chicago.

Measuring neighborhood-level change is important given the emphasis on creating a culture of digital excellence in the Smart Communities (LISC Chicago 2009).[3] The role of place is also important for

[3] Other reports provide a more in-depth view of outcomes for specific programs within the Smart Communities, the basic digital skills training in the FamilyNet Centers (Mossberger, Li and Feeney 2014) and the

research and policy addressing digital inclusion 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 a program evaluation, as in the FamilyNet and Civic 2.0 reports that accompany this one. 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 2013 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.

Civic 2.0 training for neighborhood organizations (Mossberger, Benoit Bryant and Brown 2014). See http://cpi.asu.edu.

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 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 educational environment for neighborhood schools, beyond the burdens they create for individual students. In communities where many families lack home broadband, educators may be unable to assign 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 relatives 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 non-Hispanic 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 the households already owns 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 Chicago 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.

Training and Support for Skills

- **FamilyNet Centers** for Everyday Digital training (free classes in English and Spanish) and drop-in assistance; 2,018 participants
- **Civic 2.0** training (free classes in English and Spanish) for block clubs, school groups and other neighborhood organizations; training covered online research on crime, schools, other issues; use of the City website and open data portals; social networks for neighborhood organizing; 817 participants
- **Business Resource Networks** that offered free technology assessments, training, and technical assistance for neighborhood businesses with less than 500 employees; 461 assessments
- **Digital Youth Network** after-school programs in middle schools; by creating multimedia projects, students learn about digital technology while gaining the discipline and critical thinking skills that will help them in school and in life; XX Smart Communities participants
- **YOUmedia** programs for middle-school youth established in 3 neighborhood libraries, in a partnership between the Chicago Public Library and Digital Youth Network
- **Digital Youth Summer Jobs** available to participants from the Smart Communities areas, with internships involving technology skills for future employment, a netbook, and aircard; 60 participants

Outreach/Awareness

- **5 Technology Organizers** who did outreach and conducted Civic 2.0 training for community organizations

- **5 Community Portals** supported by portal managers (in each of the 5 lead agency communities);

- **Advertisements** on buses and bus shelters emphasizing the benefits of being online

There were 5 lead agencies responsible for implementing the programs: The Resurrection Project (Pilsen/Lower West Side); Teamwork Englewood (Englewood); Greater Auburn Gresham Development Corporation (Auburn Gresham); Southwest Development Corporation (Chicago Lawn); and Bickerdike Development Corporation (Humboldt Park). Altogether, 9 community areas were considered part of the Smart Communities, as the program served some community areas that were adjacent to the lead agency neighborhoods. Resources for outreach, however, were located within the lead agency communities.

Affordability

- **6 FamilyNet Centers** that provided Everyday Digital participants with financial counseling and consumer information for broadband adoption

- **Comcast Internet Essentials** outreach and referral for eligible residents

- **Netbooks with software** distributed to Everyday Digital and Civic 2.0 participants who completed courses, on a first-come, first served basis; 1,280 distributed for Everyday Digital and 625 for Civic 2.0 participants

- **Desktops with software** distributed to small businesses participating in the Business Resource Networks; 100 distributed

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. Financial counseling was available to assist participants in budgeting for broadband services. Beginning in the fall of 2011, 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. Households eligible for Internet Essentials receive basic broadband for a cost of $9.95 per month, purchase a refurbished computer for $150, and receive some introductory training. Comcast reported early in the Internet Essentials program that Cook County (where Chicago is located) had the highest participation of any county in the U.S. (Comcast 2012). It is not possible to tell how many of these discounted subscriptions were in the Smart Communities or even in the City of Chicago. But, this does indicate some general awareness of the program in the region.

Additionally, the 3 training programs distributed netbooks to residents and community groups that completed the training programs, and desktops to small businesses that participated in the Business Resource Networks. There were more participants than netbooks or desktops purchased through the program. So, they were awarded on a first-come first-served basis.

Theory of Change

The Smart Communities program is based on a theory of change that was first outlined in a 2007 report by the [Chicago] Mayor's Advisory Council on Closing the Digital Divide. This was further developed in the Smart Communities master plan (LISC Chicago 2009) and was confirmed by evaluators in interviews conducted with the organizations involved in the program.

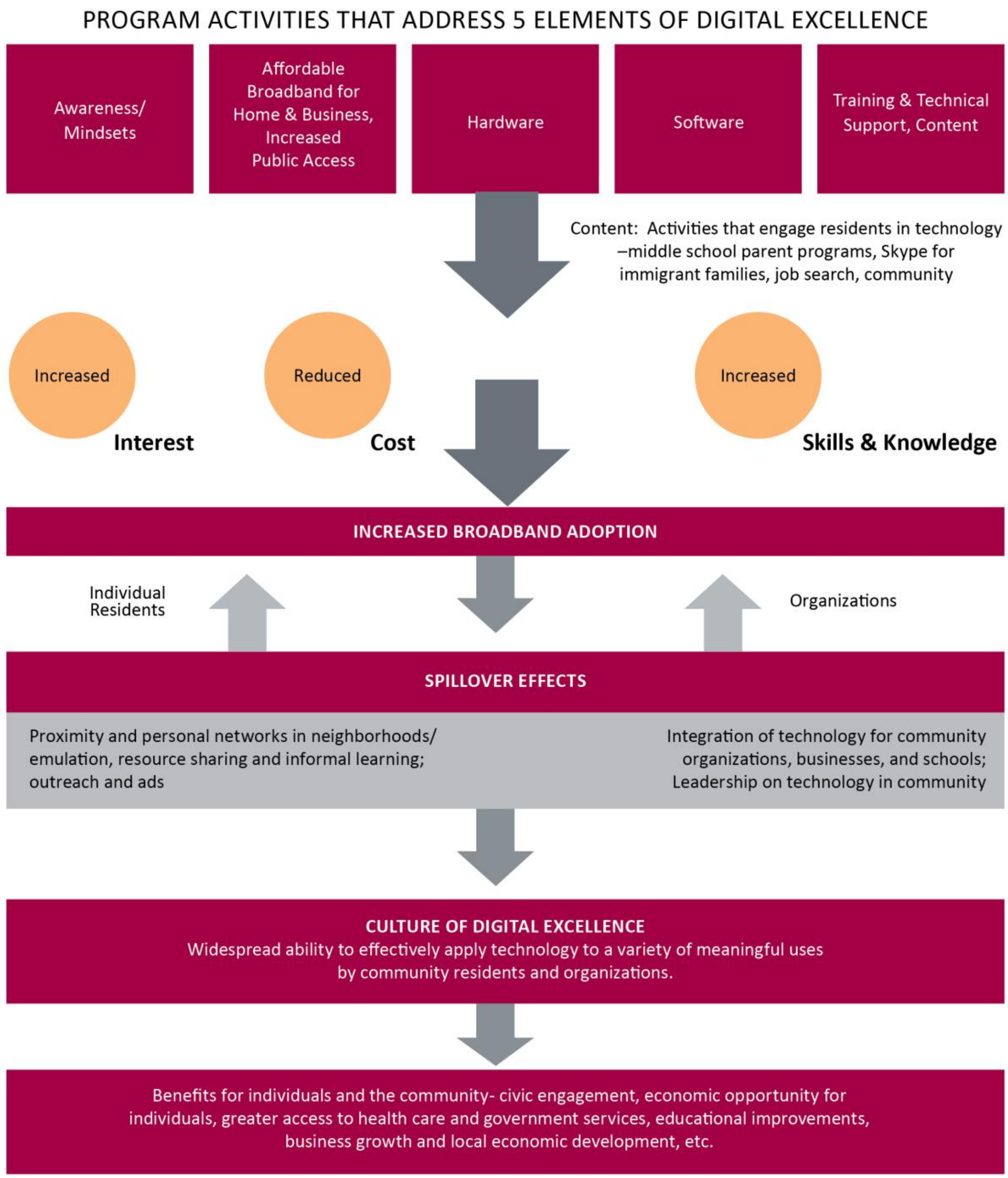
The five components of digital excellence in communities identified in the 2007 report are awareness and changing mindsets; affordable home broadband and the availability of public access; affordable and appropriate hardware and software; and the availability of training, support, and relevant content. The activities implemented in the Smart Communities therefore addressed these components in an effort to reduce barriers such as lack of interest; the cost of hardware, software, and broadband connectivity; and lack of skills to engage in a variety of activities online.

While some Smart Communities residents and organizations became directly involved in the program by participating in training or receiving netbooks or desktops, the intention of the Smart Communities program was there were many others who could potentially be reached indirectly. This included individuals in the neighborhoods who interacted with trainees, learning from them or gaining the motivation to go online themselves. Additionally, neighborhood residents who did not receive training may have been convinced to use the Internet at home or in other settings because of word-of-mouth in their neighborhoods, outreach campaigns conducted by Tech Organizers, uses they observed in community organizations, and ads on the bus lines serving the target neighborhoods. Training for block clubs, school groups, small businesses and other neighborhood organizations was intended to encourage the use of technology in activities throughout the neighborhood, to provide models for Internet use and leadership to promote and sustain change in the community. A feedback loop shows that both the training programs and the informal learning and outreach are intended to be mutually supportive.

Digital excellence was defined in the 2007 report and in the Smart Communities master plan in similar terms, as “full participation in meaningful activities for households, businesses, and institutions” (LISC Chicago 2009, 3). As part of a comprehensive community-building initiative, this includes a variety of activities that might promote quality of life for residents and businesses. The BTOP program is also guided by the national goals defined in the National Broadband Plan. In this study, we measure a number of activities online that are consistent with both the Smart Communities Master Plan and the National Broadband Plan. These are use of the Internet for job search, taking a class online, information on public transit, health information, politics online, government information, use of the City of Chicago website, and use for work.

Ultimately, these activities might be expected to lead to improved outcomes for individual residents and their communities. Such outcomes are difficult to measure in the near term, but in the longer term neighborhood-level change in Internet use and activities online could potentially lead to decreased poverty rates, increased employment, higher graduation rates, healthier residents, or better-informed citizens. Tracking these indicators in the long run will provide better evidence of the impact of the Internet use measured here. This report addresses intermediate outcomes, such as Internet use and activities online.

Figure 1 - Theory of Change for Smart Communities



COMMUNITY CONTEXT

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. As Table 1 shows, the target neighborhoods are at least 75 percent African-American and Latino. Predominantly African-American neighborhoods in the Smart Communities tend to have high poverty rates (of 40% or more), and neighborhoods with high percentages of Latinos have low graduation rates (in the 50% and 60% range). Although activities throughout the community and personal 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).

Table 1. Smart Communities Demographics at Program Inception, 2005-2009

	Demographic Characteristics (%)				
CCA	**Black**	**Latino**	**Asian**	**Poor**	**High School Grad**
Humboldt Park	43	53	0	34	63
Pilsen	3	82	1	30	56
Englewood	99	0	0	43	73
West Englewood	97	2	0	40	69
Auburn Gresham	99	1	0	27	78
Chicago Lawn	56	37	1	27	68
West Lawn	4	73	0	17	66
Gage Park	6	86	0	19	51
West Elsdon	2	75	1	12	62
City Avg.	34	27	5	20	79

Source: U.S. Bureau of the Census, American Community Survey 5 Year Estimates, 2005-2009.

Our research question is whether Internet use increased in the Smart Communities after the program intervention? Evaluations of programs to provide Internet access or skills tend to rely on surveys of participants. While valuable (and also part of this evaluation, as discussed in the companion reports), 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 percentage of the population has access and uses the technology for online activities at the community level in target neighborhoods, 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), 2011 (2500 respondents) and 2013 (2400 respondents) to measure Internet access and use 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 cell phone use in the at the time, as reported by the Center for Disease Control (CDC). The interviews were conducted in Spanish and English. Similar questions on Internet access and activities online were asked all three years, allowing a comparison over time. For the descriptive graphs the results were weighted in terms of gender, race, etc.

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 geographic area. To generalize from a small sample to an entire neighborhood can be problematic and lead to bias. To overcome this problem, we use multilevel statistical modeling (hierarchical linear modeling) to estimate Internet access and use for Chicago's 77 neighborhoods at three points in time (2008, 2011 and 2013).

Respondents in the three surveys were asked to identify their cross-streets (we did not geocode respondents based on their telephone number from the survey, but rather the information they provided about their home address). 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 American Community Survey for the appropriate citywide survey (2008, 2011 or 2012) 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. 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 (a form of statistical simulation) to generate geographic estimates of broadband access and online activities for neighborhoods in Chicago. 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.

Our null hypothesis is that the designation as a Smart Community made no difference in rate of change in Internet use and digital citizenship/online activities, 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 five years of initiatives, with the training primarily in the last 9 months. We use the estimates of Internet access and use in Chicago neighborhoods in 2008 and 2013 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 2 lists the 9 Smart Communities and the estimate of the percentage of the population using the Internet in any location and with home broadband access in 2008 and 2013. 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 percentage points during this five year period.

Table 2. Access to the Internet, Smart Communities Estimates, 2008 and 2013

	Broadband at Home			**Internet Use Anywhere**		
Community	2008	2013	Change	2008	2013	Change
City Average	*61*	*68*	*0.07*	*75*	*81*	*0.06*
Humboldt Park	0.43	0.47	0.04	0.68	0.72	0.04
Lower West Side	0.39	0.61	0.22	0.62	0.83	0.21
Englewood	0.56	0.70	0.14	0.80	0.91	0.11
West Englewood	0.35	0.55	0.20	0.59	0.79	0.20
Auburn Gresham	0.38	0.61	0.23	0.60	0.84	0.24
Chicago Lawn	0.51	0.55	0.04	0.75	0.76	0.01
West Lawn	0.56	0.56	0.00	0.77	0.71	-0.06
Gage Park	0.38	0.42	0.04	0.59	0.64	0.05
West Elsdon	0.62	0.62	0.00	0.83	0.82	-0.01

Note: Estimates are based on multilevel statistical models and random Chicago residents conducted in 2008 and 2013. 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.

On average, the increase in both broadband at home and Internet use anywhere in the Smart Communities appears to be 4 percentage points higher than in other Chicago community areas.

Table 3. Access to the Internet (Smart Communities Compared to All Other Community Areas

Community	Broadband at Home			Internet Use Anywhere		
	2008	2013	Change	2008	2013	Change
Smart Communities Estimates	0.47	0.56	0.09	0.69	0.78	0.09
All Other Community Area Estimates	0.64	0.69	0.05	0.83	0.87	0.04
Citywide Average (weighted percentages)	0.62	0.70	0.08	0.81	0.84	0.03
DIFF Treatment (Smart Community) - All other communities			0.04			0.04

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.

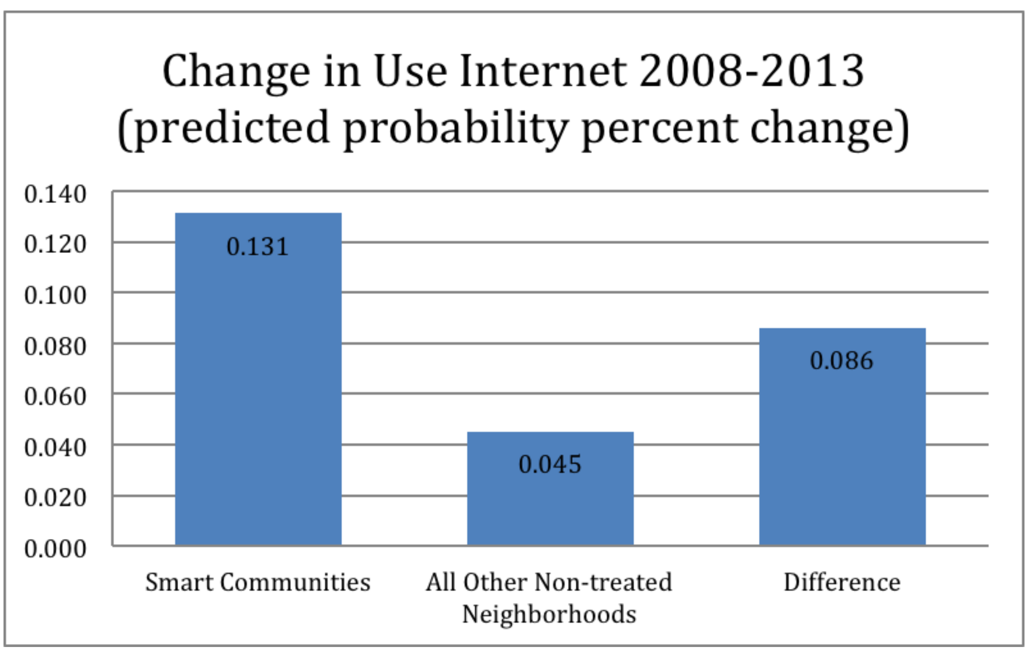
The graphs presented in Figures 1A-5A are based on predicted probabilities generated from multivariate regression models reported in Tables 1A-4A with all other variables in the model held constant at mean values. These statistical simulations allow us to estimate the substantive effect of the explanatory variable (Smart Communities designation) on the outcome variable, change in population with Internet access or engaging in online activities, by community areas. In the multivariate regression models reported in Tables 1A-4A below, the outcome or dependent variable is created by taking the difference in our estimates from 2013 minus 2008. The outcome variables measure change in Internet use or online activities over the five-year period. A binary predictor variable measures whether the neighborhood had Smart Communities 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 2012 5-year American Community Survey, provided by the U.S. Census Bureau. The data were downloaded from the Census website at the tract level and then aggregated to the neighborhood level, 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 2013 neighborhood level values (see Tables 1A-4A). The models control for change in the neighborhoods in terms of socioeconomic status, racial and ethnic diversity and age.

Appendix Table 1A, column 1 predicts change om 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 92 percent confidence interval (two-tailed test) or 96 percent confidence interval for a direction (one-tailed) significance test. This result provides empirical evidence that the treatment (policy) was effective. This result was also found when comparing rates of change in Internet access between 2008 and 2011.

Figure 1A graphs the predicted rate of change in Internet use at any location in the Smart Communities compared to other community areas from 2008 to 2013. Holding change in all other demographic and economic factors constant (such as gentrification), Internet use increased by 4.5 percent in non-treatment communities and 13 percent in the Smart Communities. This means there was a 9-percentage point higher increase in Internet use in the Smart Communities than in other Chicago neighborhoods. This change includes those who do not have broadband at home, but who 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. **In Chicago, there appears to be a 9 percent boost in Internet use over the five year evaluation window, when we control for other factors.**

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 graphs report the difference in the rate of change between the treatment group (Smart Communities neighborhoods) and the control group (all other community areas).

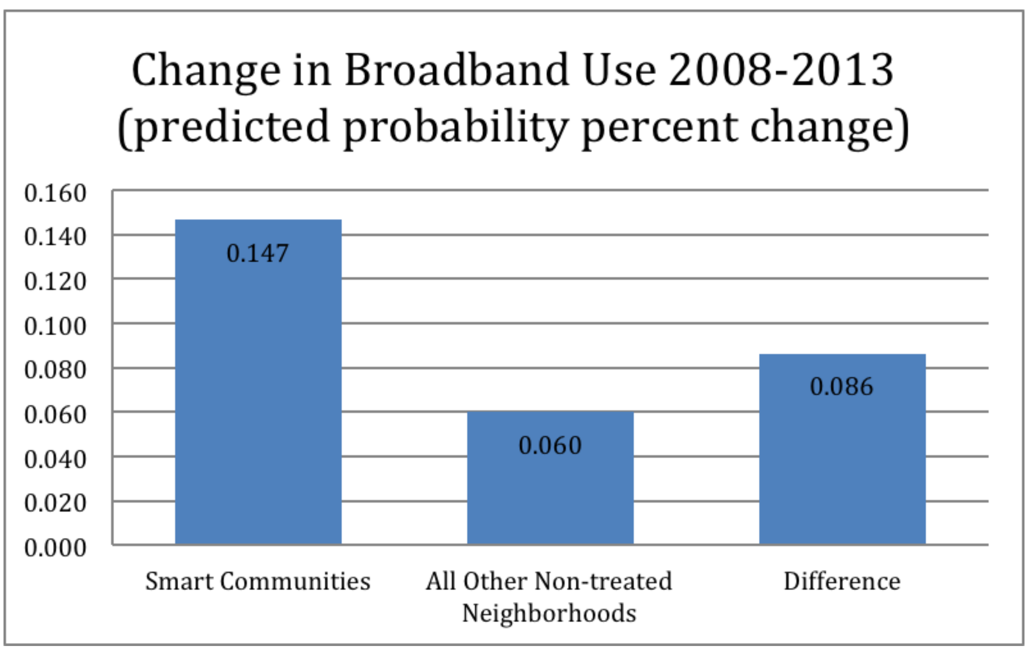
Figure 1A



Note: Estimates based on multivariate statistical models with other neighborhood level factors (change in poverty rates, demographic factors, etc), held held constant at mean values.

In column 2 of Table 1A the coefficient for the treatment (Chicago Smart Communities) is again positive and statistically significant with the 92% confidence interval (or 96% confidence interval for a directional test). There is evidence that home broadband access increased in the Smart Communities neighborhoods faster than compared to other areas of the city. Although the program did not address affordability or the cost associated with home broadband use, there appears to be a spillover effect from the program in encouraging home broadband adoption. This is a change from 2008-2011. There were not significant differences in home broadband use in the Smart Community neighborhoods compared to other Chicago neighborhoods from 2008 to 2011; but, during the five year period of 2008-2013, the Smart Communities had a 9 percentage-point higher increase in home broadband adoption compared to other Chicago community areas, and controlling for demographic change (see Figure 2A). This almost 10 percentage-point difference over the five year period 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. But the treatment also appeared to have spillover effects increasing access with home broadband subscriptions. **In Chicago, neighborhood change in the Smart Communities appears to be 9 percentage points higher for home broadband adoptions over five years.**

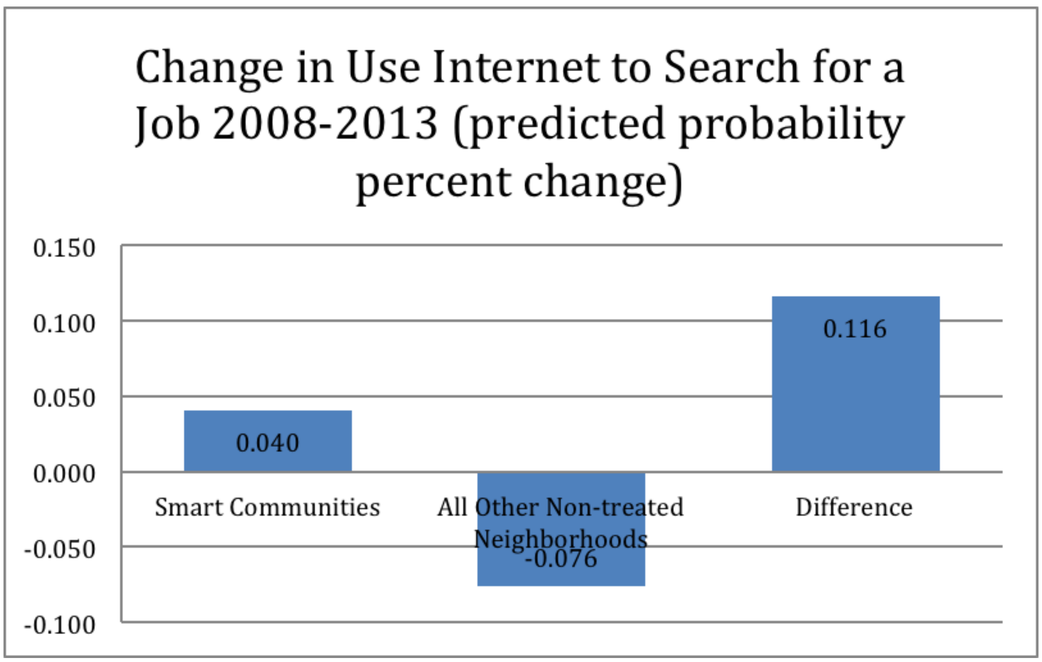
Figure 2A



Note: Estimates based on multivariate statistical models with other neighborhood level factors (change in poverty rates, demographic factors, etc), held constant at mean values.

We also see statistically significant differences in uses of the Internet for online activities, comparing the Smart Communities and other Chicago neighborhoods. In column 3 of Appendix Table 1A a similar multivariate regression model is presented to measure change in the percent of the neighborhood population searching for a job online, a core economic activity. The coefficient for the treatment (Chicago Smart Communities) is positive and statistically significant with a 95% confidence interval. There is evidence that online job search increased in the Smart Communities neighborhoods faster than other areas of the city, with the difference in the rate of increase for online job search 11 percentage points higher in the Smart Communities than other Chicago neighborhoods (see Figure 3A). **In Chicago, the Smart Communities neighborhoods appear to have had an 11 percent boost in online job search activities over five years.**

Figure 3A



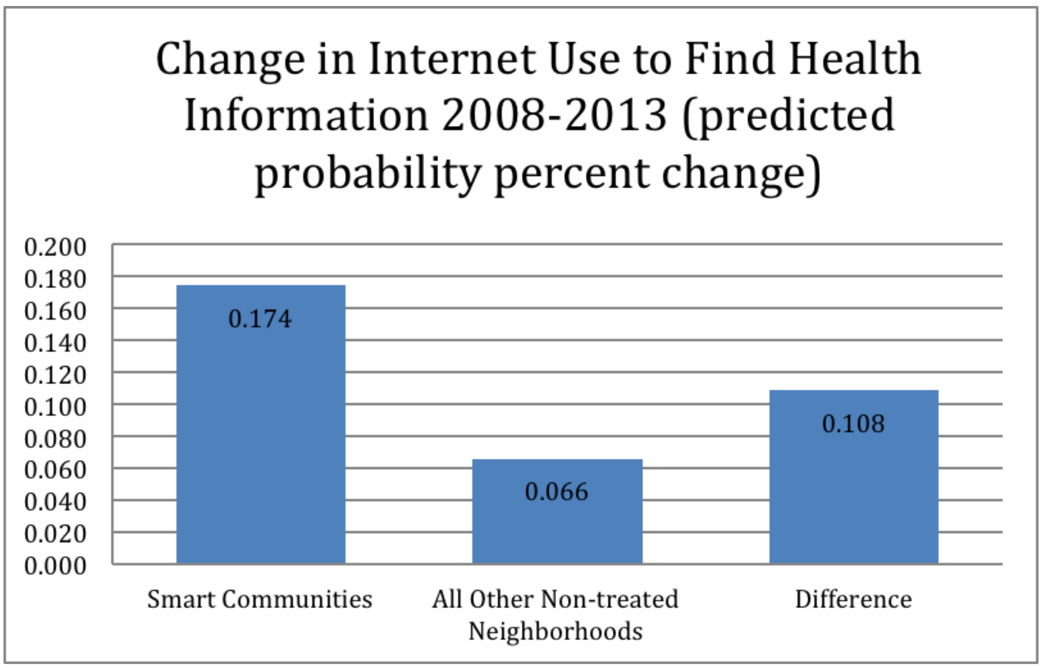
Note: Estimates based on multivariate statistical models with other neighborhood level factors (change in poverty rates, demographic factors, etc), held constant at mean values.

When comparing the shorter time frame of 2008 to 2011, 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.

But when comparing change over the five-year period of 2008 to 2013, residing in a Smart Community was associated with increased rates of change in other online activities as well (see column 1 Table 2A and 3A). Change in using the Internet for health information was 17 percentage points in the

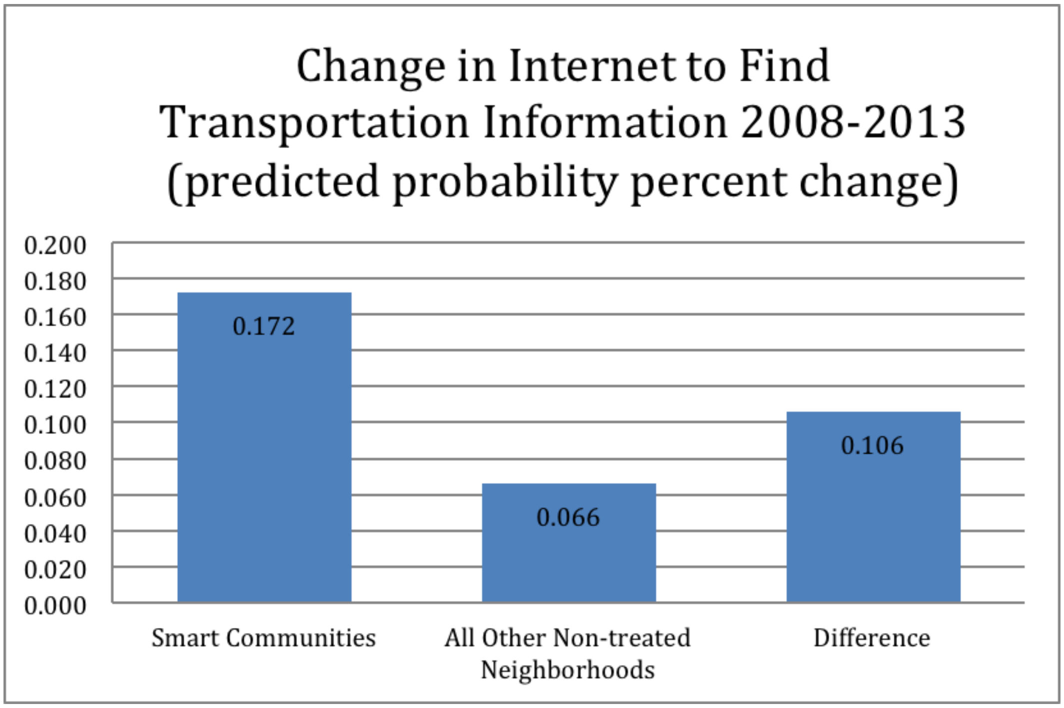
Smart Communities, and the increase was only 6.6 percentage points in other neighborhoods; an 11 point difference. Similarly, the increase in using the Internet for transportation information was 17 percentage points in the Smart Communities and was 6 percent in other Chicago neighborhoods, more than a 10-percentage point difference comparing the treated and non-treated neighborhoods. This suggests that the treatment appeared to have a measurable effect not only in increasing Internet access and home use, but in a range of important economic and social activities online. **The Smart Communities experienced a 10-11 percent greater increase in online search activities for health information and transportation over five years, compared to similarly-situated Chicago neighborhoods.**

Figure 4A



Note: Estimates based on multivariate statistical models with other neighborhood level factors (change in poverty rates, demographic factors, etc), held constant at mean values.

Figure 5A



Note: Estimates based on multivariate statistical models with other neighborhood level factors (change in poverty rates, demographic factors, etc), held constant at mean values.

Other online activities were included in the survey, but we did not find any statistically significant differences for these activities online, comparing changes in the Smart Communities with other Chicago neighborhoods. The activities where there was no significantly higher rate of increase or decrease were:

Use of the Internet for government information (any government)
Use of City of Chicago website
Use of the Internet for political information
Use of the Internet for an online class or training

Both of the latter two categories (online political information and online education) are less common activities overall in Chicago (see Mossberger, Tolbert and Anderson 2014 on the citywide survey). The areas in which there **were** significant differences are clearly priorities for people going online in these communities. The higher poverty rates are a motivation for job search, and health and transportation information are among the most common activities online for City of Chicago residents.

Yet, analysis of the three Chicago surveys indicates that we can be fairly confident that Internet use, broadband at home and online job search, health information, and transportation information have increased more in the communities that received federal program dollars for outreach and training. Designation as a Smart Community was not randomly assigned (and was a quasi-experiment), but still the methods used here compare a treated case to a non-treated case. The statistical controls help us measure change in access in the neighborhoods.

CONCLUSION: NEIGHBORHOOD-LEVEL CHANGE AND PUBLIC POLICY

Tracking Internet use over time at the neighborhood level is one way that we can measure the effects of digital inclusion initiatives, particularly those that have the goal of catalyzing community-wide change, as in the Smart Communities program. Using unique community-level data drawn from surveys and estimates from multilevel models, we measured change in the Smart Communities BTOP program from 2008-2013, compared to other Chicago community areas.

There were in fact significantly higher increases in broadband adoption and in several types of Internet use in the Smart Communities by 2013. The Smart Communities had a 15 percentage-point increase in broadband adoption at home, and a 9 percentage point difference compared to other Chicago community areas, and controlling for demographic change. Similarly, the Smart Communities experienced a 13 percentage-point increase in Internet use in any location (9 percentage points higher than in other Chicago neighborhoods). There was a 4 percentage-point increase in job search over this five year period (12 percentage points higher than in other neighborhoods, which experienced some decline over time). The Smart Communities had an 18 percentage-point jump in Internet use for health information and a 17 percentage-point increase for online transportation information. Both of these were nearly 11 percentage points higher than the increases for similarly-situated Chicago neighborhoods.

Estimating Internet use at three points in time provided insights on the process of change. From 2008 to summer 2011, less than a year after the inception of the Smart Communities program, there was a higher rate of increase in the Smart Communities for Internet use in any location, but not broadband at home or activities online. By the time the next survey was conducted, in December 2012 and January 2013, there was a statistically significant difference in broadband adoption at home and 3 of the 7 activities online that were measured. In the prior report based on the 2011 data, we observed that "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?" This was in fact the case for health, jobs, and mass transit information.

We also noted in the report on the 2011 data that 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 (Mossberger, Tolbert and Hamilton 2012). By 2013, the Smart Communities had higher rates of home broadband adoption as well as greater increases in activities online. While we cannot pinpoint the exact cause of this increase, there are a few possibilities. One is that time and experience encouraged home adoption. Another is that promotion of Comcast's $9.95 a month broadband for households with children in the school lunch program played a role. This program began in Fall 2011 after the prior survey was conducted, and we highlighted it in the last report as an area of potential change for 2013 (Mossberger, Tolbert and Anderson 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 (Mossberger, Li and Feeney 2014; Mossberger, Benoit Bryan and Brown 2014). There was a 28 percentage-point increase in Internet use for FamilyNet program participants, and they engage in a variety of activities online. Participants were asked whether Internet use after the classes had helped them to do a variety of things: 30% of these respondents said the classes helped them to get a job, 40% said they helped them to follow what their children did in school, 57% said they helped to manage their health, and 69% said they helped them to get government services. One-third of the FamilyNet respondents reported helping others to use the Internet, and half of those they helped lived in the neighborhood. 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. The Smart Communities also offered classes for community organizations on how to use the Internet to research issues online and to access government services. Survey results from these participants and interviews with community organizations indicate that many neighborhood groups may have participated in creating a spillover effect as well (Mossberger, Benoit Bryan and Brown 2014).

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, with implications for tracking outcomes in these communities over time.

There is a need for further study as well, looking at changes in outcomes for these communities. Will greater Internet use be associated with increased employment, for example? Much more needs to be known about how Internet use affects the ability of neighborhoods to be integrated into the economic fabric of their regions. How do increases in Internet use affect the support systems for neighborhood schools, for homework and parental involvement? Will differences in Internet use be related to higher graduation rates or other educational improvements at the scale of the community? Are more connected neighborhoods better able to represent their interests with city government, report problems, find resources, and engage residents in their communities? More needs to be known, overall, about whether or how this increased Internet will matter for the collective fortunes of the participating communities.

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Table 1A: Multivariate Regression Models of Change in Internet Use and Online Activities Across Chicago Community Areas (Neighborhoods) 2008-2013 Varying Smart Community Designation

	Change in Internet Use		Change in Broadband Use Home		Change in Searching for a Job Online	
	b/se	p	b/se	p	b/se	p
Treatment	0.070*	0.083	0.069*	0.080	0.079*	0.050
(Chicago Smart Community)	(0.040)		(0.039)		(0.040)	
Change in Poverty Rate	-0.006	0.188	-0.007	0.169	-0.011**	0.013
	(0.004)		(0.005)		(0.004)	
Change in % HS Degree	0.004	0.242	0.004	0.226	-0.001	0.705
	(0.003)		(0.003)		(0.003)	
Change in % Above 65 years	0.009	0.101	0.007	0.276	-0.004	0.506
	(0.005)		(0.006)		(0.006)	
Change in % Black	0.002	0.413	0.001	0.638	0.002	0.422
	(0.002)		(0.003)		(0.003)	
Change in % Latino	0.001	0.542	0	0.898	0	0.762
	(0.002)		(0.002)		(0.001)	
Change in % Asian	-0.004	0.174	-0.005	0.285	-0.007**	0.004
	(0.003)		(0.005)		(0.002)	
Constant	0.019	0.542	0.035	0.286	-0.008	0.808
	(0.031)		(0.032)		(0.032)	
R^2	0.139		0.143		0.158	
Number of cases	74		74		74	

Unstandardized ordinary least square regression coefficients, with robust standard. Probabilities based on two tailed tests. Three of Chicago's community areas (non-treated areas) lacked data for either 2008 or 2013, reducing N to 74.

Table 2A: Multivariate Regression Models of Change in Internet use and Online Activities Across Chicago Community Areas (Neighborhoods) 2008-2013 varying Smart Community Designation

	Change in Finding Health Information Online		Change in Taking a Class Online		Change in Finding Information about Politics Online	
	b/se	**p**	**b/se**	**p**	**b/se**	**p**
Treatment	0.073*	0.052	-0.009	0.743	0.034	0.405
(Chicago Smart Community)	(0.037)		(0.026)		(0.041)	
Change in Poverty Rate	-0.003	0.518	-0.009**	0.027	-0.004	0.403
	(0.004)		(0.004)		(0.005)	
Change in % HS Degree	0.006**	0.042	-0.004*	0.069	0.006**	0.048
	(0.003)		(0.002)		(0.003)	
Change in % Above 65 years	0.010*	0.069	-0.004	0.481	0.003	0.731
	(0.005)		(0.005)		(0.007)	
Change in % Black	0.001	0.673	0.000	0.882	0.000	0.936
	(0.003)		(0.003)		(0.003)	
Change in % Latino	0.002	0.153	-0.003**	0.022	0.001	0.632
	(0.001)		(0.001)		(0.002)	
Change in % Asian	-0.005	0.280	-0.005	0.138	-0.010**	0.006
	(0.005)		(0.004)		(0.003)	
Constant	-0.003	0.914	0.149**	0.000	0.018	0.557
	(0.030)		(0.023)		(0.031)	
R^2	0.178		0.250		0.162	
Number of cases	74		74		74	

Unstandardized ordinary least square regression coefficients, with robust standard. Probabilities based on two tailed tests. Three of Chicago's community areas (non-treated areas) lacked data for either 2008 or 2013, reducing N to 74

Table 3A: Multivariate Regression Models of Change in Internet Use and Online Activities Across Chicago Community Areas (Neighborhoods) 2008-2013 Varying Smart Community Designation

	Change in Searching for Information on Public Transportation		Change in Finding Information About Government Online		Change in Using Chicago City Website	
	b/se	p	b/se	p	b/se	p
Treatment	0.070**	0.031	0.026	0.424	-0.007	0.823
(Chicago Smart Community)	(0.032)		(0.032)		(0.031)	
Change in Poverty Rate	-0.002	0.557	-0.006	0.120	-0.006*	0.076
	(0.004)		(0.004)		(0.003)	
Change in % HS Degree	0.006*	0.059	0.002	0.487	-0.001	0.639
	(0.003)		(0.003)		(0.002)	
Change in % Above 65 years	0.003	0.671	-0.002	0.803	0.001	0.813
	(0.006)		(0.006)		(0.005)	
Change in % Black	-0.001	0.815	0	0.945	-0.001	0.712
	(0.003)		(0.003)		(0.002)	
Change in % Latino	-0.002	0.173	-0.001	0.671	-0.003**	0.013
	(0.001)		(0.001)		(0.001)	
Change in % Asian	-0.011**	0.000	-0.006**	0.044	-0.004*	0.067
	(0.003)		(0.003)		(0.002)	
Constant	0.02	0.516	0.021	0.422	0.129**	0.000
	(0.031)		(0.026)		(0.023)	
R^2	0.264		0.131		0.244	
Number of cases	74		74		74	

Unstandardized ordinary least square regression coefficients, with robust standard. Probabilities based on two tailed tests. Three of Chicago's community areas (non-treated areas) lacked data for either 2008 or 2013, reducing N to 74.

Table 4A: Multivariate Regression Models of Change in Internet Use and Online Activities Across Chicago Community Areas (Neighborhoods) 2008-2013 Varying Smart Community Designation

	Change in Using Internet at Work	
	b/se	**p**
Treatment	0.004	0.929
(Chicago Smart Community)	(0.044)	
Change in Poverty Rate	-0.007	0.228
	(0.006)	
Change in % HS Degree	0.012**	0.004
	(0.004)	
Change in % Above 65 years	-0.001	0.857
	(0.007)	
Change in % Black	0.001	0.809
	(0.005)	
Change in % Latino	0.002	0.337
	(0.002)	
Change in % Asian	-0.010	0.244
	(0.009)	
Constant	0.215**	0.000
	(0.039)	
R^2	0.248	
Number of Cases	74	

Unstandardized ordinary least square regression coefficients, with robust standard. Probabilities based on two tailed tests.
Three of Chicago's community areas (non-treated areas) lacked data for either 2008 or 2013, reducing N to 74.