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DIGITAL CITIES and DIGITAL INEQUALITY

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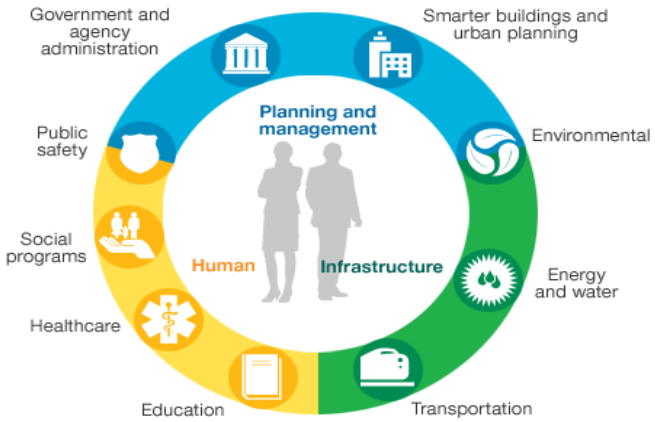
Broadband Innovation on City Agendas



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Our Vision

04/17/2013

We envision a world where digital technology and intelligent design have been harnessed to create smart, sustainable cities with **high-quality living** and **high-quality jobs.** We promote cities that embody our three core values:

- **Livability:** Cities that provide clean, healthy living conditions without pollution and congestion. With a digital infrastructure that makes city services instantly and conveniently available anytime, anywhere.
- **Workability:** Cities that provide the enabling infrastructure -- energy, connectivity, computing, essential services -- to compete globally for high-quality jobs.
- **Sustainability:** Cities that provide services without stealing from future generations.

A smart city gathers data from **smart devices and sensors** embedded in its roadways, power grids, buildings and other assets. It shares that data via a **smart communications system** that is typically a combination of wired and wireless. It then uses **smart software** to create valuable **information and digitally enhanced services**.

Some of those services are used by the city itself. Examples include emergency response centers and city-wide control centers. Likewise, enhancements such as smart power grids and smart water grids improve efficiency and reliability while also giving customers detailed information to help them reduce their bills. And smart transportation uses the power of computers to optimize travel throughout the city.

Some of those services are delivered digitally via computer or smart phone. Examples include online permitting, online lookup of information such as buried cables, water mains, bus arrival times, traffic maps, crime reports, emergency warnings, taxi locations and much more.

Market Size Estimates of the smart cities market vary widely. The one constant is a universal expectation of substantial growth. New cities will be built and existing ones will be retrofitted to create economic development and improve the lives of citizens

- According to ABI Research, smart cities technology is an $8.1 billion market today and in five years, the market will grow to almost five times that size, reaching **$39.5 billion**.
- Pike Research forecasts that investment in smart city technology infrastructure will total **$108 billion** during the decade from 2010 to 2020.
- The Smart 2020 report is even more bullish, claiming the related technologies and industries will

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Metropolitan Innovation

Cities foster innovation (Glaeser 2011)
Metro areas are the nation's engines of prosperity (Brookings 2010)

- Density – knowledge spillovers across firms and specialization in labor markets
- Agglomeration economies
  - Centers of knowledge and culture – universities, health research, museums
- Diversity and exchange of ideas
  - Advantages in the knowledge economy, face-to-face interactions complement online interactions (Glaeser 2011)

Internet Use Matters for the Economy in Communities

- Broadband **infrastructure** shows positive outcomes for employment, number of businesses, property values in communities (Gillett et al. 2006)
- For employment growth **across sectors** (health, manufacturing, finance, real estate, education, etc.) (Crandall, Lehr and Litan 2007)
- Technology **applications** (in various industries) will be the primary source of productivity growth in coming decades (Byrnjolfsson and Saunders 2010)
- **Internet use** in firms in **metropolitan areas** produces greater gains in productivity, wages
  (Forman et al. 2005, 2008, 2009)

Internet Use Matters for Economic Opportunity for Individuals

- Longitudinal data show Internet use at work and *at home* are both associated with higher wages (DiMaggio and Bonikowski 2008)
- Internet use at work accounted for about $118/week more in wages in 2003, controlling for other influences (Mossberger, Tolbert and McNeal 2008)
- Even for workers with only a high school education or less, it resulted in $111/week more (Mossberger, Tolbert and McNeal 2008)
- Connecting workers with better jobs for the level of education they have is one of the most effective economic development strategies (Bartik 2003)
- Nearly ¾ of job seekers use the Internet, which is often the only way to apply (American Library Assoc. 2010)

Internet Use and Education

- Innovations such as Khan Academy - new resources for individualized study at home and at school
- Flipped classrooms
  - work online outside the classroom
  - class time for discussion and group work that promotes critical thinking and collaboration
- Libraries often have time limits of 30 minutes and long waits
  - 76% of libraries believed they did not have enough computers to meet demand in 2010 (American Library Assoc. 2011)

Internet Use and Parent Engagement

October 2012 Cuyahoga County Survey
(Tolbert and Mossberger 2013)

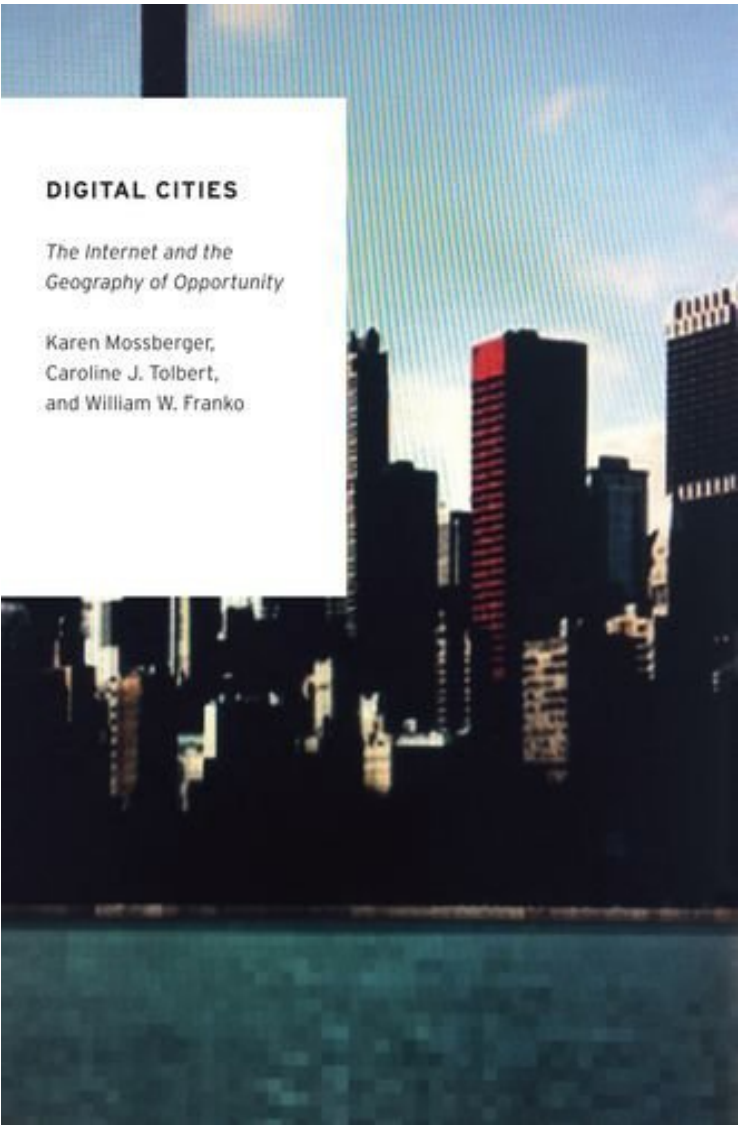
68% of parents use child's school website
88% of those have home broadband
50% of parents check the school portal for grades or attendance
88% of those have home broadband
62% email teachers
90% of those have home broadband
50% use homework/instruction website
85% of those have home broadband
20% use Internet to help children with college or career info
87% of those have home broadband

Innovation Alone Not Enough

Network Externalities – Value of broadband/wireless networks increase with number of users –

3 in 10 did not have broadband at home in US in 2011 – US Dept. of Commerce

- Social benefits depend on broad networks of use
- Large % of population offline, absence of certain populations constrains
  - Workforce development and human capital
  - Small business development in low-income communities
  - Efficiencies in mass transit
  - Transformation of education – flipped classrooms, customized instruction, parental engagement through portals
  - E-government implementation, especially for social services
  - Online information and deliberation for civic engagement
  - Health care reforms that stress personal management of health data, access to health information resources



Oxford University Press 2012

Metropolitan Needs:

- **Speed for innovation in economy and public institutions**
- **Affordability for adoption by residents and businesses**

Variation Across Cities: Prospects for Innovation

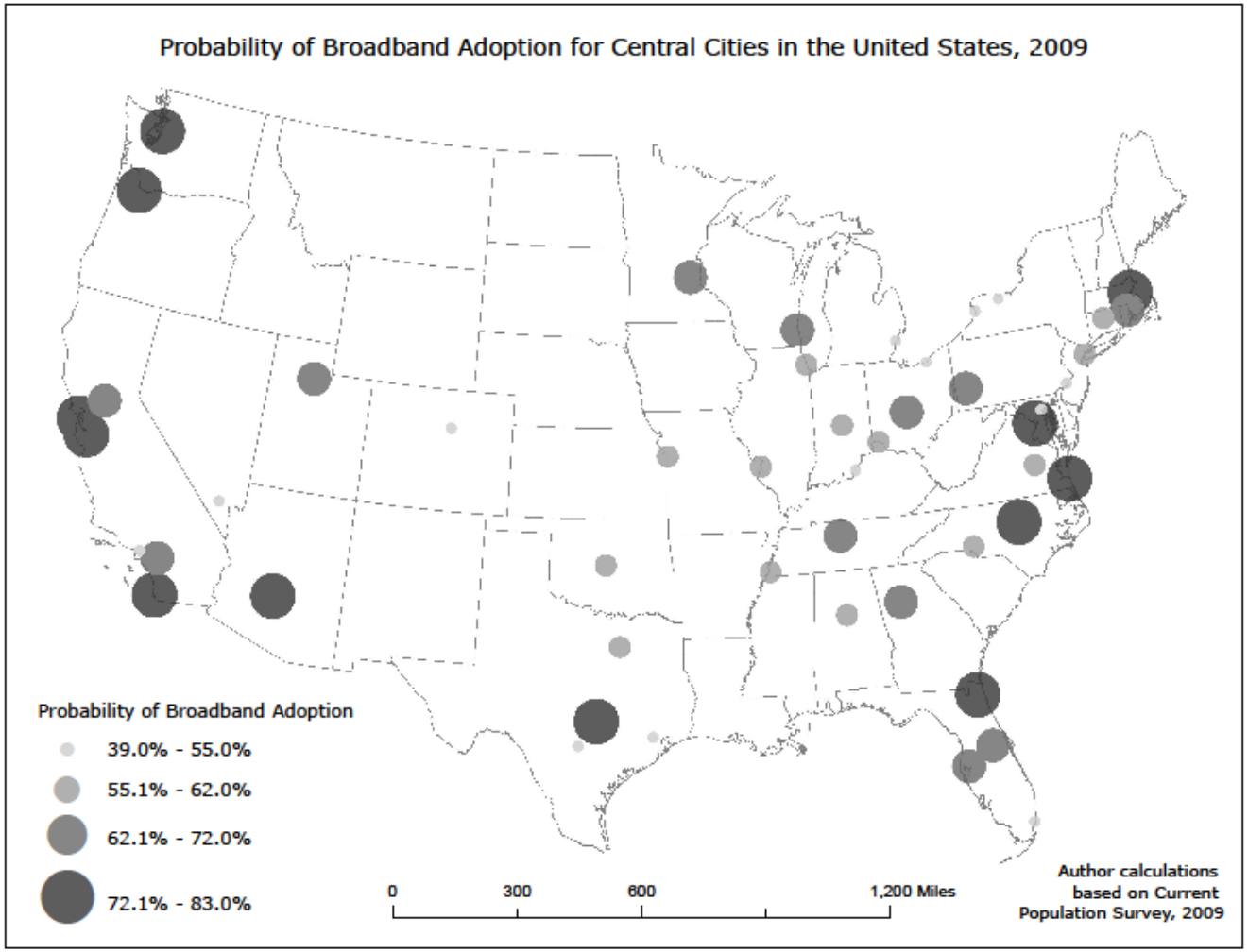
- ***How do central cities compare?***
- ***How do racial and ethnic groups fare across places?***
- ***How do "balance" metro areas compare – to central cities and to each other?***
- Comparing and ranking – identifying needs and setting policy agendas
- No comparable data at city or metro level

Methods and Variables

(Mossberger, Tolbert and Franko 2012)

- Data from 2007 & 2009 CPS for 50 largest metro areas (MSA's), for central cities and balance areas
- Multilevel models to predict probabilities of technology use
- Census and ACS data merged with individual-level data from CPS
- Aggregate-level variables include population size, per capita income, and % of MSA or central city that is African American, Latino, educated with a high school diploma, over 65 years of age, and employed in the information sector

Cities and Broadband Adoption, 2009



Top 10 Central City Rankings, Uses High-Speed Internet at Home, CPS 2009

	Avg.		Predicted Probability	Rank	White	Black	Latino	N
Seattle, WA	**76%**	**(2)**	**0.83**	**(1)**	**0.85**	**0.74**	**0.68**	**309**
Portland-Vancouver-Beaverton, OR-WA	**75%**	**(4)**	**0.80**	**(2)**	**0.82**	**0.70**	**0.63**	**380**
San Francisco, CA	**73%**	**(6)**	**0.80**	**(2)**	**0.85**	**0.74**	**0.68**	**335**
San Jose, CA	**76%**	**(2)**	**0.80**	**(2)**	**0.86**	**0.75**	**0.69**	**251**
Virginia Beach, VA	**78%**	**(1)**	**0.79**	**(5)**	**0.83**	**0.71**	**0.64**	**123**
Boston, MA	**75%**	**(4)**	**0.78**	**(6)**	**0.83**	**0.70**	**0.64**	**350**
San Diego, CA	**73%**	**(6)**	**0.78**	**(6)**	**0.83**	**0.71**	**0.65**	**367**
Austin-Round Rock, TX	**68%**	**(10)**	**0.76**	**(8)**	**0.82**	**0.70**	**0.63**	**239**
Phoenix, AZ	**70%**	**(8)**	**0.74**	**(9)**	**0.80**	**0.66**	**0.59**	**368**
Jacksonville, FL	**69%**	**(9)**	**0.73**	**(10)**	**0.78**	**0.63**	**0.56**	**192**
Raleigh-Cary, NC	**66%**	**(12)**	**0.73**	**(10)**	**0.79**	**0.65**	**0.58**	**155**
Washington-Arlington-Alexandria, DC-VA-MD-WV	**64%**	**(17)**	**0.73**	**(10)**	**0.80**	**0.66**	**0.60**	**1933**

Bottom Central City Rankings, Uses High-Speed Internet at Home, CPS 2009

	Avg.		Predicted Probability	Rank	White	Black	Latino	N
Los Angeles, CA	**49%**	**(44)**	**0.49**	**(44)**	**0.63**	**0.46**	**0.39**	**1204**
Miami, FL	**51%**	**(38)**	**0.48**	**(45)**	**0.63**	**0.46**	**0.38**	**202**
Detroit, MI	**48%**	**(45)**	**0.47**	**(46)**	**0.60**	**0.43**	**0.36**	**339**
Cleveland-Elyria-Mentor, OH	**46%**	**(47)**	**0.44**	**(47)**	**0.54**	**0.37**	**0.30**	**126**
Rochester, NY	**39%**	**(49)**	**0.43**	**(48)**	**0.53**	**0.36**	**0.30**	**58**
San Antonio, TX	**44%**	**(48)**	**0.43**	**(48)**	**0.59**	**0.42**	**0.35**	**324**
Buffalo, NY	**38%**	**(50)**	**0.39**	**(50)**	**0.44**	**0.28**	**0.23**	**131**

Broadband Across Cities, 2009

- Cities estimates vary widely, from 39% (Buffalo) to 83% (Seattle) for broadband at home
- Low-ranked cities are often hard-hit economically or have high populations of low-income Latinos
- Cities with high broadband adoption tend to have more vigorous economies, often information technology industry
- Some high-ranking cities known for digital inclusion programs
- Racial/ethnic disparities exist everywhere, but all groups do better where high % of city's population is online

Comparing Phoenix City & Suburbs

2009 CPS estimates	% Home Broadband Overall	Rank	White	Black	Latino
Phoenix	74	9	80	66	59
Balance suburbs PHX metro	78	11	81	71	63

Digging Deeper within Regions and Cities

- Central cities generally lag suburbs, despite increased suburban diversity*
- Regions differ in city-suburban segregation and poverty
- Suburban differences obvious in Cuyahoga County survey
- Neighborhood differences within cities – Chicago data

US – 69% in 2011
Chicago – 67.5% in 2011 – Chicago as a case in urban inequality

*A few high-ranked cities slightly exceed their suburbs

Disparities Within Metros: Cuyahoga County, 2012

Estimates	% Home Broadband	% Internet Use Anywhere	% Mobile	% Mobile & Broadband
Pepper Pike	93	99	47	47
Cleveland	54	86	29	20
East Cleveland	53	84	31	23
Warrensville Heights	50	81	27	20

Chicago as a Case

- Unique neighborhood-level data for Chicago across 77 official community areas, 2008 (repeated in 2011 and 2013)
- RDD survey of 3465 Chicago residents in English and Spanish, conducted by authors
- Multilevel models merging in census tract data to generate predicted probabilities and maps
- Predicted probabilities for 20 variables, including broadband at home, Internet use anywhere, activities online, barriers

HOW DO BARRIERS VARY ACROSS NEIGHBORHOODS?

Fig. 8.1

Percentage of Respondents by Chicago Community Area
Citing Lack of Interest as Reason for No Home Access, 2008

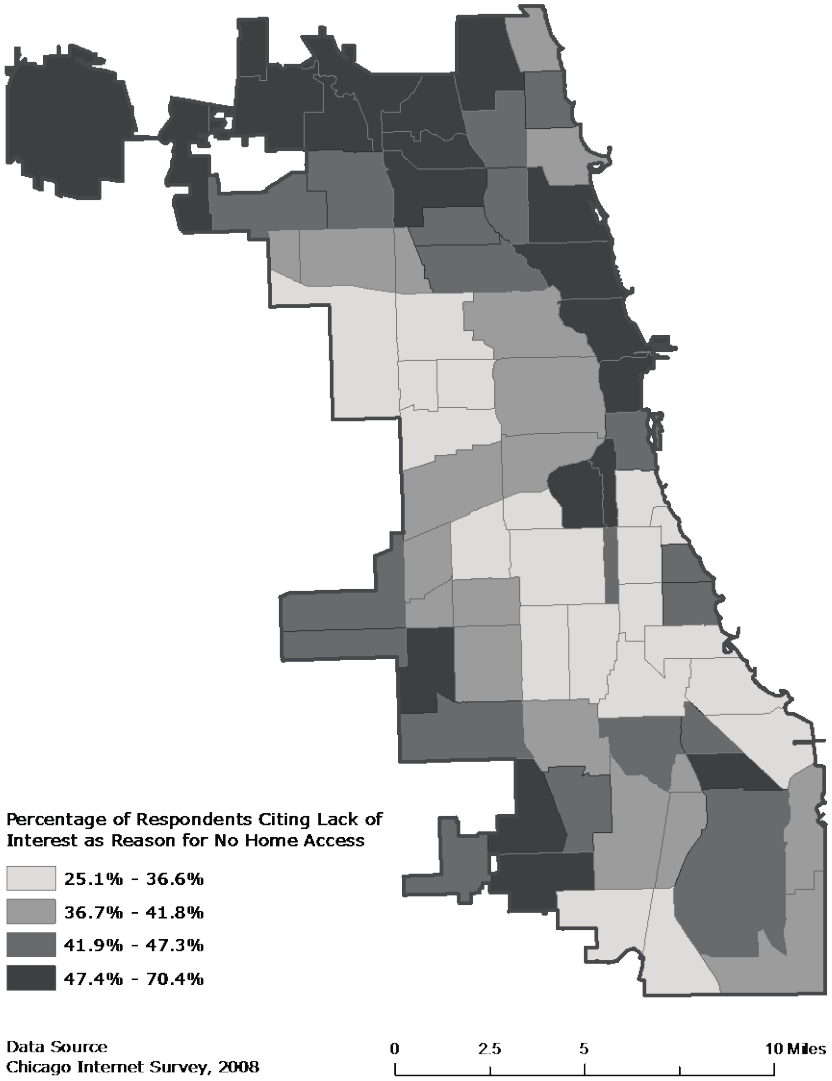
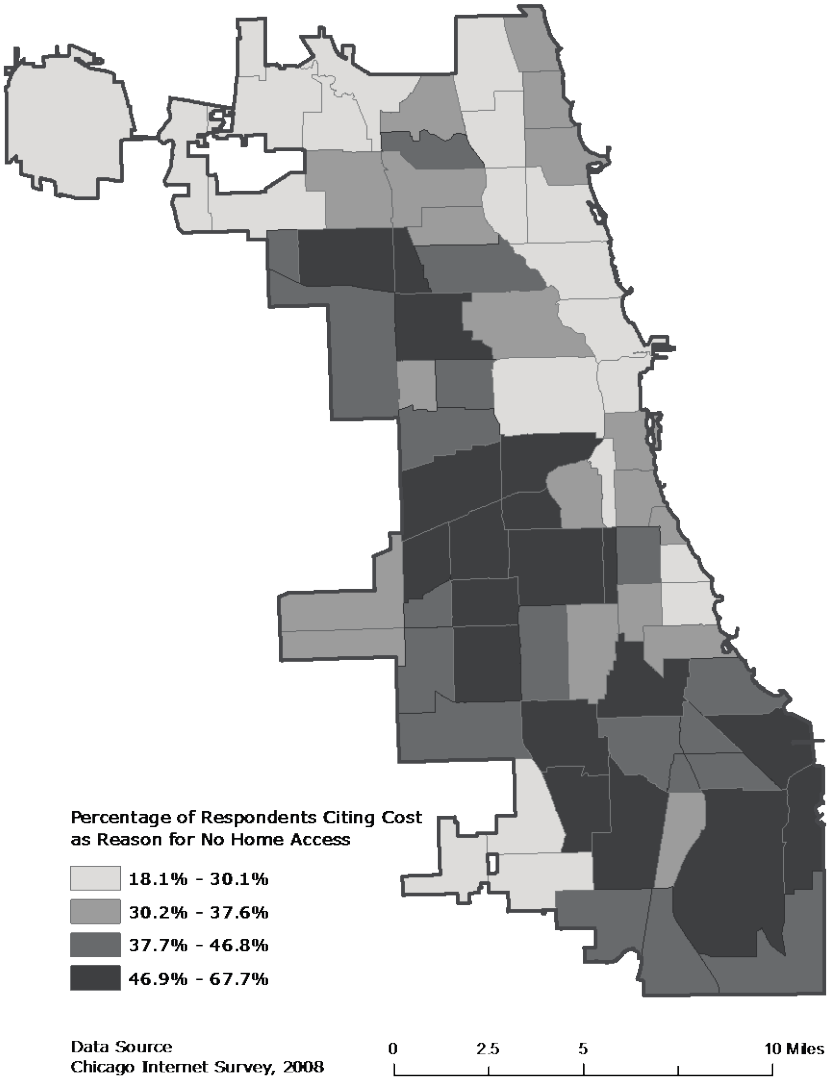


Fig. 8.2

Percentage of Respondents by Chicago Community Area
Citing Cost as Reason for No Home Access, 2008



Neighborhoods, Race & Technology

Using multilevel models to control for both individual and neighborhood variables –

- Segregation (and concentrated poverty) magnify barriers to technology use, beyond-individual-level income, education, race/ethnicity, etc.
- *Double burden of concentrated poverty*

Mobile growing among African-Americans and Latinos, but is this second-class access? (Crawford 2011)

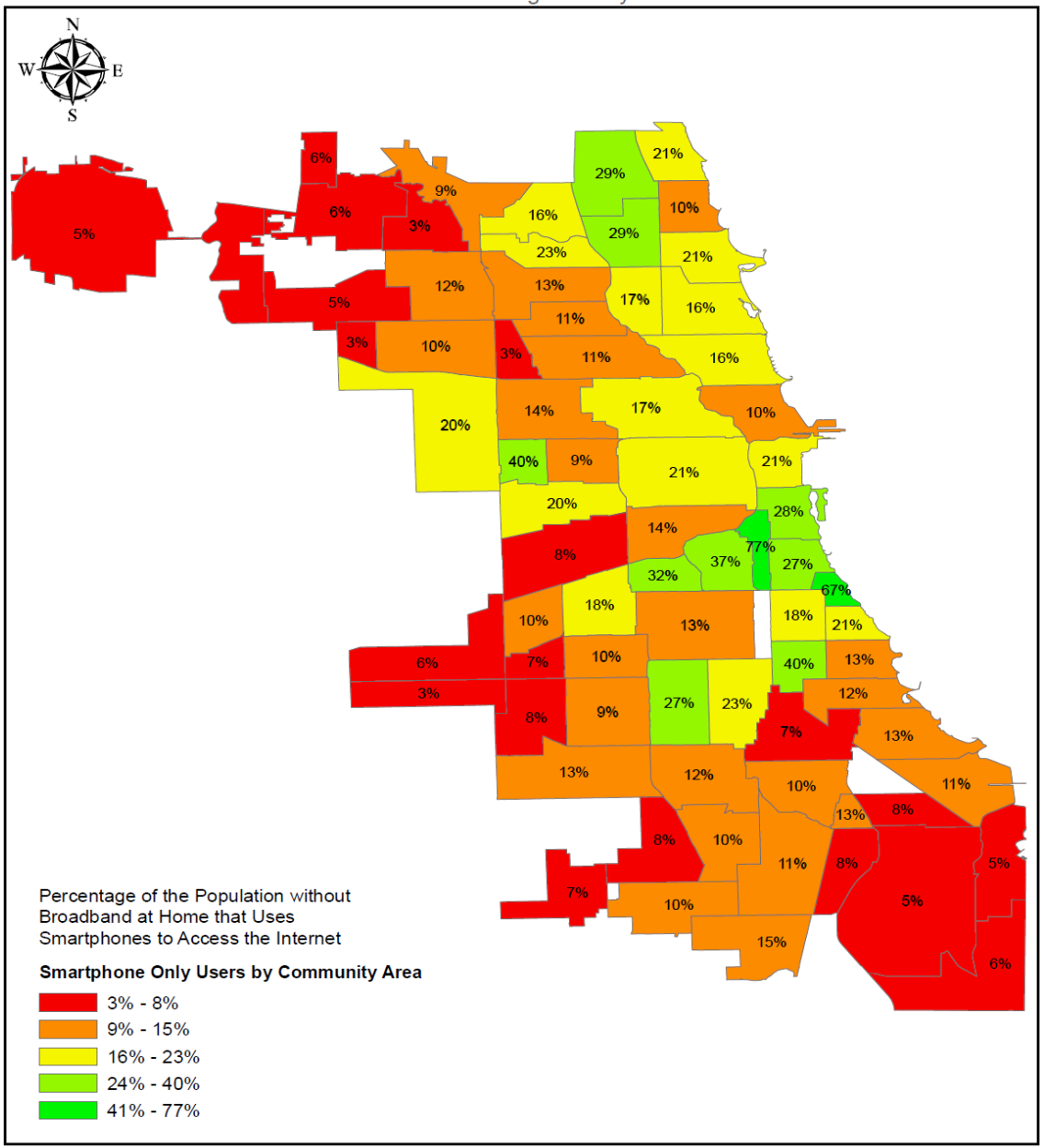
Controlling for other factors, home broadband is associated with -

- human-capital activities online
- higher levels of Internet knowledge/skill

Mobile-only Internet users still disadvantaged, though do more online than those with no personal access
(Mossberger, Tolbert and Franko 2012; Mossberger, Tolbert and Hamilton 2012; Tolbert and Mossberger 2013)

Smartphone Use with No Home Broadband by Community Area

2011 Chicago Survey



Policy Implications

- Addressing neighborhood inequalities and regional disparities is needed to realize potential benefits of broadband and IT innovation
- Cities, regions, neighborhoods with low technology use have fewer resources for innovation in education, health, e-government, economic development
- Technology disparities can reinforce existing place-based inequalities in education, income, etc.
- Shared labor markets suggest pronounced city/suburban disparities may have impact on regional capacity for innovation
- Addressing innovation and inequality in urban areas should be an intergovernmental as well as local priority