TOWARD CONNECTED, INNOVATIVE AND RESILIENT METRO REGIONS

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Why should policymakers care about information technology use in their regions? Quite simply, because today information technology is fundamentally transforming the way in which we do nearly everything. These changes are important for the capacities and opportunities of individual residents, and for the development, quality of life, and resilience of communities.

For individuals, Internet use is necessary to participate in society, for access to information on jobs, government services, and health care, for civic engagement, and for economic opportunity (Mossberger, Tolbert and McNeal 2008). Think about how we apply for jobs today, file taxes, compare prices, look for a new apartment, check on our children's homework and grades, and navigate our way around. Information and communication online are so essential that the United Nations has called Internet access a human right (Kravets 2011).

Yet, nationally, and in the City of Chicago, about 30% of the population in 2013 does not have broadband at home – they do not have regular and effective access to the Internet (NTIA 2013; Tolbert and Mossberger 2013). Approximately 15 percent of Chicago residents (and 15% nationally) do not use the Internet at all.

This is a public policy concern for many reasons, including the public benefits that can be generated from technology use, for innovation and community resilience, as well as social equity. Local governments are critical actors in realizing these policy goals, and the interconnected fabric of metropolitan regions makes it important to examine these issues at that scale.

Information technology use matters for what economists call public goods, as the benefits of Internet use are not confined to the individuals who use the technology, but affect communities as a whole. Broadband, or high-speed Internet, makes possible innovative uses in health, education, economic development, energy and environmental management, mass transit, public safety and emergency management, government service delivery, political participation, and many other areas important to the development and quality of life in communities. The public goods characteristics of

broadband have inspired the creation of wide-ranging initiatives that cross policy areas, such as the National Broadband Plan in the United States (FCC 2010) and a Digital Agenda for the European Union (European Commission 2010). Yet is local governments that have substantial responsibility in many of these policy areas in the U.S., and that have the potential for important leadership on technology use.

Major cities and their metropolitan regions are the engines of the national economy (Katz and Bradley 2012; Ledebur and Barnes 1998; Glaeser 2011). They are population centers with enormous social impact for the nation as a whole. Today 2/3 of Americans live in the top 100 metropolitan areas, which cover 12 percent of land space but produce 75% of national GDP (Katz and Bradley 2012). These metropolitan regions are defined by a common labor market and commuting patterns (Katz and Bradley 2012), and the actions of neighboring communities easily spill across boundaries. Metro areas are connected through multiple interactions and networks, which can be enhanced through information technology use.

To introduce the contributions in this volume, we begin by discussing the role of digital technology for local and metropolitan innovation, public goods, and resilience. While the individual chapters will examine the significance of technology in several critical areas – workforce development, advanced manufacturing, health, and e-government – there is a need to frame these policy areas in a more general context, including theories of urban development and the metropolitan institutional environment. Next, we examine the presence of neighborhood and metropolitan disparities in technology use that present challenges for realizing these public policy goals, considering actions to foster better public policy.

METROPOLITAN INNOVATION AND SOCIAL BENEFITS

Public and private efforts alike envision cities and their urban regions as incubators for technological innovation across policy areas. Google is installing a superfast gigabit broadband networks in Kansas City, KS and Kansas City, MO, and more recently, Austin, TX and Provo, UT (seehttps://fiber.google.com/about/) . The White House Office of Science and Technology Policy launched US Ignite in partnership with six city-regions that agreed to experiment with applications for gigabit broadband with the goals of transforming "how we receive healthcare, educate our children, keep our communities safe, become more energy efficient, train our employees, and manufacture goods" (http://us-ignite.org/what-is-us-ignite/). World-wide, technology firms like Cisco and IBM have partnered with local governments for "smart city" solutions to powering electrical grids, managing transportation systems, protecting public safety, and promoting environmental sustainability (http://www.cisco.com/web/about/ac79/docs/ps/motm/Smart-City-Framework.pdf).

Social and economic innovations are most likely to occur in dense and diverse metropolitan areas, with their specialized labor markets, intense activity, knowledge spillovers across firms, larger and more specialized governments, and wealth of cultural and research institutions (Forman et al. 2005, 2008; Glaeser 2011, 247). Through their density and scale, "cities concentrate, accelerate, and diversify social and economic activity" (Bettencourt and West 2011, 52). Cities and their metropolitan regions can be viewed as an "innovation ecosystem empowering the collective intelligence and co-creation

capabilities of user/citizen communities for designing innovative living and working scenarios "(Schaffer et al. 2011). The application of information and communication technologies can positively affect this ecosystem (Komninos, Pallot, and Schaffer 2013).

Broadband use in communities can stimulate economic development (Gillett, Lehr and Osorio 2006; West 2010; Qiang 2010; Sohn, Kim, & Hewings 2005). Information technology applications across sectors and in a variety of industries drive productivity and growth (Byrnjolfsson and Saunders 2010; Crandall, Lehr and Litan 2007). But, in urban areas, firms are more likely to adopt advanced technologies and employ more complex uses of the Internet that lead to greater productivity and economic growth. In contrast, rural firms tend to use the Internet in basic ways, such as for email or web browsing (Forman et al. 2005, 2009). The thicker labor markets in metro areas facilitate more knowledge spillovers across firms, and the cost of innovation using the Internet is lower, because firms can draw upon existing talent and skills rather than developing them internally (Forman et al. 2008). The development of advanced manufacturing technologies discussed by Wiall for this forum is one example.

Economic theories of urban leadership in technology use (Forman et al. 2009) point to the skills of the workforce for using technology as an important factor in urban innovation. Wage growth associated with Internet use is disproportionately concentrated in metropolitan areas, indicating higher returns to skill (Forman et al., 2009). Workforce development policies, however, are often instruments for addressing both skill and income disparities, and there is evidence that Internet use matters for individual wages as well. Longitudinal data demonstrate that Internet use at home and on the job lead to higher wages, likely because home Internet use signals useful skills (DiMaggio and Bonikowski 2008). Other research shows that Internet use at work results in higher wages even for less-skilled workers with a high school education or less (Mossberger, Tolbert and McNeal 2008). These findings suggest that workforce development should address technology skills for disadvantaged workers as well as for a competitive edge in attracting or developing businesses with more knowledge-intensive occupations. West examines technology and workforce development in metro regions in his contribution to this forum.

Concentrating the nation's population, as well as medical and research institutions, metropolitan areas are important testbeds for health care reforms. These include emerging practices that empower individuals with more information and tools for managing their health, as described by Callan for this forum.

As Fountain discusses in her contribution, information technology also makes possible innovations for government, including more convenient, efficient, and round-the-clock access to services and information. Additionally, however, governments are experimenting with open data portals, social media, and online town hall meetings that promise opportunities for greater transparency and dialogue on public issues (Mergel 2013; Mossberger, Wu and Crawford 2013; Feeney, Welch and Haller 2011; Bertot, Jaeger and Grimes 2012). Local governments have long been regarded as schools for democracy where face-to-face participation is most likely to occur (Berry, Portney and Thomson 1993), and so the development of e-government at the local level has important potential for fostering civic participation, as well as trust and confidence in government (Tolbert and Mossberger 2006). Large

cities have traditionally been pioneers in e-government use (Ho 2002; Jimenez. Mossberger and Wu 2012), with more professionalization as well as scale.

Although the contributions in this volume focus on advanced manufacturing, workforce development, health, and e-government, there are many other ways in which digital technologies can improve urban services and quality of life. Mass transit and energy conservation are just two examples of information technology applications with particular resonance for cities and metropolitan areas.

Exploiting positioning sensors and computing techniques, investment in public transportation has shifted from traditional infrastructure to IT-based service improvements, which emphasize pre-trip information, on board information, smart cards and other convenient processes (Camacho, Foth, & Rakotonirainy 2013). "Big data" can be harnessed for better modeling of traffic flows and planning, and real-time information on traffic and parking is available in many cities (Wilkie, Sewell and Lin forthcoming; see http://gamma.cs.unc.edu/RoadNetwork/; see open data portals for San Francisco and New York). Through the use of the computing abilities of information technology, cities can make optimum use of existing infrastructure in order to reduce consumption of fossil fuels and achieve significant green house gas emissions reduction (Winkelman et al. 2010). The city of Pleasanton, California, for example, uses a traffic camera system to identify and differentiate between cars and bicycles so that it can adjust the timing of the traffic light for cars or bicycles to cross a busy intersection. This helps reduce car idling, unnecessary fossil fuel consumption and green house gas emissions (Desouza 2012).

Energy information systems (EIS) have been used in cities to measure energy usage performance and are viewed as a promising technology to reduce energy use in buildings (Granderson, Piette, & Ghatikar 2011). Smart meters are EIS applications that provide consumers with detailed and real-time energy consumption information, but also link this information directly to the utility provider, who can apply dynamic pricing based on the use of energy in peak and non-peak hours. Smart meters increase consumers' awareness of energy usage and have the potential to change energy use behaviors, and help achieve energy saving in a city as a whole. For example, Pacific Gas and Electric (PG&E) tested dynamic pricing in Bakersfield, California, on 2,300 homes under this system. The result was that there was as much as a 13 percent decrease in peak hour energy usage (Desouza 2012).

Technology can also be used for "crowdsourcing" and bottom-up processes of problem-solving. In cities across the globe, "Living Labs" present challenges faced by cities and submitted by local governments, inviting citizens and organizations to develop solutions (http://www.llga.org/connect.php) Digital technologies can power a number of improvements for metropolitan areas through their ability to transmit information and provide new opportunities for communication and participation.

METROPOLITAN RESILIENCE

The same density, scale and complexity of metropolitan regions that fosters innovation and impact can also create vulnerability to environmental hazards, natural disasters, public safety threats, economic shocks and other disruptions. Natural disasters such as Hurricane Katrina and Superstorm Sandy, along with the tragedy of the World Trade Center, have placed concerns about metropolitan resilience on urban agendas. A resilient system is defined by its two main features—its ability to absorb change and disturbance, and the persistence of systems while retaining its basic functions and structure (Walker et al. 2006); together with the ability to survive, adapt and transform itself (Ludwig et al. 1997,

28); being able to cope with external shocks and surprises. It is not just concerned with preventing disturbances, but it also concerned with adaptation to change (Eraydin & Tasan-Kok, 2013, 40).

Some principles have been applied by scholars to define the measurable aspects of resilient cities. These principles include recovery, connectivity, social capital, adaptability, robustness, flexibility, and transformability (Eraydin & Tasan-Kok 2013). All these principles actually complement each other to enable cities' capacities to withstand, cope with, and respond to disturbance and without suffering from loss or degradation of its functions and structures.

Information is crucial. An urban system must have the capacity to sense incremental and major changes in the environment and to monitor the urban system's performance, and then further use the information gathered to learn from past experience, to experiment with possible alternative actions, and to anticipate the future (Ercoskun 2012). Information technology is a crucial resource for the establishment and enhancement of these capacities of an urban system (Huston and Warren 2013).

Technology is also important for connectivity (Eraydin & Tasan-Kok, 2013). For example, Wallace and Wallace (2008) conclude that the social networks and interconnection between urban neighborhoods are the basis of metropolitan resilience. Information technology also helps promote the interconnectivity within and between metropolitan areas (Chourabi et al. 2012). Examples of IT usage in enhancing interconnectivity and urban resilience can be found in studies on disaster management. These studies indicate that the use of online social media in crisis events and in disasters can facilitate public participation in recovery efforts and communication during the response. For example, Palen (2008) studies how local residents used online social media to acquire, disseminate, and communicate information in the 2007 southern California wildfires, and also indicates the insufficiency of traditional media and government official channels in providing real-time information. Liu et al. (2008) also indicate the use of the online photo sharing website, Flickr, in disaster preparation, warning, response, and recovery efforts, and conclude that this use of information technology has increased the interconnectivity of citizens and has fostered grassroots activities, which are essential for metropolitan disaster resilience. Information technologies contribute to the adaptability and flexibility of urban systems by connecting decentralized and distributed resources across the region, by making information available to residents and businesses, and providing networks for communication.

INCLUSION IS NEEDED FOR INNOVATION AND RESILIENCE

Internet use has network externalities – that is, the social benefits of technology increase with widespread use and inclusive networks. Regions that have lower rates of Internet use are constrained in a number of ways – in the skills within the local workforce, for example, in the ability of local governments to deliver services online more efficiently and effectively, in the capacity of local hospitals to promote preventive care through patient information. Low rates of broadband adoption at home affect the ability of school districts to transform K-12 education through methods like flipped classrooms and to involve parents on a more continuous basis through school portals. Neighborhoods with few residents online are likely to suffer disproportionately during crises. As Hurricane Katrina demonstrated, low-income neighborhoods often have fewer resources to cope with disasters, anyway; a lack of

connectivity makes them even more vulnerable. In general, local institutions can't fully move into the digital age when the populations they serve are offline or only tenuously connected to the Internet.

For residents, digital citizenship, or the ability to participate in society online, requires both regular access to the Internet and the skills to use it (Mossberger, Tolbert and McNeal 2008, 1). One way in which to measure the quality of access and skills that individuals have is to examine the range of activities they are able to engage in online. This is especially true for what Hargittai (2002) has called human capital-enhancing activities online – for jobs, finances, education, health care, political participation, and civic engagement. These are more demanding activities requiring some knowledge about how to search for and use information, that Internet users engage in with greater experience and higher levels of education (DiMaggio et al. 2001). These are exactly the goals of policies such as the National Broadband Plan (FCC 2010). Forms of access matter, as broadband adoption at home (or the combination of broadband and mobile phones) is significantly associated with a greater range of activities online, controlling for other factors (Mossberger, Tolbert and Franko 2012; Mossberger, Tolbert and Hamilton 2012).

As mobile technology proliferates, and is embraced at high rates by African-Americans and Latinos, assumptions abound about the disappearance of the "digital divide." According to the Pew Internet and American Life Project, nationally 74% of African-American cell phone users and 68% of Latino cell phone users access the Internet on their smartphones, in contrast with 59% of non-Hispanic whites (Duggan and Smith 2013). A small percentage of the population goes online, however, primarily through mobile phones, without broadband at home. This group is predominantly African-American and Latino, low-income, less-educated, and young (Mossberger, Tolbert and Franko 2012), and accounts for 9% of African-Americans and 15% of Latinos in Chicago in 2013 (Mossberger and Tolbert 2013). They enjoy some of the benefits of technology, but according to research, they do less online and have fewer technology skills (Mossberger, Tolbert and Franko 2012; Mossberger, Tolbert and Hamilton 2012). So, while the spread of mobile phones is changing how and where individuals use the Internet, broadband at home is still an important indicator to track for comparing technology adoption and disparities. Fully-connected Internet users are those who have multiple devices, combining the continual access and mobility of smart phones, and the functionality of larger screens and keyboards on laptops and personal computers.

Cities and Metros Across the Nation

Technology use varies substantially between cities and regions, according to estimates for Internet use and broadband use for the 50 largest cities and their suburban areas based on the 2009 Current Population Survey (Mossberger, Tolbert and Franko 2012).[1] Broadband adoption at home

[1] Estimates for Internet use (anywhere) and broadband adoption at home are produced for both central cities and their suburbs (MSA balance areas) for the 50 largest metropolitan areas, and by race and ethnicity. Multilevel statistical models include individual-level data from the Current Population Survey and aggregate-level variables to control for demographic and economic factors unique to each region. The central-city aggregate data was obtained from the American Community Survey (3-year estimates, 2007-09) and the *State and Metropolitan Area Data Book* suburban area model estimates. Aggregate-level variables in the statistical models include population

ranged between 39% in the city of Buffalo and 83% in Seattle. Other cities at the top of the list have an IT industry presence and highly-educated populations, such as Portland, OR, San Francisco and San Jose. Those at the bottom of the list include places with substantial poverty and disinvestment, such as Cleveland, Detroit, and Rochester, NY, or cities with high proportions of Latinos, such as Los Angeles, San Antonio, and Miami. But, while African-Americans and Latinos had lower rates of Internet use or broadband adoption than Non-Hispanic whites in all cities, the disparities were smaller in places where there was a high percentage of the population as a whole online. In this case, traditionally disadvantaged groups were more likely to be digital citizens when there was a technology-rich environment overall (Mossberger, Tolbert and Franko 2012).

Comparing broadband adoption and Internet use estimates for central cities and suburbs shows that while cities generally lagged behind their suburbs, both tended to place similarly in the rankings. Scholars have argued that central city and suburban economic fortunes are closely linked by the common regional economy, and this seems to be true for the most part for Internet use in metropolitan areas (Ledebur and Barnes 1998; Pastor et al. 2000). Yet, there were also some glaring exceptions, where there were wider gaps in technology use between city and suburban rankings. For example, Milwaukee, Denver, and Rochester's central cities ranked low in Internet use, yet their suburban regions were in the top ten. The Milwaukee metropolitan area is one of the most racially segregated in the U.S. (Logan and Stults 2011) and Denver has a high percentage of Latinos (Mossberger, Tolbert and Franko 2012). Regional information technology disparities clearly reflect other social inequalities in metropolitan areas.

The estimates described above, based on the Current Population Survey, could not differentiate between suburban jurisdictions within regions. In recent decades, suburban poverty has grown, and it varies across jurisdictions within metropolitan areas (Kneebone 2011; Allard and Roth 2010). It is an oversimplification to compare only city and suburban disparities, as some poor suburbs clearly have needs for greater digital inclusion as well. Using a 2012 survey of Cuyahoga County residents, Tolbert and Mossberger (2013) estimated Internet use and activities online across the different municipalities in Cuyahoga County. Cleveland and inner rings suburbs were disadvantaged in most respects, except for higher rates of mobile access (Tolbert and Mossberger 2013). Extending this analysis for individual municipalities, they found that estimated home broadband adoption varied from 50% in Warrensville, 53% in East Cleveland and 54% in Cleveland to 93% in Pepper Pike, an affluent eastern suburb (Tolbert, Mossberger and Hamilton 2013, unpublished estimates). Clearly suburban regions are not homogenous in terms of technology use, and these gaps may affect the capacity of these low-income communities for effective delivery of government services, economic development, and education.

Chicago Neighborhoods: Place Matters

It is in Chicago, which falls midway in the national city rankings and which has rates of Internet use near national averages, that we can see place-based patterns of disparities in urban neighborhoods

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size, per capita income, and the percent of the 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. See Mossberger, Tolbert and Franko 2012, p. 90 for more information.

as well. Research on the effects of concentrated poverty and segregation has demonstrated what the Brookings Institution has called the double burden of being poor and living in a high-poverty neighborhood (Federal Reserve and Brookings 2008). Spatial concentration of poverty is associated with 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). Use of multilevel models to analyze national data indicate that beyond individual characteristics, residence in low-income areas also diminishes the likelihood of Internet use (Mossberger, Tolbert and Gilbert 2006), and similar analyses show the impact of neighborhood segregation and poverty in Chicago for home adoption (Mossberger, Tolbert , Jimenez and Bowen 2012). While such analysis cannot reveal the causes for these neighborhood effects, possible influences may include relatively higher prices for goods and services that affect spending for Internet subscriptions, less information about and informal support for Internet use within resident social networks, lower exposure to the Internet on the job, and educational disparities that are patterned by neighborhood and affect skills (Mossberger, Tolbert, Jimenez and Bowen 2012; Kaplan and Mossberger 2012).

Paradoxically, while Internet use could help transcend the constraints faced by residents in low-income neighborhoods, technology inequalities are shaped by the same geography of poverty. By comparing Internet use and activities online in the most-connected and least-connected Chicago community areas, the impact of these disparities is readily apparent. The tables below show 2013 estimates for Internet use in Chicago's neighborhoods, for the most-connected community areas (Table 1) and the least-connected (Table 2) (Tolbert, Mossberger and Anderson forthcoming).

Table 1. Internet Use and Online Activities for Highest-Ranked Chicago Community Areas, 2013

Broadband Use Highest-Ranked Area (%)	Internet Use Percentage	Health Info Percentage	Job Search Percentage	Online Class Percentage
OHARE (91%)	98	91	48	55
NEAR WEST SIDE (90%)	98	85	70	60
LINCOLN PARK (90%)	98	86	52	51
BEVERLY (89%)	98	86	54	50
LAKE VIEW (89%)	98	86	51	50
NORTH CENTER (89%)	98	85	51	49
CITY AVERAGE (70%)	**84**	**74**	**58**	**45**
Broadband Use Highest-Ranked Area (%)	**Transportation Info Percentage**	**E-government Info Percentage**	**Chicago Govt. Website Percentage**	**Politics Information Percentage**
OHARE (91%)	84	83	75	84
NEAR WEST SIDE (90%)	84	79	73	80
LINCOLN PARK (90%)	82	79	73	80
BEVERLY (89%)	75	76	73	75
LAKE VIEW (89%)	80	78	72	78
NORTH CENTER (89%)	78	78	77	76
CITY AVERAGE (70%)	**66**	**61**	**58**	**60**

Source: Multilevel models from Tolbert, Mossberger and Anderson (forthcoming), 2013 Chicago Survey of Internet Use (Partnership for a Connected Illinois)

In the highest-ranked Chicago neighborhoods listed in Table 1, Internet use is almost universal and around 9 out of 10 residents have broadband at home. These high-ranked neighborhoods are in affluent or solidly middle-class areas, mostly on the North side (with the exception of Beverly). Residents of these community areas are much more likely to perform most activities online in comparison with city averages, with the exception of job search online, which is around the city average in most of these neighborhoods. In these connected neighborhoods, a higher percentage of residents go online to get information on health, transit, government, and politics, and to take a class online.

Table 2. Internet Use and Online Activities for Lowest-Ranked Chicago Community Areas, 2013

Broadband Use Lowest-Ranked area (%)	Internet Use Percentage	Health Info Percentage	Job Search Percentage	Online Class Percentage
MONTCLARE (24%)	38	31	6	6
WEST GARFIELD PARK (39%)	63	49	30	17
BURNSIDE (39%)	57	50	24	17
BRIGHTON PARK (40%)	61	49	25	17
GAGE PARK (42%)	64	51	28	16
SOUTH LAWNDALE (43%)	62	53	33	17
EAST SIDE (43%)	61	52	24	15
CITY AVERAGE (70%)	**84**	**74**	**58**	**45**
Broadband Use Lowest-Ranked area (%)	**Transportation Info Percentage**	**E-government Info Percentage**	**Chicago Govt. Website Percentage**	**Politics Information Percentage**
MONTCLARE (24%)	16	21	21	16
WEST GARFIELD PARK (39%)	45	36	41	35
BURNSIDE (39%)	36	40	40	38
BRIGHTON PARK (40%)	36	32	37	26
GAGE PARK (42%)	34	31	36	25
SOUTH LAWNDALE (43%)	34	33	36	27
EAST SIDE (43%)	35	35	36	30
CITY AVERAGE (70%)	**66**	**61**	**58**	**60**

Source: Multilevel models from Tolbert, Mossberger and Anderson(forthcoming), 2013 Chicago Survey of Internet Use (Partnership for a Connected Illinois)

In neighborhoods where a low percentage of the population has broadband at home or uses the Internet anywhere, it is not surprising that smaller percentages of residents are engaged in all of these activities online (see Table 2). What is striking, however, is **how few** access this important information

online, and the impact that may have for individual opportunity and community outcomes in these neighborhoods. It is sobering to realize that some activities (job search and online classes) are in the single digits in Montclare, and less than one-third of residents are estimated to have performed any of these activities online. At best, about half of the population in the other low-ranked community areas have gotten health information online. While there is some variation across the community areas, all trail the city averages by at least 20 percentage points in health, 25 percentage points in job search, 28 percentage points in online classes, 21 percentage points in transportation and government information, 18 percentage points in use of the city website, and 22 percentage points in political information. There are many "less-connected" Internet users in these neighborhoods, who go online at least occasionally, but do not have broadband at home (Mossberger, Tolbert and Franko 2012). For example, Internet use (anywhere) is estimated to be at least 20 percentage points higher than broadband at home in West Garfield Park, Brighton Park, and Gage Park. In the more affluent neighborhoods that are highly connected, the differences between broadband adoption at home and Internet use anywhere is less than 10 percentage points. This indicates that many residents of poor neighborhoods recognize a need to use the Internet, but that affordability is a barrier (see Mossberger, Tolbert and Franko 2012 and Mossberger, Tolbert, Jimenez and Bowen 2012).

TOWARD A MODEL OF METROPOLITAN TECHNOLOGY CAPACITY

While the Internet is a vital resource for cities and metropolitan regions for a variety of reasons – for innovation, social benefits, and resilience – there is substantial inequality in the U.S. in Internet use across cities and metropolitan areas, and within them.

As complex systems, metro regions have markets, governments, and civic institutions that vary in their ability to take advantage of innovation or to adapt and thrive in the face of social, economic, and technological change. The regional character of the U.S. economy makes it more like a league of nations rather than a single national system (Ledebur and Barnes 1998), and federalism decentralizes public policies and governance as well. Authority is often fragmented across hundreds of municipalities and special districts and shared with state and federal agencies. This raises questions about the potential for diverse regions to take advantage of information technology – to build widespread, innovative, adaptive, and inclusive networks of use embracing businesses, governments, community anchor institutions and residents.

What can be done to address technology inclusion in metropolitan areas? Actions undertaken by neighborhoods and cities can change outcomes. Research on the Smart Communities program in Chicago[2] indicates that between 2008 and 2013, Internet use, broadband at home, and Internet use for information on jobs, health and transportation experienced a statistically significant increase in participating neighborhoods, in comparison with other Chicago community areas (Tolbert, Mossberger

[2] The Smart Communities program was operated by the City of Chicago, in collaboration with the Chicago Local Initiative Support Corporation and neighborhood groups. The partnership also included the MacArthur Foundation and the Chicago Community Trust, and funding was provided by the Broadband Technology Opportunities Program, administered by the National Telecommunications and Information Administration of the U.S. Department of Commerce, as part of the American Recovery and Reinvestment Act.

and Anderson 2013).[3] Surveys of program participants and interviews with community organizations also provide further evidence of change in these communities (Mossberger, Feeney and Li 2013; Mossberger, Benoit-Bryan and Brown 2013).

Yet, individual neighborhood programs may have insufficient scale without additional support, and cities with the highest need often have the fewest resources to promote digital inclusion in their schools, libraries, and community centers. Because the private sector provides most Internet services, the affordability of home access is a need that has not been well-addressed by public policy. Can collaboration at a regional scale provide a stronger basis for policy leadership than the efforts of individual cities?

Katz and Bradley (2012) have argued that metros are the most likely to offer solutions to many policy problems, and regional efforts potentially have more power and scale. For example, in Northeast Ohio, One Community has been a vehicle for addressing high-speed infrastructure, cutting-edge applications in institutions such as the Cleveland Clinic and Case Western University, alongside digital inclusion programs that bring together partners such as neighborhood groups and county government (see www.onecommunity.org and http://us-ignite.org/cleveland-story/). The Google Fiber initiative is also an example of regional collaboration, between Kansas City, KS and Kansas City, MO. Google is providing the gigabit broadband, but local governments and nonprofit organizations are partners who will be important for determining the extent to which this project results in greater inclusion. Just as local governments have pooled their resources to purchase insurance or other goods at favorable prices, there could be a metropolitan partnership to work with broadband providers or to form a public private-partnership for innovative broadband use, affordable high-speed broadband, and training.

Regional organizations can also convene and coordinate existing efforts, to collaborate with the private sector and nonprofits, or to provide a voice for change at other levels of government. Programs such as Internet Essentials and Connect2Compete offer discounted broadband for households with children enrolled in free or reduced-price school lunch programs, but there are many eligible households not reached. A coordinated regional effort could be more effective than a patchwork of initiatives in individual communities. The Federal Communications Commission is debating changes to the Lifeline program, which now provides subsidies for phone service for low-income individuals, but could support broadband access in the future. Local interests could be more effectively represented by regional coalitions at the federal level, working with state agencies that also have a role in determining how the Lifeline program is implemented. Regional cooperation around broadband issues could also foster learning across programs and jurisdictions, about digital inclusion programs, or emerging practices for economic development, education, and more.

[3] The study used a city-wide survey and multilevel models over time, and controlled for a number of factors, including demographic differences between the neighborhoods (whether all low-income communities were catching up) and for demographic change (whether gentrification or other population change could account for the results). Some other activities online did not change at the neighborhood level – Internet use for work, or political participation online among them.

Regions are integrally interconnected – through their labor markets, economic activity, and costs and benefits that spill over across municipal and other jurisdictional boundaries. Residents access services from different governments in the region, especially in the Chicago area, which is one of the most fragmented and complex, with many municipalities, townships, special districts, and counties (Hendrick 2011). Information technology can provide a basis for innovation in firms, and effective, transparent, and accountable government. The regional scale is an ideal arena for learning across across sectors, to take advantage of experimentation across the many businesses, governments and nonprofit organizations that populate a metropolitan area. A resilient region is one that has rapid information flows and connectivity, to promote efforts reaching across residents, sectors, and communities. An agenda for inclusion is also an investment in the human capital of the region – for greater access for all to resources for education, health, economic opportunity, and civic participation. As is evident in high-performing metro areas, where a high proportion of the population is online, traditionally disadvantaged groups are more likely to be fully-connected as well (Mossberger, Tolbert and Franko 2012). In Chicagoland and in other regions, there is good reason for collective action at the metropolitan scale, to promote a vision of a connected region – one that is innovative, resilient, and inclusive.

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