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Two decades of e-government diffusion among local governments in the United States

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ABSTRACT

This study is the first to evaluate e-government diffusion among local governments in the United States over time. The diffusion rates of various types of e-government services are measured and analyzed over two decades. E-government surveys conducted by the International City/County Management Association (ICMA) from 2000 to 2011 provide an early trendline of e-government services offered, and an original two-wave panel survey was conducted in 2014 and 2019 collecting data, which extends this timeline and offers new ways to measure adoption in this later period. The panel survey includes the same 83 cities randomly selected from all cities with populations over 50,000, representing over 10% of medium and large size cities in the U.S.

The findings of this study provide a clear picture that cities across the nation have increasingly adopted a wide set of e-gov services, with some reaching near complete diffusion. A total of 45 different e-government services are evaluated, with similar e-government services organized together into informational, interactive, multimedia, financial, and social media scaled variables for further analysis. Adoption and diffusion of e-government services have been neither steady nor uniform. However, from 2014 to 2019 the trend was clear: more cities offered more e-government services more consistently.

The findings also offer insights into the characteristics of cities that have adopted e-government innovations earlier than others. Both greater population size and percent of residents with broadband access contribute in a statistically significant way to the number of e-gov services adopted, while other expected independent variables like economic measures of wealth do not. These findings contribute to a broader conversation about how the diffusion of e-government service adoption has changed over time and the extent to which that has affected the relationship between residents and their local governments throughout the first two decades of the 21st Century.

1. Introduction

While much has changed regarding e-government adoption and use by cities and their residents, it remains difficult to contextualize these changes and what they might mean for the development of e-government overall. Adopting e-government services is an innovative practice and there are a number of reasons why local governments might be expected to be particularly slow when it comes to innovation. Most cities have limited communications budgets and are severely restricted as to the amount of resources that could be utilized for potential upgrades. At the same time, the incentive for local governments to innovate is less than many other organizations because cities and towns across the nation have small, targeted audiences, namely the residents that use their services. Local governments also lack competition that exists for most other political organizations in America. All of these characteristics add up to extremely low expected level of innovation, or innovativeness for local governments around the nation (Epstein, 2018; Rogers, 2003).

Yet, even with these factors hindering innovation, a major transformation has been underway for over two decades in terms of how governments provide e-government services and information online. *E*-Government, or e-gov, is the use of information and communication technology to disseminate information and services by governments. Previous research on the adoption of services by municipal governments, has focused on particular points in time (Moon, 2002; Norris & Reddick, 2013). By exploring adoption rates of e-government services across time, this study offers an opportunity to understand if and when different e-government tools and services are adopted, and how quickly their adoption diffuses across local governments. This provides an important new perspective on the status of e-government in the United States.

This study aims to broaden our understanding of how e-government services have been adopted and deployed by local governments by

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exploring the trends in how e-government has diffused across U.S. cities over time. Specifically, this study explores the trends in the adoption of e-government services by U.S. cities over two decades from 2000 through 2019, and offers a more detailed analysis of changes from 2014 to 2019. The findings offer insights as to what changes in e-government adoption have occurred, where we are in the development of e-government in the U.S., and what characteristics of cities might make them more or less likely to adopt various services.

This study explores two related research questions pertaining to the diffusion of e-government innovations among local governments:

R1: How have e-government services diffused among local governments in the U.S. over time?

R2: What factors affect the number of e-government services that local governments offer?

The next section of this study is focused on theoretical foundation and context. It includes support for both research questions including theory regarding e-government and its evolution over time. This section includes various stages models of e-government development, scholarship exploring e-government adoption through the lens of diffusion of innovation (DOI), and other studies that have explored various factors that contribute to adoption of e-government services by local governments. Next is the methods section which details the collection of data from the International City/County Management Association (ICMA) from 2000 to 2011, original data collected during a two-wave panel survey in 2014 and 2019, and the and differences between these data. The methods section also provides details for the informational, interactive, multimedia, financial, and social media scaled variables that cluster related e-government services. The findings section includes detailed analysis of each of these scaled variables and e-government over time along with some preliminary findings about the factors that contribute to greater e-government adoption. The conclusion highlights the value of key findings and important limitations and applications of this study.

2. Theoretical background

2.1. Conceptualizing e-government

The beginning of e-government can be traced back to a report entitled *Reengineering through Information Technology*, published in 1993 by the National Performance Review, a major program under the Clinton Administration (Lenk & Traunmuller, 2002). E-government has often been described in complex ways and organized by the types of services provided or the types of groups connected (Chadwick, 2006, p. 179; Henman, 2010, p. 8). The implementation of e-government is expected to help governments disseminate information, deliver services and transform relations in a number of ways including government to citizen (G2C), government to business (G2B) and government to government (G2G) (Grönlund & Horan, 2005; Guida & Crow, 2009; Twizeyimana & Andersson, 2019). Over time many of these important elements of e-gov have been combined, and the term is generally conceptualized as governments' use of information and communication technologies (ICTs) combined with organizational change to improve the structures and operations of government (Field, Muller, Lau, Gadriot-Renard, & Vergez, 2003; Twizeyimana & Andersson, 2019).

The internet, and online tools like email, live video, and various social media platforms have reduced the barriers between citizens and their elected officers, at least for those willing to engage (Panagiotopoulos, Barnett, & Brooks, 2013; Unsworth & Townes, 2012). Generally e-government is considered to have improved the responsiveness of government (Seifert & Chung, 2009). However, responsiveness is measured in different ways and the complexity of responsiveness is well documented in the public administration context (Demir, 2011; Epstein, Bode, & Connolly, 2021; Liao, 2018; Saltzstein, 1992; Yang & Pandey, 2007). Regardless of these benefits, cities have not universally adopted e-government services, nor used them in consistent ways.

During the first decade of e-government development, local governments evolved from organizing information online to offering services and transactions (Reddick, 2004). And while local governments have, eventually, employed more interactive e-government tools, this has been far more gradual and incremental than once predicted (Norris & Reddick, 2013). For over two decades researchers have theorized about the stages of e-government development (Garson, 2003; Layne & Lee, 2001; Moon, 2002; Reddick, 2004; Tat-Kei Ho, 2002; West, 2004; Yildiz, 2007). The two most prominent models of the stages of e-government development are Layne and Lee's (2001) four stage model, and a similar five stage model also offered in 2001 by the United Nations and the American Society for Public Administration (ASPA) (Layne & Lee, 2001; United Nations, 2001). Schelin (2007) organized a typology of e-government by using both models, noting how similar these models were. Schelin's five stages describe different levels of web presence which move up in sophistication and interactivity. The five stages include 1) emerging web presence, which is fundamentally administrative, 2) enhanced web presence, which begins to include some information distribution, 3) interactive web presence including online forms and basic two-way communication, 4) transactional web presence which allows for official business or governmental services to be conducted, and 5) seamless web presence which mirrors all services provided in person (Schelin, 2007).

Social media tools like Twitter and Facebook have received growing attention for how they impact political communication and the relationship between the citizens and the political process. In particular, substantial research has focused on how American campaigns have deployed them, and their perceived or measured impact on electoral success (Baldwin-Philippi, 2015; Baldwin-Philippi et al., 2016; Bode, 2012; Bode et al., 2020; Bode, Dalrymple, & Shah, 2011; Bode & Lassen, 2016; Chadwick & Stromer-Galley, 2016; Epstein, 2018; Kreiss, 2012, 2016, 2020; Stromer-Galley, 2019; Towner & Baumgartner, 2017; Towner & Munoz, 2018; Towner & Muñoz, 2020; Williams & Gulati, 2007, 2009, 2010). However a growing body of scholarship has also explored the adoption and use of social media by local governments during the earlier years of social media adoption (Mossberger, Wu, & Crawford, 2013; Reddick & Norris, 2013), or more updated studies focused on small governments (Gao & Lee, 2017), or local governments outside of the United States (Criado & Villodre, 2020; Haro-de-Rosario, Sáez-Martín, & del Carmen Caba-Pérez, 2018), or its use to improve the functions of government (Epstein et al., 2021; Graham, Avery, & Park, 2015; Seigler, 2017). Nearly all studies focus exclusively on the adoption of Facebook and Twitter. This study expands and updates this discussion analysis by including all social media platforms used by any of the cities in our sample.

2.2. Diffusion of e-government services over time

Diffusion of innovations (DOI) scholarship explores how potential adopters move through an innovation-decision process in different ways and at very different speeds, creating a pattern of adoption, known as the S-Curve, that represents the cumulative adoption of a successful innovation over time (Rogers, 2003). While most technological innovations are not successfully adopted by all members of a population, those that are usually follow an S-curve. As shown in Fig. 1, this curve starts with very slow adoption, eventually reaching a tipping point where adoption rates increase dramatically until it diffuses through the majority of a population and adoption rates slow once again as diffusion inches closer and closer to 100% (Epstein, 2018; Rogers, 2003).

There is a large body of scholarship that has explored diffusion of e-government (Zhang, Xu, & Xiao, 2014), and there is widespread evidence that the likelihood that technological innovations spread through society depends on the characteristics of both the innovation and the potential adopter (Rogers, 2003; Wejnert, 2002). While e-government services are technically distinct, cities may identify groups of services as being similar, which can affect adoption. In fact, certain sets of e-

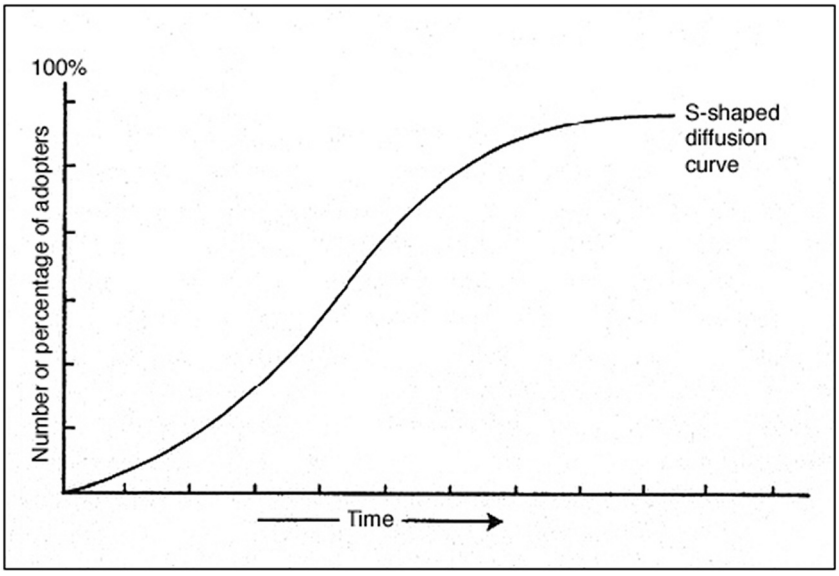

Fig. 1. The S-Curve.

government tools may be considered technology clusters, which are multiple distinguishable elements of technology that are perceived as being closely interrelated (Rogers, 2003; Teng, Grover, & Guttler, 2002). Additionally, all e-government services are not made equal in terms of what is required to offer them. Services that require ongoing maintenance, like social media accounts, require greater resources and therefore may be offered only by local governments with the ongoing resources necessary to staff those services (Connolly, Bode, & Epstein, 2018). The skills of government employees have an important impact on the diffusion of e-government (Al-Busaidy & Weerakkody, 2009), as do organizational networks (Mergel, 2013; Mergel & Collm, 2010). These factors evolve over time and can affect adoption differently at different stages of technological and resource capacity.

Beyond the characteristics of e-governments services, the attributes of the adopters themselves impact adoption and diffusion rates (Jeyaraj, Rottman, & Lacity, 2006). Scholars have focused on the traits of individuals and organizations that are more likely to innovate earlier than others, generally described as the innovativeness of potential adopters (Epstein, 2018; Goode & Stevens, 2000; Hong & Tam, 2006; Jeyaraj et al., 2006; Mahler & Rogers, 1999; Mohr, 1969; Rogers, 2003).

While it may be obvious, the decision-making process for organizations, like local governments in the United States, are very different from that of individuals. Political science and public administration scholars have noted organizational and political factors that affect the diffusion process (Berry & Berry, 1990, 2007; Karch, 2007a, 2007b; Kearns, 1992; Lee, Chang, & Stokes Berry, 2011; Sapat, 2004). Technological innovation is often costly and may have both advantages and drawbacks associated with it (Druckman, Kifer, & Parkin, 2009). The network of people working in local government including municipal office holders, public managers and the wide range of staffers and administrators working with them go through a decision-making process in which they must carefully weigh many considerations before incorporating new technologies into their organizational strategy (Jeyaraj et al., 2006; Kearns, 1992; Padgett & Powell, 2012; Rogers, 2003). Diffusion of e-government is also influenced by governmental structure and executive power, which can promote the diffusion of e-government by reinforcing the emulation of successful e-government (Yun & Opheim, 2010).

Most studies of e-government adoption have focused on a specific period of time, however there have been a few that have explored diffusion of e-government services over time. Longitudinal studies have been very rare and often evaluate diffusion at a much earlier stage in the development of e-government (Weare, Musso, & Hale, 1999). And nearly all studies that explore diffusion of e-government over time have studied regions or nations outside of the United States (Korteland & Bekkers, 2007; Maumbe, Owei, & Alexander, 2008; Mergel & Collm, 2010; Mwangi, 2006; Sang, Lee, & Lee, 2009; Shareef, Kumar, Kumar, & Dwivedi, 2011; Yeloglu & Sagsan, 2009). While environmental, political, and cultural determinants vary greatly around the world these studies do provide an important foundation as to how to explore evolving adoption and the diffusion of e-government services over time. However, there is an important gap in the existing literature that this study aims to address. Namely, a lack of updated scholarship that explores e-government adoption and diffusion over time in the United States. While there have been many valuable studies of e-government adoption, no study conducted in the past decade explores e-government adoption over time by local governments in the United States. Further the current study is novel in the duration of e-government diffusion analyzed, which extends across two decades.

2.3. *Determinants of e-government adoption*

Beyond diffusion of innovation scholarship, there have been a large number of studies that have explored the determinants of e-government adoption from a variety of perspectives (Dias, 2020; Titah & Barki, 2006; Twizeyimana & Andersson, 2019; Yildiz, 2007; Zhang et al., 2014). There are many factors that can impact e-government adoption and Dias offers a useful empirical model of local e-government implementation, organizing these factors into four groups: 1) local socioeconomic determinants like internet use and demographics, 2) internal determinants like the size of local government, financial and technical capacity, organization form and culture, 3) outside determinants including laws and regulations, and 4) political determinants including political environment and citizen participation (Dias, 2020).

Among all organization-level factors that affect adoption of technological innovations, resources are clearly very important. Goode and Stevens (2000) find that the greater an organization's level of IT support, budget, and technological experience, the more likely it is to adopt internet technology (Goode & Stevens, 2000). Insufficient staff and lack of funding may create barriers to the adoption of e-government innovations by organizations (Tat-Kei Ho, 2002). Although smaller organizations are often assumed to be the most nimble, larger organizations generally have more resources, IT knowledge, and connections to other similar organizations, and translate these characteristics into higher innovativeness (Rogers, 2003). This also applies to city size which has

also been associated with e-government adoption (Moon & Norris, 2005), and larger organizations are generally more innovative (Mahler & Rogers, 1999). Additionally, there is evidence that cities with a council-manager model are more innovative than those with a mayor-council or traditional commission form (Connolly et al., 2018). Various international studies of e-government adoption also show how environmental factors such as the culture (Al-Hadidi & Rezgui, 2010; Choudrie, Umeoji, & Forson, 2012), policy environment (Mwangi, 2006), and cultural environment of an organization (Korteland & Bekkers, 2007) can affect e-government adoption.

While there are many independent variables that can contribute to the adoption of e-government services I test three hypotheses guided by this prior research and the availability of data in the various surveys included in this study:

H1. Cities with larger populations are more likely to offer more e-government services.

H2. Wealthier cities are more likely to offer more e-government services.

H3. Cities with greater internet usage are more likely to offer more e-government services.

3. Research methods

3.1. Data collection from 2000 to 2011

This study combines original data from a two-stage survey of local governments' e-government services in 2014 and 2019 (detailed in section 3.2 below), with data from a series of professional surveys conducted by the International City/County Management Association (ICMA), one of the largest professional local government organizations in the United States. The ICMA provides research, publications, data and information, and training to over 9000 local government members (International City/County Management Association, 2014). I collected and aggregated data from the three largest ICMA surveys of *E*-Government, conducted in 2000, 2004, and 2011 (International City/County Management Association, 2001, 2005, 2011). Each of the surveys was comprehensive, but varied slightly, suggesting the new issues relevant to those implementing and studying e-government at the time.

The 2000 survey was mailed to 3749 local governments in the U.S., and just over half responded, representing local governments of all sizes across the nation. The questions included in the survey indicate the concerns prevalent during that early stage of e-government diffusion including who was primarily responsible for administering services if they existed, the barriers to e-government, and the services and information offered. The 2004 survey was sent out to 7944 local governments with populations over 2500 and 3410 responded (42.9%). This survey was useful as it took place at a particularly important transitional point when broadband was becoming more common, and the internet was starting to modernize into what became known as Web 2.0. Overall there were few major changes in the types of e-government services included in the survey but local governments were more concerned with capacity, as technological resources and demand increased. After a seven-year hiatus the next ICMA survey was conducted in 2011, and much had changed. The 2011 survey covered some new topics including specified IT staff and training and showed some new issues that had become relevant to e-government since 2004. Importantly the 2011 survey represents the first measure of mobile apps and interactive options like instant messaging, social media, video on demand, and podcasts (International City/County Management Association, 2011). This study links the three ICMA surveys for the first time to create a longitudinal analysis of e-government services. Unfortunately, comparable ICMA data since 2011 is not available.

3.2. Original survey data collection in 2014 and 2019

In order to continue to evaluate changes in e-government adoption over time, original data was collected through a two-wave panel survey that analyzed e-government services offered on local government websites and apps in August 2014 and again from those same cities in August 2019. The 2014 and 2019 data are useful in two ways. First, they create a useful extension of a longitudinal analysis of e-government services offered by local governments in the U.S., because they offer comparable data points to the earlier surveys. The services collected in each wave were modeled directly on the consistent services included in the ICMA surveys in order to create the clearest link between all surveys across the five data points spanning from 2000 through 2019. Second, they offer a unique two-wave survey of the same sample of cities, which allows for the comparison of the two samples, and also the ability to look at changes made by individual cities over the five-year span between surveys.

When data collection for this study began, a list of all 792 U.S. cities with populations over 50,000 was constructed based on the 2012 U.S. Census estimates (United States Census Bureau, 2012).[1] A sample of 83 cities was then selected using a random number generator (For map see Fig. 2, and for a full list of the cities see the Appendix A). The same 83 cities that make up the sample were used in 2014 and 2019, representing over 10% of all of the cities in America with a population over 50,000. The sample closely approximated the national averages for economic measures including median income and poverty rates, and demographic data including racial and ethnic identity for the nation overall (United States Census Bureau, 2019). Population data for each city was gathered, the most recent of which were based on July 1, 2018 estimates from the U.S. Census Bureau. The most recent median income, percentage of the population living in poverty, and racial and ethnic population data were taken from the 2013–2017 American Community Survey 5-Year Estimate (United States Census Bureau, 2019).

The official city websites for each city were analyzed and the e-government services and information offered by each city was collected. All told 45 different variables (including 12 different social media platforms) were measured for each city website, corresponding to those that were consistently included in the previous ICMA surveys and evolving slightly as new platforms became relevant. For instance, Instagram was a platform that was measured for the first time in 2014, while Snapchat was added as to the survey in 2019. For consistency, the social media variable was combined to a simple binary yes or no depending on whether they had any social media presence. Once this was done, the maximum number of features available for each site was 28, including those that were available in both 2014 and 2019 (See Appendix B for full list).

Related e-government features were then grouped together into five scaled variables guided by the stages models of e-government. Informational features included unidirectional sources of information available to web users. Many of these have remained central and often very useful components of e-government offerings, despite the fact that they have not changed much since the earliest stage of useful e-government, what Schelin classified as enhanced web presence (Madariaga, Nussbaum, Marañón, Alarcón, & Naranjo, 2019; Schelin, 2007). Next, interactive features were grouped together, including any e-government features that help facilitate communication and information sharing between web users and the government. A third scaled variable of multimedia services were created, which included a smaller set of informational and interactive features that used video, photo, or audio formats to transmit information. I created a scaled variable for payment services including the four categories that could be paid online: fines/

[1] Based on U.S. Census estimates the number of cities in the U.S. with a population over 50,000 shrank from 792 in 2012 to 775 in 2019. (United States Census Bureau, 2019)

Fig. 2. Map of Sample Cities ($n = 83$) Used in 2014 and 2019 Two Wave Panel Survey.

tickets, taxes, permits/licenses, and utility bills, which serves as a good proxy for the transactional stage of e-government. Finally, social media platforms used by each city were also scaled together. There were 10 social media platforms that were available in both waves of the survey. Table 1, below, details the e-government services included in each of the scaled variables.

Much of the analysis of the diffusion of e-government services over time is descriptive. The longitudinal data is linked in order to map diffusion over time and compare different services. This is done within the framework of diffusion of innovations theory in order to determine the relative level of diffusion of various services, and how the pace of adoption varied. This is done within the different scaled variables which are distinguished based on the stages model of e-government development. For the data from 2014 and 2019, linear regression tests and scatterplots are used to evaluate the most important determinants of e-government adoption among the cities in the two wave survey.

3.3. Important differences in the ICMA and original survey data

The 2014 and 2019 data differ from the data collected from the earlier ICMA surveys in a few notable ways. First, many of ICMA survey questions asked local governments about why they did or did not offer various e-government services and whether they intended to offer services in the future. It was not possible to ascertain intention by surveying the services and information available from the websites in 2014 and 2019.

In addition, the population ranges of local governments vary slightly with each survey in terms of the size of city surveyed. The 2000 survey had respondents from local governments of any size, including a miniscule number of respondents from communities with less than 2500 people. The 2004 survey more than doubled the sample size relative to four years earlier, and limited the population to governments with populations greater than 2500. In 2011, the population was again modified to governments serving communities with greater than 10,000 people. Finally, the sample used in 2014 and 2019 was taken from city governments with a population over 50,000. In other words, each of the

Table 1
E-Government Services Included in Informational, Interactive, Financial, and Social Media Scaled Variables.

Informational ($N = 19$)	Interactive ($N = 6$)	Multimedia* ($N = 7$)	Financial ($N = 4$)	Social Media (N = 10)
Voter registration info	Requesting services (e.g. pot holes)	Streaming video	Pay tickets/fines	Twitter
Property registration info	Mobile app	Video on demand	Pay taxes	Facebook
Business license application	Online communication (e.g. e-mail)	Podcasts	Pay utility bills	Instagram
Permit application	Real time communication (e.g. chat)	YouTube	Pay for licenses/permits	LinkedIn
Parks & recreation services	Delayed Q/A	Instagram		Tumblr
311	Social Media (Any)	Flickr		Snapchat
View Agenda/Minutes		Vimeo		Nextdoor
View Codes/Ordinances				Pinterest
Maps/GIS				Nixle
Employment opportunities				Google+
Streaming videos				
Videos on Demand				
Podcasts				
e-newsletter				
e-alerts				
YouTube				
Blogs				
Flickr				
Vimeo				

* All multimedia features are also included in either the informational or interactive scaled variables. Those that are unidirectional fall in the informational scaled variable and those that are multidirectional and are also in the interactive scaled variable.

four data sets are built from different samples representing slightly different populations of local governments, the vast majority of which were U.S. cities, with each subsequent survey focusing on slightly larger cities at the lower bound than the previous surveys.[2] Further, the surveys themselves were not identical, as each ICMA survey updated and modified some of the questions and services they measured in each iteration of their survey. However, the longitudinal analysis included in this study is based on the services and information offered, which were consistent across all data sets. The services identified in the 2014 and 2019 surveys were taken from the ICMA surveys and only new services not available in earlier iterations were added over time. Therefore, while not methodologically identical, these five data sets can be linked to present a useful sketch of changing e-government services offered by U. S. cities over time.

4. Findings

4.1. E-government adoption 2000–2019

E-government, in its most basic form, has become ubiquitous. In other words, local government websites, the contact point for e-government services, have become universal, though it took until 2014 for this to be the case. In 1995 less than 9% of local governments had a website. In 1997 that number jumped to 40%, more than doubling to 83.3 in 2000, up to 91.4% in 2004, 97% in 2011 and 100% in 2014 and 2019 (see Fig. 3) (Pew Research Center, 2019a). While local government website adoption clearly outpaced the adoption of the internet overall by Americans, that is a very low bar. Though e-government has become universal among local governments, the adoption of e-government services is far from it. We now focus on the first research question by exploring how various e-government services been adopted by local governments over time?

4.2. Adoption of E-government services over time

4.2.1. Informational E-government services

While most of the excitement about the potential of e-government to improve democratic and governmental services has been based on the interactive elements embedded within the internet, there is still substantial value in local governments being able to send a wide variety of information easily and efficiently using a number of different media forms. Local governments are offering the vast majority of these services at a very high rate. Among all 19 of the informational services, 12 (63.2%) have been adopted by at least 75% of all local governments and seven (36.8%) have been adopted by over 90% of local governments (see Fig. 8). Some of the services that were not widely adopted may be due to the fact that local governments are not entirely responsible for these services in all places. For instance, services like voter registration, property registration, and 311 might fall under county or state level responsibilities. Importantly this scaled variable includes a number of different formats and technologies and platforms that are both growing (podcasts) and declining (e.g. blogs, Flickr, Vimeo). Among the 19 different informational features, 14 provide information via text or images, four through video and one through audio. However, outside of those services affected by shared responsibilities embedded within American federalism, or particular platforms that are still emerging or clearly declining, the unidirectional informational e-government offerings, including downloadable forms for use offline, council agendas/min, and city codes and ordinances have become standard (see Fig. 4). Using the language of the stages models, this suggests that cities have effectively achieved the enhanced stage of web presence.

4.2.2. Interactive E-government services

Some of the interactive e-government features have successfully diffused throughout local governments around the country while others never caught on. Several interactive features have become widely adopted, including the ability to request services (e.g. filling potholes), online communication with elected officials (e.g. email), and any form of social media. These are services that are used widely by residents and also relatively intuitive to use for most internet users. However, these services should not be taken for granted as each requires staffing and resources to continually respond to requests. Online communication (adopted by all local governments) and social media (adopted by 96.2%) can be used to request services or information and the fact that they are offered does not necessarily mean that all local governments effectively and efficiently respond to inquiries by residents (Epstein et al., 2021).

Among the interactive services offered, local government administrators have increasingly focused on offering information on the go. Cities across the nation have overwhelmingly adopted digital tools to provide citizens with updated news and weather, safety, traffic, or other important alerts wherever they are (International City/County Management Association, 2011). And since 2014 the majority have offered e-newsletters (84.3% in 2014 and 90.4% in 2019) and e-alerts (68.7% in 2014 and 91.6% in 2019). Noticeably lacking, is the pace at which cities are adopting mobile apps to be used by their citizens on their smartphones or tablets. As of February 2019, 81% of American adults owned a smartphone and 52% own a tablet (Pew Research Center, 2019b). Furthermore, 96% of those 18–29 years old and 92% of those 30–49 owned a smartphone, suggesting that the demand for mobile e-government is only increasing (Pew Research Center, 2019b). Additionally, by 2019, 17% of American adults used their smartphone as the primary means of online access at home, a group often labeled smartphone dependent. The percentage of Black, Latino, less educated, and poorer Americans who are smartphone dependent are even higher (Anderson, 2019). Thus mobile apps are not only a useful way of accessing e-government tools, but they are the primary means for a large portion of Americans.

Although cities were slow to adopt mobile apps, there is evidence that they are starting to use them more and more. In 2011, 17% of cities offered them, with 26.5% offering them by 2014. That number more than doubled to 55.4% in 2019. As more and more Americans connect through mobile devices, often as their main or only internet connection, it would be surprising if the number of cities offering mobile apps numbers did not continue to grow in the future, offering a great opportunity for future scholars to explore. However, adoption of city specific mobile apps may be limited due to the upfront cost needed for development, the ongoing staffing needed to process the requests, and the private options that offer some comparable services like Nextdoor, which has grown quickly in popularity.

4.2.3. Multimedia features

Among all of the interactive features that could be made available by local governments, multimedia tools offering photos and video seems to be among the most obvious and easy to accomplish. They offer great utility with limited cost and other political organizations have adopted these features very quickly (Epstein, 2018; Williams & Gulati, 2011). Yet this was not the case with local governments. Nearly 10% of local governments offered streaming video services in 2004, fairly notable because only 24% of Americans had high speed internet at that time (Pew Research Center's Internet and American Life Project, 2013). Yet steaming video was only available via 55% of local governments a full decade later before jumping to a respectable 84.3% in the five years from 2014 to 2019. Both the use of YouTube as a platform and video on demand were video services that have been adopted at an even faster rate than live streaming. Video on demand, which often included an archive of city council meetings and official events, was offered by an impressive 94% of cities in the sample. But perhaps the most notable takeaway from these services is the increasing dominance of YouTube

[2] For a recent study that analyzes the underexplored e-government adoption of small municipalities, in this case U.S. municipalities under 5000 people, please see (Chen & Kim, 2019).

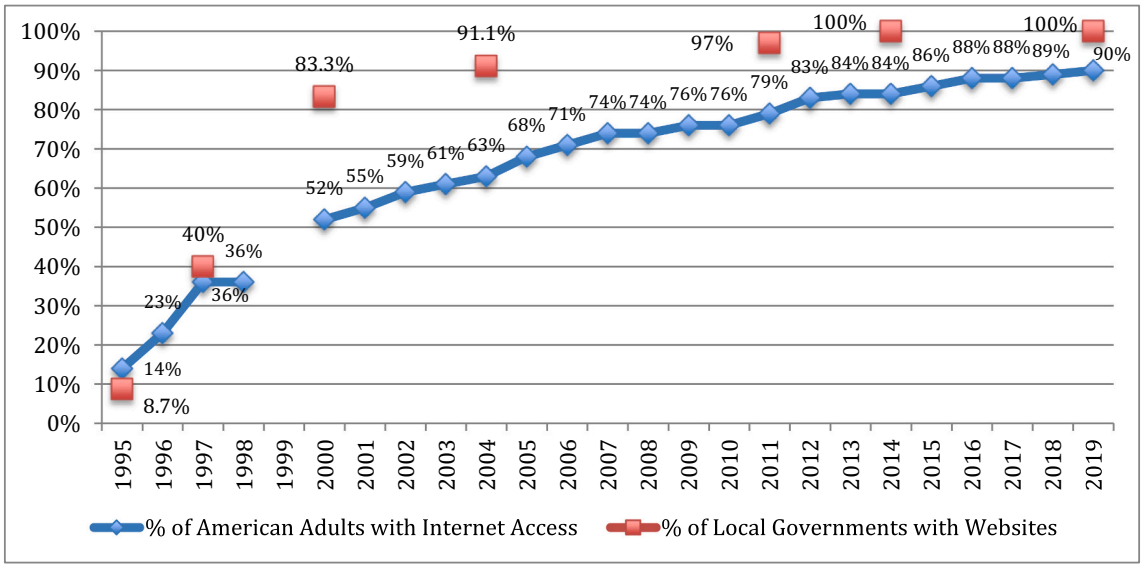

Fig. 3. Percent of Americans with Internet Access and Percent of Local Governments with Official Websites 1995–2019.

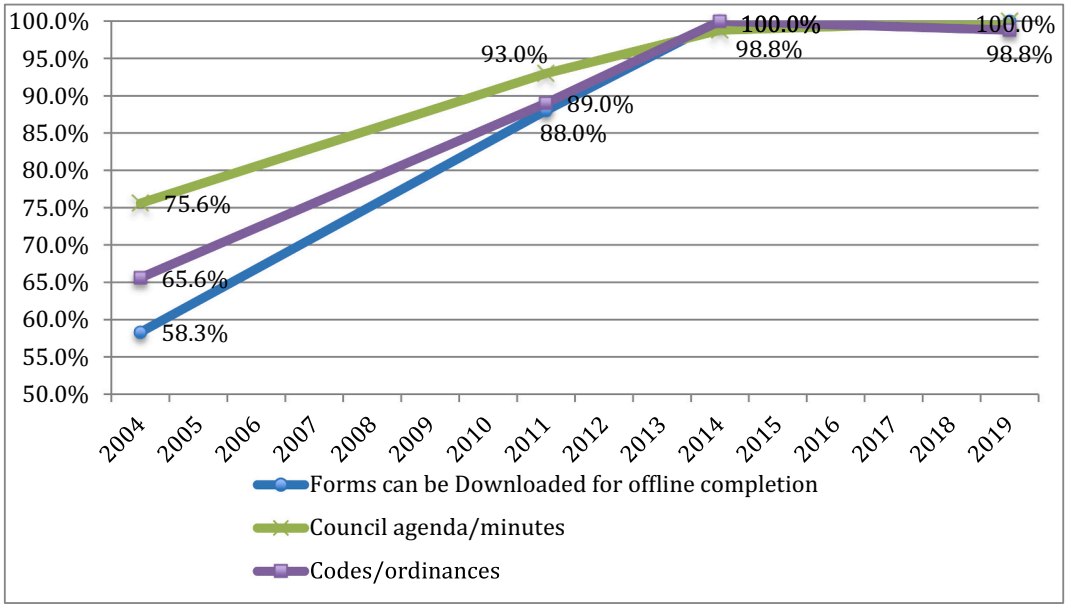

Fig. 4. E-Government Information Available 2004–2019.

and Instagram. YouTube is the dominant video platform in the United States and Instagram, owned by Facebook, has become the most popular photo sharing social media platform. Cities have adopted both quickly. Three out of four cities in the sample have an official YouTube page and nearly 60% have an official Instagram page (see Fig. 5). These adoption rates represent a 35% increase in YouTube adoption in the five years since 2014 and a staggering 1200% increase for Instagram!

4.2.4. Financial services

Offering financial services online, allowing residents to pay for services or fees from home 24 h a day could dramatically increase the convenience and efficiency of interactions between residents and their local government. These are higher stage e-government tools corresponding to the transactional stage of development. In 2000, very few local governments around the country offered financial services, though a huge number planned to offer them soon. (International City/County Management Association, 2001). These plans clearly turned out to be pipe dreams. After looking back at the trends over time it is clear that these services were not added quickly, and many of those cities waited years to offer their constituents the ability to pay for services, if they ever added these options at all. Ultimately though, the ability to pay for many common fees and bills have become the norm.

As Fig. 6 shows, cities across the country are increasingly offering residents the ability to pay utility bills (86.7% of cities by 2019) and fees for licenses, permits, tickets, or court fines (90.4% by 2019). These services appear to be on a clear S-Curve suggesting that they will continue to be offered by more and more local governments over time and will continue to get closer to universal adoption. This stands in stark contrast to the percent of local governments allowing constituents to pay tax payments online, which have leveled off at under half of local governments (42.2% by 2019). One reason for the limited growth of tax payments available through city websites may be the fact that all cities do not collect taxes. Some have no property taxes and many taxes are paid to the county in which the city is located (Connolly et al., 2018).

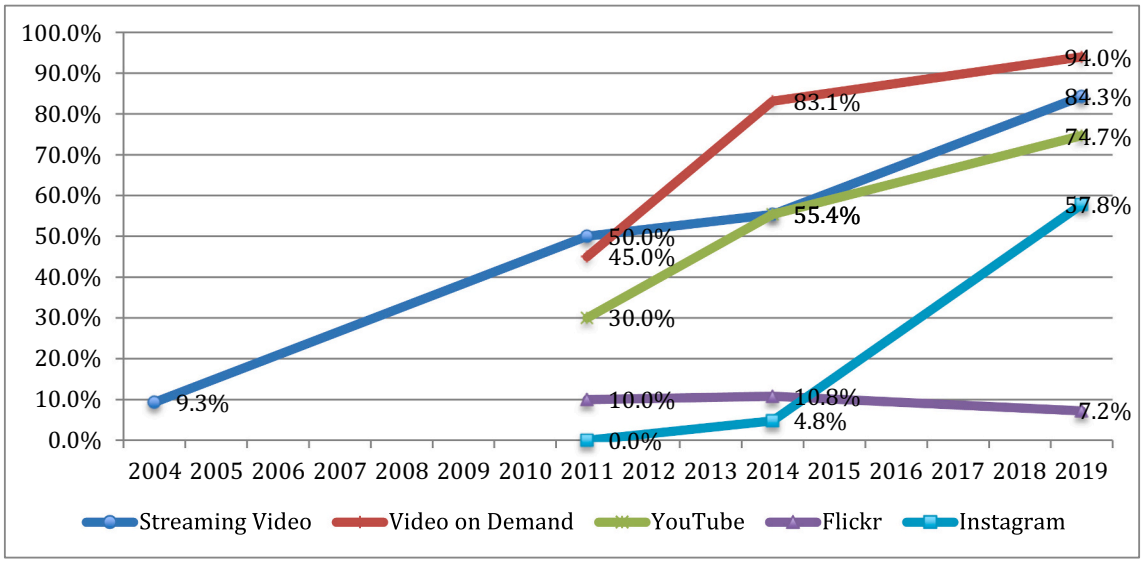

Fig. 5. *E*-Government Multimedia Features 2004–2019.

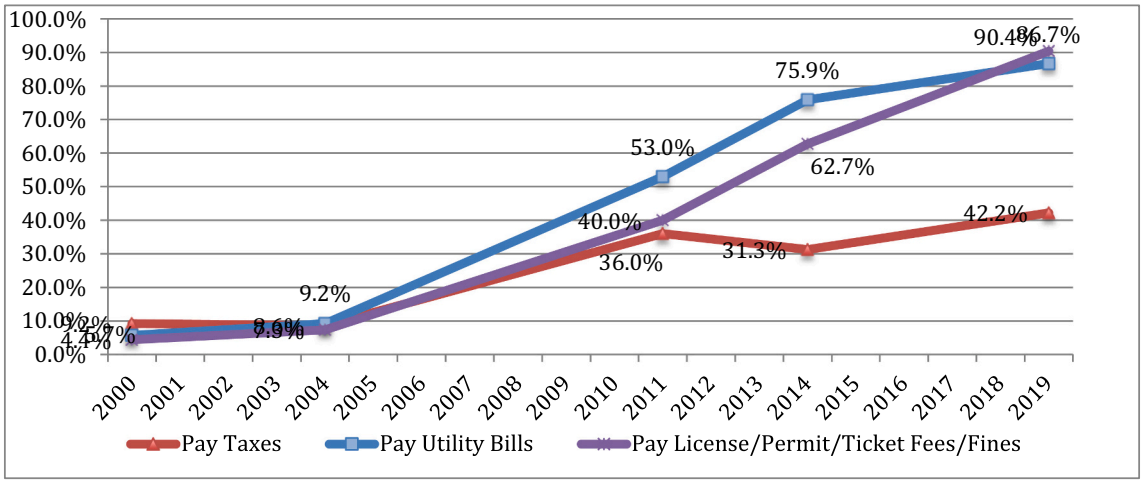

Fig. 6. *E*-Government Payment Services 2000–2019.

4.2.5. Social media adoption

Social media platforms offer widely used tools that are cost effective and generally easy to use and have further reduced the barriers between our citizens and their elected officers, at least for those willing to engage (Panagiotopoulos et al., 2013; Unsworth & Townes, 2012). This has contributed the general trend of e-government slowly but surely improving the responsiveness of government (Seifert & Chung, 2009), though the implementation and effectiveness of social media use vary widely.

Observing the adoption rate of social media innovations over time suggests they largely fit a classic diffusion of innovations S-curve. Eight percent of internet users utilized at least one social media site in 2005, increasing exponentially through 2010 and then increasing at slower and slower rates reaching 72% us U.S. adults in 2019 (see Fig. 7) (Matsa & Shearer, 2018). Local governments, usually lagging in the pace of innovation, have adopted social media platforms at a remarkably fast pace, with a near universal 96.4% offering some form of social media presence by 2019, including over 90% adopting Facebook and Twitter. In 2014, the vast majority of social media activity by cities was limited to these two platforms. However that is no longer the case as 57% of cities are using Instagram (owned by Facebook) and nearly one third are active on LinkedIn. It is notable that the level of adoption of Facebook, Twitter, Instagram, and LinkedIn by U.S. cities all outpace the percentage of the adult U.S. population that uses each platform (see Fig. 7).

Connecting the dots between social media adoption in 2014 and 2019, it starts to become clear that city governments, like campaigns, are moving toward a standard set of platforms. For local governments in the sample, Facebook and Twitter adoption from 2011 to 2019 shows evidence of the later stages of nearly complete S-curves by 2019. While some cities may never adopt Facebook or Twitter, it is reasonable to expect the use of both to continually increase following a consistent S-curve until they level off close to universal adoption. Instagram and Nextdoor both enjoyed substantial growth in adoption from 2014 to 2019, but are not guaranteed of continue nearing universal adoption moving forward.

4.3. A closer look at the growth of e-government services from 2014 to 2019

The status of e-government adoption by U.S. cities in 2014 was, in a nutshell, mixed. By nearly every measure, the data from 2019 shows vast improvement. All together there were 28 different features potentially offered by each city on their website. Out of 83 cities in the sample, four offered the same number of services in 2014 and 2019, four offered

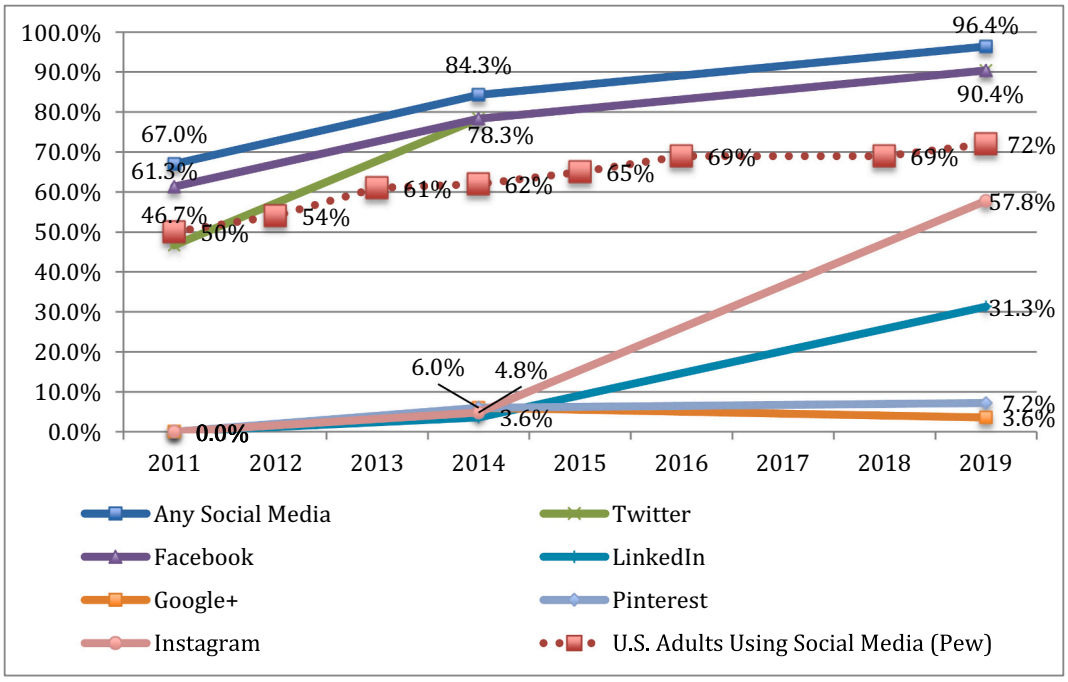

Fig. 7. Social Media Adoption by Local Governments 2011–2019.

slightly fewer services, and 75 cities (90.3%) offered more services in 2019. The average city in the sample offered 13.5 services in 2014, a number that jumped to 18.7 five years later. Some of these services increased modestly over five years and others, like video on demand and the adoption of newer platforms like Instagram, LinkedIn, and Nextdoor increased dramatically. Overall, cities adopted substantially more e-government services in 2019 than in 2014, and were also more consistent doing so, with more services becoming more standard (see Fig. 8). The standard deviation of total number of services offered shrank from 3.84 in 2014 to 2.51 in 2019.

Among the many types of e-gov tools offered, social media has perhaps witnessed the greatest change from 2014 to 2019. Fig. 9 shows the overwhelming adoption of Facebook and Twitter, and a strong adoption rate for Instagram and Nextdoor, each of which increased

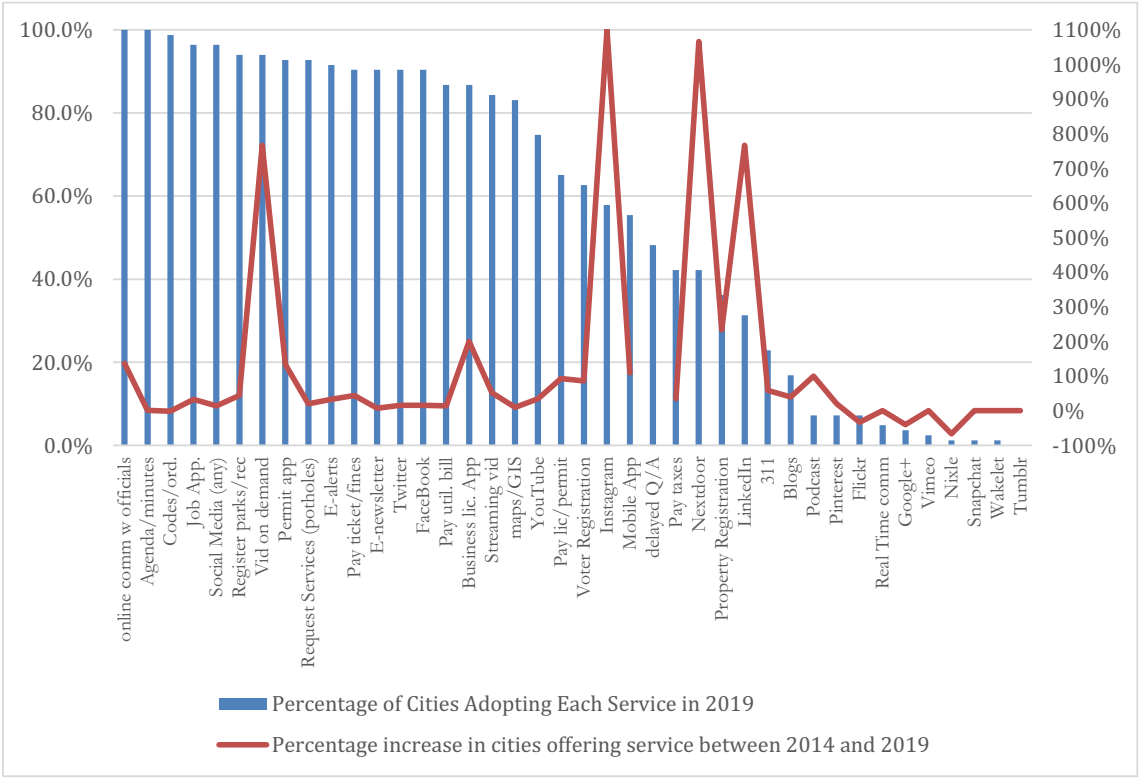

Fig. 8. Percentage of Cities adopting various *E*-Gov Services and the Percentage Increase in Adoption 2014–2019.

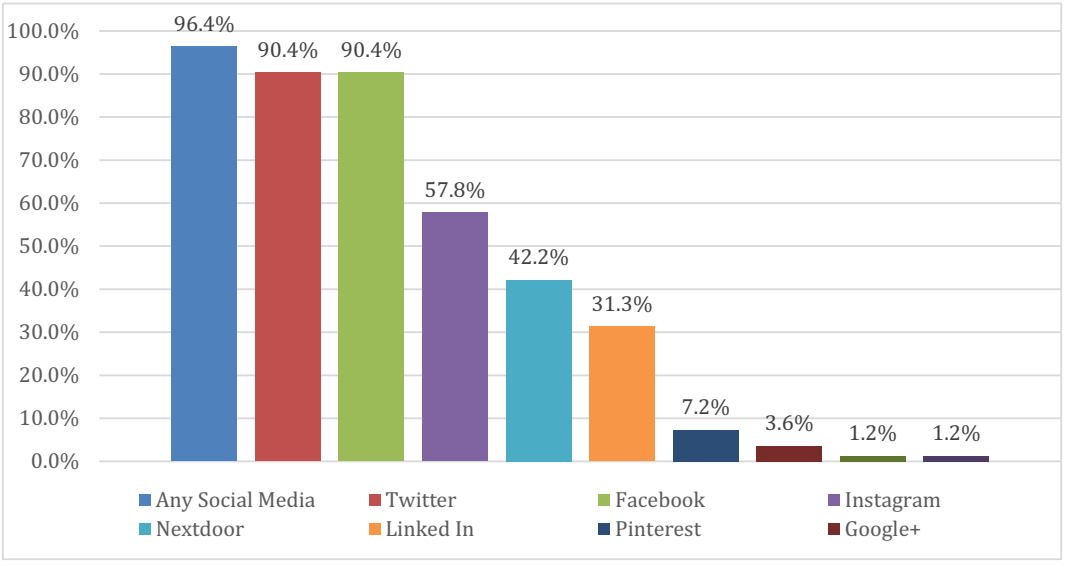

Fig. 9. Percentage of U.S. Cities Adopting Various Social Media Platforms, 2019.

dramatically since 2014.

4.3.1. What affects e-government adoption by local governments?

It is time to turn attention to the second research question: What factors affect the number of e-government services that cities offer? Some recent studies have explored why different cities might be more or less likely to adopt various e-government services (Connolly et al., 2018). This study offers an opportunity to update previous research by using data from a two-stage panel survey. While there are many independent variables that can contribute to the adoption of e-government services, three leading hypotheses guided by prior research are tested.

H1. Cities with larger populations are more likely to offer more e-government services.

H2. Wealthier cities are more likely to offer more e-government services.

H3. Cities with greater internet usage are more likely to offer more e-government services.

Greater populations would likely lead to more e-government services offered because larger cities would have a larger target audience thus increasing demand for greater services, and likely more human and capital resources available to create and maintain e-government services. The relative wealth of a city is likely to accompany higher number of e-government services because e-government infrastructure is expensive, and more easily accessible by wealthier populations with greater access to the internet. The greater the internet usage the greater potential demand for e-government services.

The hypothesis that larger city populations would be linked with more e-gov services was confirmed. There was a strong and consistent correlation between population of a city and the total number of e-government services available (0.333 in 2014 and 0.326 in 2019). A preliminary linear regression test indicated the moderate and statistically significant influence of population size on the total number of e-gov services offered ($R^2 = 0.106$, p-value = .0026). The scatterplots of this relationship, shown in Figs. 10 and 11 below, are perhaps the most useful way to see not only the relationship between city size and e-gov services offered, but also see the sizable shift from 2014 to 2019. Comparing these two figures highlights two important findings, the positive shift in the overall number of e-government services available and the consolidation of the cluster in 2019. Overall the story is clear, from 2014 to 2019 more cities offered more e-government services more consistently.

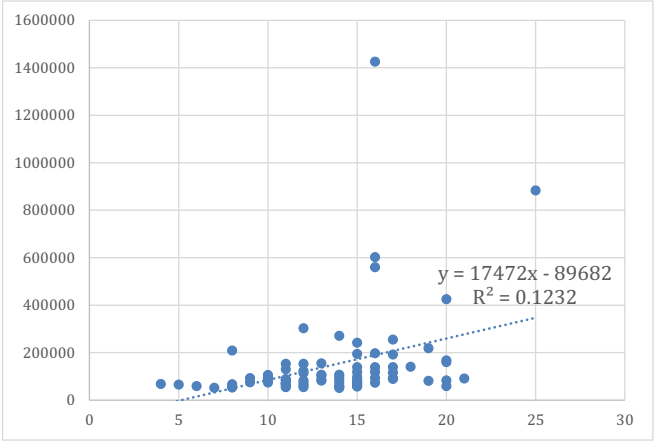

Fig. 10. Total E-Gov Features and City Population Size 2014.

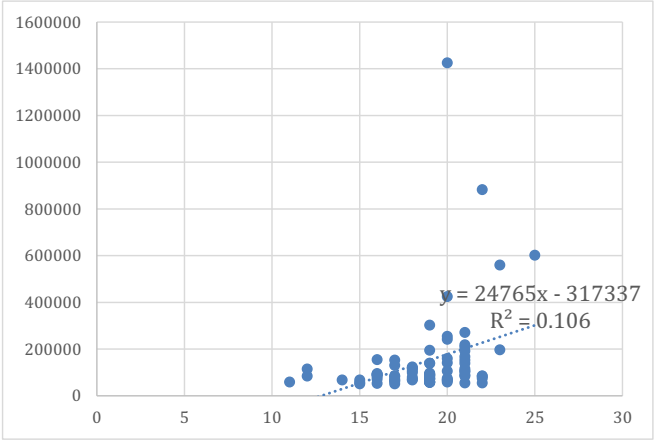

Fig. 11. Total E-Gov Features and City Population Size 2019.

The second hypothesis, that wealthier cities would offer more e-gov services was not confirmed using the proxies available. Neither median

income, nor poverty rate were statistically significant in leading to more e-gov services. However, the third hypothesis, which focused on broadband access in each city was statistically significant (R^2 0.088, p-value = .0065), suggesting that local governments may respond to the ability to use the services more than the relative wealth of residents, a topic worth exploring in future studies.

4.3.2. Changes in informational, interactive, financial and social media adoption

The majority of e-government features are informational in nature ($N = 19$), but interactive features ($N = 6$) which require multidirectional communication, multimedia features ($N = 7$), financial features ($N = 4$) which offer online payment options for residents, and social media features ($N = 10$) are more specific, and each were offered by many more cities on average in 2019 than 2014. Cities in the sample adopted 3.4 out of a total of six communication services, an increase of 1.3 since 2014. This is significant because many of these services require more ongoing staffing, a high demand for many local governments. Cities also added financial services in significant ways offering, on average, 2.8 out of four possible payment categories, up from two in 2014.

As mentioned earlier, social media perhaps witnessed the most dramatic changes, with most cities using more social media platforms. In fact, cities adopted, on average, 3.3 social media platforms 2019, up from 1.8 five years earlier. Fort Collins, CO was the social media champion as the only city that adopted eight different social media platforms, though further qualitative analysis would be required to measure how well they actually used these platforms.[3]

5. Conclusions

Many scholars have explored the adoption of e-government services by using snapshots of particular years. And there have been studies that explored adoption of e-government over time in some nations and regions around the world. However, no study has explored e-government diffusion over time among local governments in the United States until now. Utilizing the ICMA e-government survey data from 2000, 2004, and 2011, and comparable original data collected in 2014 and 2019, this study evaluates which e-government services have been adopted by local governments and the speed, or lack therof, of e-gov diffusion from 2000 to 2019.

Ultimately this study finds that pace of adoption of e-government services by U.S. cities was slow for much of the timeline under review but increasingly picked up, especially between 2014 and 2019. By 2019 more cities offer a more consistent set of services than ever before, though substantial variation still exists. A greater number of e-government features were strongly influenced by a larger population size and, to a lesser extent, broadband access, but were not affected in a statistically significant way by economic variables such as median household income or poverty rate. The pace of adoption is far from constant and the diffusion rate for some services have changed quickly at different times, which is the case for newer social media platforms and video services in the period from 2014 to 2019.

It is easy to view the inconsistent amount of e-government features available and become discouraged about the current state of e-government adoption. However, this masks the fact that so many e-government features have become widely available and will likely follow the trajectory of other successful S-curves in the future. Sixteen of the 29 services have become relatively standard, and have been adopted by at least 80% of cities. These services include many informational forms, some interactive, multimedia, and financial services, and Twitter and Facebook among social media platforms. Other e-government services have either stalled in terms of their adoption rate, or have been inconsistently adopted among U.S. cities, at least during the period under review.

The two wave panel data from 2014 and 2019 offered some very useful insights, including the clear support for claim that cities with more broadband access and larger populations offer more extensive e-government services. However equally useful was the ability to extend the trend line of e-government expansion from 2000 all the way to 2019. The characteristics of the local governments sampled varied widely, yet the e-government services that they offer are becoming much more clearly uniform, a realization that only becomes clear when these changes are viewed over time.

Nevertheless there are important limitations to this study which must be addressed. Most notably is the lack of uniformity across the methods and samples used. The samples in each of the ICMA surveys and the two original surveys were each a bit different from each other. They varied in the size of the local government included in each sample, the size of the sample itself, and the questions included. The diffusion of e-government among cities with populations over 50,000 may be substantially different than for towns with less than 5000 people. However the e-government services that were identified were nearly uniform across all surveys, other than new services that emerged over time and others that faded from existence. Yet, the lack of uniformity may give some pause as to the utility of the methods and findings included in this study. There were additional data limitations inherent in using ICMA data. The survey summaries are available from ICMA but the complete raw data from these three surveys were not. This did not affect the topline descriptive comparisons across all five data points across time, however it is a notable black box that should be considered. It is important to note that these limitations do not apply to any comparisons made between 2014 and 2019 data as they were constructed from uniform data sets and the same sample of local governments.

Finally, there were determinants that could have potentially had an impact on the types of local governments that were more likely to adopt e-government services that were not tested in this current study. Future scholarship may wish to test more potential determinants based on a simpler and more consistent set of data. And also test determinants of specific types of e-government services as opposed to the overall number of services offered. The tradeoff between duration of diffusion analyzed and the consistency of the data in the current study is notable. Even with these limitations, this study offered an unparalleled look at two decades of e-government diffusion among local governments in the United States. This offers utility for scholars of e-government and local government practitioners that are interested in the trends of overall e-government diffusion, and specific types of services that dramatically impact the relationship between local governments and their residents.

Acknowledgements

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

[3] For one example of measuring the quality of social media responsiveness see (Epstein et al., 2021).

Appendix A. 2014 & 2019 Multi Stage City Sample ($N = 83$)

2014 and 2019 samples (N = 83) listed alphabetically. Data include city, state, total number of e-government services (29 maximum), population, population change 2000–2018, and median income.

City	State	Total *E*-Gov Services 2014	Total E-Gov Services Offered 2019	2018 Population	Population Change 2000–2018	Median Income 2018
Albany	GA	14	19	75,249	−2.8%	$ 31,843
Albuquerque	NM	18	23	560,518	2.6%	$ 49,878
Alexandria	VA	22	20	160,530	14.7%	$ 93,370
Allen	TX	14	21	103,303	22.7%	$ 104,132
Appleton	WI	11	22	74,526	2.5%	$ 55,817
Auburn	WA	20	19	81,905	16.7%	$ 64,400
Baltimore	MD	17	25	602,495	−3.0%	$ 46,641
Beaumont	TX	17	18	118,428	1.0%	$ 45,268
Bend	OR	16	19	97,590	27.3%	$ 60,563
Bossier City	LA	5	14	68,235	10.5%	$ 48,468
Carlsbad	CA	20	21	115,877	10.5%	$ 102,722
Carson	CA	20	16	91,909	0.2%	$ 75,517
Carson	NV	12	21	55,414	0.3%	$ 49,341
Chula Vista	CA	17	21	271,651	11.4%	$ 70,197
Clifton	NJ	12	17	85,273	1.4%	$ 74,963
Daly City	CA	14	18	107,008	5.8%	$ 86,342
Danbury	CT	14	21	84,730	4.7%	$ 68,068
Delray Beach	FL	18	20	69,358	14.4%	$ 53,233
Des Plaines	IL	15	19	58,959	1.0%	$ 67,415
Duluth	MN	16	22	85,884	−0.4%	$ 47,227
Fayetteville	NC	9	21	209,468	4.4%	$ 43,439
Flagstaff	AZ	19	19	73,964	12.0%	$ 51,758
Fort Collins	CO	23	21	167,830	15.9%	$ 60,110
Fullerton	CA	17	21	139,640	3.3%	$ 71,660
Greeley	CO	15	21	107,348	15.5%	$ 52,887
Gulfport	MS	12	16	71,870	6.0%	$ 37,243
Huntsville	AL	19	23	197,318	9.4%	$ 51,926
Irving	TX	17	20	242,242	12.0%	$ 58,196
Kansas City	KS	13	21	152,958	4.9%	$ 41,671
Kirkland	WA	20	21	89,557	11.1%	$ 104,319
La Mesa	CA	20	19	59,556	4.5%	$ 59,629
Lafayette	IN	14	19	72,168	4.8%	$ 43,894
Lake Forest	CA	15	19	85,623	10.6%	$ 96,963
Lakeville	MN	12	20	65,877	17.6%	$ 102,943
Lakewood	CA	16	18	80,140	0.1%	$ 84,055
Lawton	OK	10	16	92,859	−4.1%	$ 44,335
Madera	CA	6	17	65,706	7.0%	$ 40,731
Manhattan	KS	13	22	54,959	5.4%	$ 47,632
Margate	FL	9	19	58,656	10.4%	$ 43,782
Medford	OR	14	17	82,347	9.9%	$ 45,361
Minneapolis	MN	23	20	425,403	11.2%	$ 55,720
Mission	TX	11	12	84,827	9.2%	$ 45,792
Moore	OK	13	17	62,103	12.7%	$ 62,347
Mountain View	CA	22	22	83,377	12.7%	$ 120,351
Nashua	NH	11	19	89,246	3.2%	$ 70,316
New Britain	CT	15	19	72,453	−1.0%	$ 43,611
New Haven	CT	12	17	130,418	0.4%	$ 39,191
Norman	OK	13	18	123,471	11.3%	$ 53,733
North Richland Hills	TX	16	18	70,836	11.8%	$ 65,340
Norwalk	CT	17	19	89,047	4.0%	$ 81,546
Palatine	IL	12	18	68,053	−0.7%	$ 76,633
Pasadena	TX	11	17	153,219	2.6%	$ 50,207
Pasadena	CA	21	20	141,371	3.1%	$ 76,264
Peabody	MA	10	16	53,278	3.9%	$ 65,085
Perth Amboy	NJ	8	15	51,928	2.2%	$ 50,883
Placentia	CA	15	17	51,671	1.5%	$ 88,501
Port St. Lucie	FL	17	19	195,248	18.9%	$ 54,046
Rapid City	SD	10	20	75,443	10.2%	$ 48,895
Reading	PA	12	16	88,495	0.5%	$ 28,755
Richland	WA	18	19	57,303	19.1%	$ 71,025
Roseville	CA	19	19	139,117	16.8%	$ 81,119
Royal Oak	MI	15	20	59,461	3.9%	$ 74,140
San Diego	CA	19	20	1,425,976	9.5%	$ 71,535
San Francisco	CA	28	22	883,305	9.7%	$ 96,265
Santa Monica	CA	24	19	91,411	1.9%	$ 86,084
Scottsdale	AZ	20	20	255,310	17.4%	$ 80,306
Sioux City	IA	13	16	82,396	−0.4%	$ 48,559
Spokane	WA	21	21	219,190	4.6%	$ 44,768
Spokane Valley	WA	17	18	99,703	11.1%	$ 48,015

(*continued on next page*)

(*continued*)

City	State	Total *E*-Gov Services 2014	Total E-Gov Services Offered 2019	2018 Population	Population Change 2000–2018	Median Income 2018
Springfield	MA	7	11	59,282	−2.1%	$ 34,887
Springfield	IL	16	16	155,032	1.2%	$ 37,118
Springfield	OH	15	12	114,694	−2.0%	$ 51,789
St. Louis	MO	13	19	302,838	−5.1%	$ 38,664
St. Peters	MO	14	15	57,127	8.7%	$ 73,604
Sugarland	TX	16	18	118,600	10.0%	$ 108,994
Sunrise	FL	13	16	95,458	13.2%	$ 53,237
Tempe	AZ	18	21	192,364	18.9%	$ 51,829
Thornton	CO	17	19	139,436	17.4%	$ 73,517
West Allis	WI	16	19	59,492	−1.5%	$ 47,669
West Covina	CA	11	20	106,311	0.2%	$ 74,551
Weston	FL	13	17	71,210	8.9%	$ 96,173
Yakima	WA	19	19	93,884	2.9%	$ 42,092
Yorba Linda	CA	11	15	67,787	5.6%	$ 123,962

Appendix B. 2014 and 2019 City Sample Variables

1. City Demographics:
   a. City name
   b. State
   c. Population rank
   d. Population
   e. Change in population 2010–2018
   f. Median income
   g. Percent of population living under the poverty line
   h. Percent of population with broadband access
   i. Percent of population that identifies as:
      i. White
      ii. Black
      iii. Asian
      iv. Hispanic
      v. White, Non-Hispanic
2. *E*-government services offered by cities:
   a. Pay tickets/fines
   b. Pay taxes
   c. Pay utility bills
   d. Pay for licenses/permits
   e. Voter registration
   f. Property registration
   g. Apply for a business license
   h. Permit application
   i. Parks and recreation services
   j. 311 information available online
   k. Request services (e.g. fix potholes)
   l. Request government records online (2014)
   m. View government records online (2014)
   n. Mobile app(s)
   o. Interactive maps/GIS
   p. Employment opportunities
   q. Download official city forms (2014)
   r. Online communication with officials (e.g. e-mail, social media, etc.)
   s. View minutes/agenda from city meetings
   t. View city codes or ordinances
   u. Streaming video (e.g. meetings, public forums, etc.)
   v. Video on demand (e.g. meetings, informational videos, etc. including via YouTube)
   w. Real time communication
   x. Delayed response Q/A
   y. Podcasts
   z. E-newsletter
   aa. E-alerts
   bb. Blogs
   cc. Flickr
   dd. Vimeo (2019 only)
   ee. YouTube

ff. Social media:
    i. Twitter
    ii. Facebook
    iii. LinkedIn
    iv. Tumblr
    v. Instagram
    vi. Google +
    vii. Pinterest
    viii. Foursquare (2014)
    ix. Nextdoor
    x. Yelp (2014)
    xi. MyConnection (2014)
    xii. Tumblr (2019)
    xiii. Nixle

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