Variations in the adoption of and willingness to use e-services in three differentiated urban areas

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Abstract

This study analyses electronic service (e-service) adoption in regards to socio-spatial dynamics. Conceptually the paper focuses on the interrelations of both private and public e-services and on the influence that demographic variables have on e-service adoption. To empirically engage in this discussion the study uses segmented residential areas representing different socio-spatial characteristics; namely 'city center', 'high-income suburban' area, and 'lower-income suburban' area. With data from an extensive postal survey and standard statistical methods for analyzing survey data the paper shows the extent of existing differentiation in e-service use between genders and according to age, education and income, as well as spatial differences between the studied residential areas. The study results, thus, clearly indicate that the e-service use has still statistically differentiated user profiles, particularly if it is considered in a spatial setting. The paper concludes by addressing directions for the future research.

Keywords: digitalization, demographic differences, electronic services, electronic governance, socio-spatial differences

1 INTRODUCTION

Companies and public bodies have initiated and produced numerous information and communication technology (ICT) reliant commercial and governmental projects in order to achieve efficiency gains in productivity, reliability and process functionality (Wielicki and Arendt 2010; Linnefell, Hallin, and Lagergren 2014; Nam 2014). Meanwhile, public e-services (or e-government) have 'mirrored the development of e-commerce' (Lee, Tan, and Trimi 2005, 99) resulting from projects that utilise ICTs for delivering services for citizens (Almarabeh and AbuAli 2010; Joseph 2013; Lindgren and Jansson 2013). This development has produced a myriad collection of embedded daily practices that form to a new means of conducting shopping, information sharing, social mediation and government-citizen relations online (Colesca and Dobrica 2008).

The use of e-services is tightly connected to the adoption of ICTs that are unevenly diffused globally as well as locally (Chen and Wellman 2004; Graham 2011; van Deursen and van Dijk 2014), thus, geography has significantly defined this development. Cities have been especially eager to adopt new solutions in order to enhance and change their service provision tactics (Inkinen 2010; Deakin 2012; Graham 2013; Graham, Zook, and Boulton 2013). There are cultural and socio-economic differences among countries and regions, which have resulted in diverse patterns of adoption and use of e-services at the national and local levels (Reggi et al. 2014; Carter et al. 2016). However, earlier studies have rarely investigated the geographical differences in e-service adoption among sub-regional entities, such as neighborhoods (cf. Hsu et al. 2005; Bernhard and Wihlborg 2015). This paper focuses on these local differences by employing fine-grained sampling and provides survey insights on citizens' use of e-services within differentiated urban areas inside the Helsinki Metropolitan Area (HMA) located in Finland.

As far as individual socio-economic backgrounds are concerned, previous studies have proved that gender, education, age and income are significant explanatory factors of e-service adoption (e.g. van Aerschot and Rodousakis 2008; Agudo-Peregrina, Hernández-García, and Acquila-Natela 2016; Friemel 2016; Gray, Gainous, and Wagner 2017). These differences are reflected in the targets of national (or regional) policies aiming to promote digitalization and the egalitarian access to e-services (Billón, Ezcurra, and Lera-López 2008;

Pósfai and Fèjer 2008). Recently, the discussion has shifted from the dichotomy of users (in the past commonly associated with high-income, well-educated, younger males) and non-users to more detailed analyses of what types of services are being used (and how) by different demographic groups. For example, Goldfarb and Prince (2008) have shown that although high-income and highly educated people are overall more likely to have adopted e-service use per se, e-service users with low-income levels and less education are actually spending more time online in absolute terms (also van Deursen and van Dijk 2014). In line with this, Agudo-Peregrina, Hernández-García, and Acquila-Natela (2016) have presented how the average e-shoppers have gradually changed, in accordance with the Internet expansion, to encompass new segments of consumers resulting in more heterogeneous socio-demographic characteristics of online shoppers. Therefore, the research focus of this paper is, instead on the overall statistics of e-services, on what services are used and for what purposes by segmented distinct socio-economic groups.

The specific research questions of this paper are related to the differences in e-services adoption among different residential areas within the HMA per socio-spatial background characteristics and to the differences in e-service adoption among different population groups per demographic variables including gender, age, education, and income levels. The paper is organized as follows: First, a literature review together with the conceptual definitions of this paper, leading to the research hypothesis, is presented. Second, a description of the applied data and methods is given. Third, the results of the analyses answering the research hypothesis are presented followed by a discussion on the implications of the most significant findings. Finally, the paper concludes with a summary of key empirical observations and subsequent suggestions for future research.

2 BACKGROUNDS AND HYPOTHESIS

Digitalization is commonly referred to as ‘a social, economic and cultural process where individuals, organizations and access, adopt, use and utilize digital technologies’ (Merisalo 2016, 14; cf. Katz, Koutroumpis, and Callarda 2014, 32). E-services may be seen as a product of digitalization. In essence, e-services refer to a complex package of products and services offered online including: 1) public sector services (*e-government*)

(Fang 2002); 2) business-to-business products (Senn 2000); and end-user services for 3) commercial purposes (Burt and Sparks 2003), such as online auctions and shopping on-line (*e-commerce*), as well as 4) free-of-charge services (commonly still tied to e-commerce through advertisement), such as social media applications (Huang and Benyouncef 2013).

This paper focuses particularly on the interaction and development of public and commercial end-user services (e-government and e-commerce). It engages in the discussion of e-commerce and e-government *vis-à-vis* the concept of the digital divide (a gap that exists in the use of ICTs and e-services among different countries and user groups; e.g. James 2008) which have in the past been relatively disconnected research areas (Helbig, Gil-García, and Ferro 2009). Empirical evidence has shown that the adoption of e-services is dependent on different demographic variables, such as age, education, income level and gender (Inkinen 2006; Taipale 2013), and socio-spatial settings (van Deursen and van Dijk 2014; Merisalo 2016) of individuals and groups of individuals.

In terms of geographical differences, the existing literature has identified a digital divide favoring developed countries over developing ones, mainly due to gaps in per capita income and telecommunication infrastructure between the rich and poor countries (Chinn and Fairlie 2007; Skaletsky et al. 2016). Similarly, studies on adoption and e-service use have discussed the differences between urban and rural (or peripheral) regions, showing that there is a gap in the technology access and e-service usage between the two, in favor of the urban ones. This is also related to uneven access to home computers and the Internet (partly due to income, education, and attitudes) between urban and rural populations (Wilson, Wallin, and Reiser 2003; Stern, Adams, and Elsasser 2009; Prieger 2013; Philip et al. 2017). However, these divides have been observed to be closing (Fink and Kenny 2003), leading Willis and Tranter (2006) claiming that geographical location is no longer a primary cause of Internet inequality.

The original digital divide of physical access related to Internet and ICT equipment, has evolved into a divide that includes differences in skills and know-how for using various e-services (van Dijk and Hacker 2003; van Deursen and van Dijk 2010, 2014; van Dijk 2017). In other words, the discussion has shifted from access to

usage (Büschi, Just, and Latzer 2016). As such and resembling the classical models of innovation diffusion (Rogers 1962; Hägerstrand 1967), it has been forecast that the digital divide should indeed close in the future. The expenses associated with an early adoption of ICTs should decrease for 'latecomers', while the difficulty of learning the use of new technology is expected to decrease in time due to the development of more user-friendly applications (Wilson, Wallin, and Reiser 2003).

There are, however, also recent studies, which have claimed that the significant gaps in the access and usage of ICTs (and e-services) between countries as well as internal gaps between different population groups will persist (Hilbert 2010, 2016; Cruz-Jesus et al. 2016; Lindblom and Räsänen 2017). It has been argued that limited academic attention has been focused on the differences within and between socio-spatial characteristics of technology use in metropolitan areas (Holloway 2005). Therefore, only a handful of papers discussing the use of e-services in the context of differentiated neighborhoods within cities are explicitly identifiable (Atkinsson, Black, and Curtis 2008; Chang, Zheng, and Cao 2016). The existing literature on socio-economic conditions does, however, provide hints on the likely variation that is expected to exist between different city-region types with varying socio-economic conditions. Particularly, it has been emphasized how lower income neighborhoods are at a disadvantage when it comes to e-service adoption (Hsu et al. 2005). This discussion leads to the first hypothesis:

> H1. There are differences in e-service adoption between differentiated residential areas within the HMA in accordance to their socio-spatial characteristics.

The examination of differentiated e-service use starts here in accordance with earlier research that has identified three key variables explaining the majority of ICT adoption: age, education and income. Youth generations are commonly eager and quick to adopt new e-services, while the elderly might be reluctant towards changes and adoption of e-services (Loges and Jung 2001; Willis and Tranter 2006; Bélanger and Carter 2009; Friemel 2016). Similarly, education plays a role in the use of e-services, as earlier studies have proven that population with higher educational backgrounds have been more intense in their e-service usage compared to those with lower education (Hoffman, Novak, and Schlosser 2000; Korupp and Szydlik 2005;

Bélanger and Carter 2009). This is related to the skills needed for using e-services (van Deursen and van Dijk 2014).

Since the use of e-services requires investments in hard- and software, e-service use is related to the income levels of individuals (or households). Populations with lower income levels have been viewed to be at a disadvantage (i.e. the digital divide) compared to populations with higher incomes (Hoffman, Novak, and Schlosser 2000; Bélanger and Carter 2009; Agudo-Peregrina, Hernández-García, and Acquila-Natela 2016). However, this connection is recognized to be less significant in comparison to the previous two (age and education): there is proof in the literature that there are nuanced differences between the usage of e-services among different income level groups that go beyond the simple user versus non-user dichotomy (e.g. Goldfarb and Prince 2008; van Deursen and van Dijk 2014). For example, several public services are specifically targeted for low-income groups (Akman et al. 2005). Increased Internet use among a populace has been verified to be linked with the increased use of public e-services in populations with low-incomes (Taipale 2013), whereas using e-commerce has been shown to be positively associated in populations with high-incomes (Eid 2011). When we consider gender, there are clear differences in the use patterns and amounts of time consumed online between men and women (Gray, Gainous, and Wagner 2017); i.e. deriving from the socialization patterns of boys and girls and the old stereotype of computers being mainly 'toys for boys' (Cooper 2006; Willis and Tranter 2006). This discussion leads to the two following hypotheses:

H2. Individuals' income level affects the use of e-services:

a) Populations with high-income levels are likely to use e-services related to e-commerce and public services related to earnings more often than populations with low-income levels.
b) Populations with low-income levels are likely to use public e-services related to social welfare more often than populations with high-income levels.

H3. Men are more likely to use e-services than women.

Finally, it has to be noted that also other non-socio-spatial issues such as trust, perception of risk and customer satisfaction influence e-service adoption (Liu and Wei 2003; Liao, Chen, and Yen 2007; Bélanger

and Carter 2009; Mou, Shin, and Cohen 2017). This is also a methodological question as pointed out by Liu et al. (2016) in their assessment of ICT's impact on survey data properties. As conceptualized by Merisalo (2016), the use of e-services is bound to individuals' possibilities (e.g. access and income), capabilities (e.g. skills) and willingness to invest in and utilize digitalized products – referred to as e-capital (also Merisalo, Makkonen, and Inkinen 2013).

The willingness to adopt e-services has been highlighted as a critical success factor of digitalization initiatives (Carter and Bélanger 2004; Löfstedt 2005). Willingness may be defined as a personal decision to either select or deselect the use of newly emerging technologies and services. Therefore, it is a combination of personal properties towards technological developments that are connected to the socio-economic and demographic life-situation of the person in question. Willingness is treated here as a proxy variable to describe individual's attitude and actions towards the adoption of e-services. The survey question, which directly asked about willingness to prioritize e-services over other forms of service provision, is a 5-point Likert scale, and was presented in the survey as follows: 'I am willing to use e-services as a priority service delivery form'. This willingness to prioritize e-services over other service delivery types (postal mail, telephone or reception desk) has been proven to be connected to (and also determined by) other factors than those relating strictly to demographics and socio-spatial settings (Gilbert, Balestrini, and Littleboy 2004; Carter and Bélanger 2005; Dinev and Hart 2006).

The question of the impacts of this willingness to the actual adoption of e-services has been mainly discussed in the previous literature through national contexts, not as a question of socio-economically differentiated small scale regional units, such as postal code areas or neighborhoods, nor in accordance with differentiated demographic user groups of technologies (Gong 2009; Udo, Bagchi, and Kirs 2012; Sharma 2015). Therefore, the last hypotheses are:

> H4. The willingness to prioritize e-services over other service delivery types is a major explanatory factor for actual e-service use.

H5. The willingness to priorities e-services is connected to:

a) The socio-spatial settings of individuals.

b) The demographic background variables of individuals.

3. DATA AND METHODS

The paper utilizes extensive postal survey data collected in the Helsinki Metropolitan Area in 2010. The survey was stratified into three different spatial categories in order to obtain a representative sample from different residential areas: 1) the city center of Helsinki (region type 1: CC), 2) higher socio-economic suburban areas (region type 2: HSA) and 3) lower socio-economic suburban areas (region type 3: LSA). Case region selection was based on the data from Statistics Finland by taking into an account the following variables: education, household income and home ownership. HSA included five residential districts, with high socio-economic profiles, whereas LSA include three residential districts with lower socio-economic profiles:

- The average proportions of tertiary educated during the data collection year 2010 were: 46% in the CC; 52% in HSA and; 24% in LSA.
- The average household incomes during the data collection year 2010 were: 42 723 €/year in the CC; 41 232 €/year in HSA and; 22 372 €/year in LSA.
- The share of population living in owner-occupied houses during the data collection year was: 41 % in the CC; 85% in HSA and; 33% in LSAs

The Population Register Centre conducted the random sampling within these three city-region types. The total sample size was 2 500 that resulted in 971 responses (response rate 39 %): 468 from the city center, 220 from the HSA and 283 from the LSA. The overall schematic of the survey variables and the methods applied is presented in Figure 1.

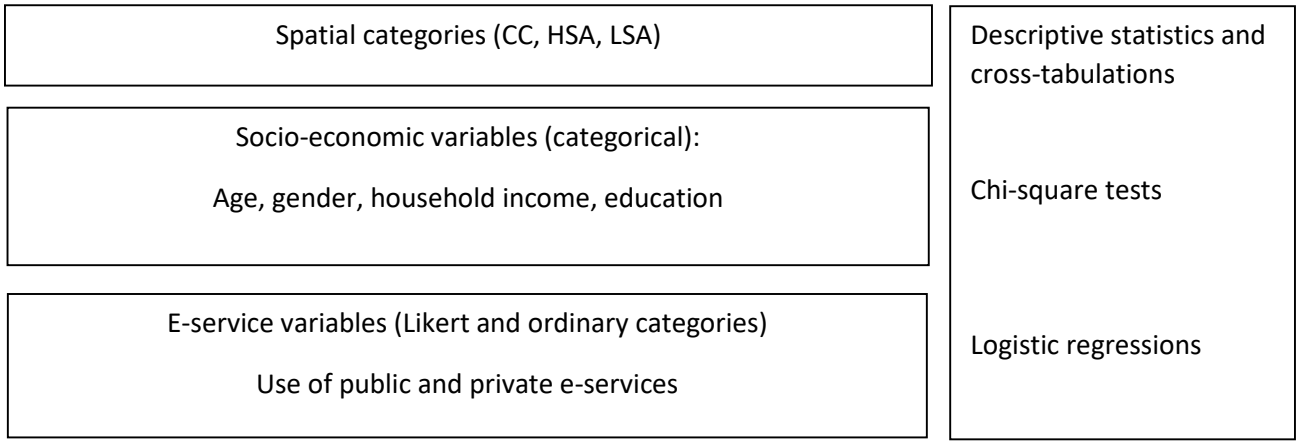

Figure 1. Thematic classification of the survey data and methods applied.

The survey included questions concerning the socio-economic status (age, gender, household income and education) of the respondents and questions concerning their use e-services. The following e-services were selected for the investigation from the survey: 1) electronic tax form provided by the Finnish Tax Administration; 2) e-employment office provided by the Ministry of Employment and the Economy; 3) e-services provided by KELA (i.e. the Social Insurance Institution of Finland); 4) e-notice of removal (provided by Population Register Centre and Postal Service); 5) mobile (SMS) ticket to public transport in Helsinki (provided by Helsinki Region Transport, owned by the city of Helsinki); 6) WLAN access in public space; 7) activity in e-shopping; and 8) activity in online auctions. The first five of the e-services relate to e-government, the sixth to a combination of e-government and e-commerce (as WLAN access provision is done by both sectors) while the last two relate to e-commerce.

The survey design directed the selection of appropriate methods for the analysis of (mainly) categorical variables to include 1) descriptive statistics, 2) cross-tabulations, 3) chi-squares and 4) logistic regression. These tools were utilized in order to corroborate or invalidate the formulated hypotheses. Cross-tabulations and chi-square tests were applied to analyze how the use of e-services differ between the different city-region types (CC, HSA and LSA), whereas logistic regression analyses were utilized to indicate how the independent variables and willingness to prioritize e-services are connected to the probability to use e-services. Nagelkerke R^2 was used to estimate the explained variations. Chi-square tests were also applied in

order to examine how demographic and socio-spatial variables are connected to the residents' willingness to prioritize e-services over other service delivery forms.

There are certain limitations that should be acknowledged in the use of spatially segmented surveys. The data is valid in terms of its representativeness of the people in the designated three areas (CC, HSA and LSA), but the exceedingly fast phase of technological transformation can make single technologies outdated very quickly. This has been recognized in the study as all the hypotheses are bound to analyze social and economic characteristics of households in relation to their general practices (device free; i.e. including home computers, laptops, e-phones, tablets, etc.) towards e-services. In addition, the creation of segmented regions (or small scale areas) is always a question of making distinctions between categories such as 'center and periphery' or 'low and high' that are commonly context dependent. This has been acknowledged in the survey design and as indicated by the statistical differences in the socio-economic profiles of the study areas (in terms of education, average household incomes and the percentage of owner-occupied houses) the applied segmentation may be considered valid. Finally, surveys tend to provide extensive amounts of 'middle ground' information particularly with Likert-scale variables, also applied in this study. This has been acknowledged here by complementing these variables also with several, less ambiguous, dichotomous distinctions applied in the study.

4 RESULTS

The analyses start with an investigation onto the adoption of different public and private e-services within the different city-region types; CC, HSA and LSA (Table 1). The results show that the CC is statistically significantly at the head of the adoption of the examined e-services in comparison to suburban areas: a larger proportion of the residents in the CC use private and public e-services compared to the population of the suburban areas. Additionally, there is a statistically significant difference between the respondents' willingness to prioritize e-services according to whether they live in the CC (more willing) or in the suburban area (less willing) (Table 2). This result holds for all other types of e-services surveyed other than the use of

e-employment office (Table 1). Moreover, there are no statistically significant differences between the use of e-services in the two suburban areas, HSA and LSA, expect in the use of the e-employment office. These results are most likely connected to the socio-economic profile of the LSA, especially to the unemployment rate that was (in 2010) considerable higher in the LSA with 10.8% more than in the CC (5.1%) or in the HSA (3.8%) (Helsinki Region Statistics 2017). In addition, the age profile of the respondents is different within the three city-region types: the average age of respondents in the CC was 38 while it was 45 in the HSA and 41 in the LSA. These demographic variables, discussed in greater detail below, are also the likely explanations behind the result that confirms the first hypothesis of existing differences in e-service adoption between differentiated residential areas within the HMA in accordance with their socio-spatial characteristics.

Table 1. Respondents' use of e-services according to different city-region types; chi square statistics.

E-service use: proportions (%) and amounts (N) of the respondents							Chi square statistics			
							CC-Suburban areas		Suburban areas (HSA-LSA)	
	CC (%)	N	HSA (%)	N	LSA (%)	N	χ^2	sig.	χ^2	sig.
Electronic tax forms	58.2	260	49.0	102	43.8	116	13.428	0.000	1.300	0.266
E-employment office	52.5	234	37.7	78	56.8	151	1.431	0.235	16.979	<0.001
E-services by KELA	44.1	197	30.9	64	35.4	93	11.000	0.001	1.028	0.326
E-notice of removal	55.5	248	32.9	68	35.4	93	41.259	<0.001	0.324	0.625
Mobile tickets	63.0	281	18.4	38	23.5	62	164.599	<0.001	1.824	0.212
WLAN in public spaces	51.9	233	34.4	72	30.6	81	36.461	<0.001	0.806	0.375
E-commerce	91.3	410	84.7	177	82.6	219	12.663	<0.001	0.356	0.618
Online auctions	52.1	234	45.9	94	45.9	94	5.996	0.015	0.436	0.513

Whilst there are a few exceptions, such as the use of tax forms, WLAN in public spaces, mobile tickets and e-commerce in HSA and the use of e-services by KELA in LSA, the results generally confirm findings from earlier studies (e.g. Holloway 2005; Inkinen 2006) age is a significant factor in explaining the probability of using e-services (Table 2). In all the other e-services all the other age groups have a higher probability to use e-services than the oldest age group (51–60 years) present in the survey population irrespective of where they live (in the CC or suburban areas). The same picture emerges from the willingness to prioritize e-services

between different age groups (Table 3): the oldest age group were the least willing to switch to using public or private services online.

In relation to education, a rather unsystematic picture emerged from the survey data. The highly educated were more willing, than respondents without higher education, to prioritize e-services (Table 3) and higher education does increase the probability to use e-services provided by KELA, e-notices of removal, mobile tickets, WLAN in public spaces and online auctions (Table 2). However, the connections between education and individual e-service types are statistically significant only among the residents of the CC. Therefore, the role of education in e-service use is not uniform.

The higher the average household income, the more willing the respondents were to prioritize e-services (Table 3), but there are marked differences in what types of services are being used. In other words, the impact of income levels varies as higher household income especially decreases the probability to use the e-employment office and e-services offered by KELA (Table 2); i.e. services that are aimed at the unemployed or those in need of services related to social insurance. On the contrary, higher incomes increase the probability to use electronic tax forms and e-commerce. These results are intuitively clear and corroborate the second hypothesis. Income level affects the use of e-services differently in relation to the utility of the e-service; higher income increases the use of e-services related to earnings (electronic tax form) and spending (e-commerce), whereas lower income increases the use of e-services related to social insecurity (e-employment and e-services by KELA).

In relation to the third hypothesis, gender is also shown to affect the use of e-services. However, the differences are less apparent as hypothesized based on the earlier literature. In fact, only clear difference between the genders seems to exist in the male dominance of using WLAN in public spaces (Table 2). Moreover, even though there is a difference in the willingness to prioritize e-services between the genders (Table 3), these results, although statistically significant, should be viewed with caution because of the small sample size. Therefore, the fifth hypothesis that the likelihood of men to use e-services would be higher than that of women was not confirmed. Contrarily, the results challenge the old stereotype of male dominance in

technology use since the data show female dominance in using e-employment office and e-services provided by KELA.

Lastly, because individual preferences (not accounted for by the demographic variables) were hypothesized to affect the adoption of e-services, a variable measuring the willingness to prioritize e-services over other service forms was added to the model (Table 2). As shown by the analyses, it turned out as a strong explaining factor increasing the probability to use (all the tested) e-services (at least to some extent). Moreover, in HSA this willingness is the only statistically significant independent variable in the model for using electronic tax forms. Therefore, the fourth hypothesis was confirmed. Similarly, and as evident also from the above discussions related to the earlier hypotheses, the willingness to prioritize e-services has been shown to be connected to the demographic and socio-spatial background characteristics of the respondents (Table 3). Thus, also the last (fifth) hypothesis was supported by the data.

Table 2. Socio-spatial and demographic characteristics of e-service use in the Helsinki Metropolitan area; logistic regression analysis.

Exp(B)	**Electronic tax form**				**E-employment office**				**E-services by KELA**				**E-notice of removal**			
Region type	ALL	CC	HSA	LSA	ALL	CC	HSA	LSA	ALL	CC	HSA	LSA	ALL	CC	HSA	LSA
Sex																
Women	1.000	1.000	1.000	1.000	1.000	1.000***	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Man	1.163	1.650*	0.579	0.987	0.446***	0.343***	0.624	0.437*	0.613**	0.749	0.379*	0.541*	0.964	1.008	0.963	0.955
Age																
18 - 29	2.401***	3.112**	0.225	3.571**	8.752***	13.626***	11.725***	8.880***	3.820***	5.682***	4.115	1.720	7.540***	11.494***	1.941	2.534*
30 - 40	2.465*	2.997**	1.185	2.964**	3.728***	4.588***	2.124	10.494***	2.159**	2.550**	3.539*	1.215	4.443***	4.454***	21.195***	2.059
41 - 50	2.163*	3.572**	1.142	2.130	1.408	4.017**	0.856	0.892	1.369	1.266	1.295	1.633	2.494***	2.861*	7.047**	1.126
51 - 60	1.000***	1.000**	1.000	1.000**	1.000***	1.000***	1.000***	1.000***	1.000***	1.000***	1.000*	1.000	1.000***	1.000***	1.000***	1.000
Education																
No higher education	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Higher education	1.213	1.454	0.911	0.602	0.812	0.997	1.539	0.431*	1.580**	1.997*	1.311	1.058	1.786**	1.522	1.192	1.490
Household incomes																
Below 20 000	1.000***	1.000**	1.000	1.000	1.000***	1.000***	1.000	1.000*	1.000**	1.000*	1.000	1.000	1.000	1.000	1.000**	1.000*
20 000 - 59 999	2.005*	2.368**	8E+08	1.672	0.446*	0.573	0.226	0.146*	0.472**	0.438*	1.824	0.374	0.939	1.768	0.189	0.452
60 000 - 99 999	2.069*	1.964	2E+09	2.147	0.321**	0.37*	0.275	0.082*	0.334***	0.349*	2.714	0.198*	0.612	1.346	0.620	0.212**
More than 99 999	3.534***	3.450**	3E+09	3.800	0.148***	0.150***	0.171	0.042**	0.319***	0.299*	2.708	0.262	0.961	1.391	1.992	0.185*
Willingness to prioritize e-services																
Disagree	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Agree	3.031***	3.199**	4.622**	4.114**	1.351	2.099*	0.814	1.225	2.264***	2.111	1.388	3.643**	2.609***	4.342***	1.673	1.380
Nagelkerke R^2	**0.131**	**0.151**	**0.222**	**0.145**	**0.313**	**0.364**	**0.170**	**0.423**	**0.180**	**0.233**	**0.160**	**0.155**	**0.222**	**0.249**	**0.396**	**0.151**

***, **, * denote statistical significance at the 1, 5 and 10% significance levels.

Table 2. Socio-spatial and demographic characteristics of e-service use in the Helsinki Metropolitan area; logistic regression analysis (continued).

Exp(B)	**Mobile tickets**				**WLAN in public spaces**				**E-commerce**				**Online auctions**			
Region type	ALL	CC	HSA	LSA	ALL	CC	HSA	LSA	ALL	CC	HSA	LSA	ALL	CC	HSA	LSA
Sex																
Women	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Man	0.886	0.855	0.715	0.598	3.030***	2.989***	2.891*	3.388***	0.975	1.641	0.819	0.578	1.467*	1.508	1.924	1.428
Age																
18 – 29	3.940	3.211**	0.430	6.947**	3.396***	3.956***	1.750	3.136*	4.017***	3.839*	2.286	3.220*	2.191**	2.593*	0.423	2.489*
30 – 40	5.326***	5.979***	2.652	12.004***	2.230***	2.929*	1.359	2.271	6.526***	19.719**	2.865	4.290*	2.643***	2.362*	7.433***	2.555*
41 – 50	1.764*	1.146	1.288	8.366**	1.998**	3.179*	1.245	2.236	2.041*	1.643	1.826	2.170	1.508	1.545	1.703	1.830
51 – 60	1.000***	1.000***	1.000	1.000**	1.000***	1.000*	1.000	1.000	1.000***	1.000*	1.000	1.000	1.000***	1.000*	1.000*	1.000
Education																
No higher education	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Higher educated	1.714**	1.076	1.367	1.181	1.732***	1.670*	0.916	1.618	1.060	0.744	0.555	1.355	1.480*	1.359	1.334	1.233
Household incomes																
Below 20 000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
20 000 - 59 999	1.088	1.824	7E+07	0.760	0.741	0.890	4E+08	0.507	1.480	2.261	2.728	1.133	0.961	1.377	0.074	0.626
60 000 - 99 999	0.799	2.034	3E+08	0.320	0.819	1.035	8E+08	0.398	2.188	5.797*	5.444	1.712	1.108	1.377	0.093	1.012
More than 99 999	0.100	1.818	3E+08	0.451	1.029	1.011	1E+09	1.080	3.173*	3.302	7.632	4E+08	1.003	1.184	0.060	1.251
Willingness to prioritize e-services																
Disagree	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Agree	1.931***	1.674	8.353	2.151	2.548***	3.496*	1.593	3.100*	4.269***	3.758**	5.023**	4.664**	1.837**	2.538*	0.764	2.512
Nagelkerke R^2	**0.186**	**0.164**	**0.187**	**0.209**	**0.188**	**0.185**	**0.153**	**0.226**	**0.187**	**0.208**	**0.203**	**0.216**	**0.093**	**0.092**	**0.200**	**0.121**

***. **. * denote statistical significance at the 1. 5 and 10% significance level.

Table 3. Respondents' 'willingness to prioritize e-services'; Chi square statistics.

%	Fully agree	Partly agree	Difficult to say	Partly disagree	Fully disagree	N	x²	sig.
Sex								
Women	28.7	38.4	16.8	12.5	3.5	487	10.218	0.036
Man	36.8	35.9	16.8	8.3	2.2	446		
Age								
18 - 29	34.4	38.7	15.6	10.4	0.9	212	24.101	0.02
30 - 40	36.9	40.4	14.5	6.7	1.6	255		
41 - 50	32.6	35.6	17.2	10.7	3.9	233		
51 - 60	26.8	33.8	19.9	14.3	5.2	231		
Education								
No higher education	26.7	38.9	17.0	13.2	4.2	424	19.339	0.001
Higher educated	37.5	35.8	16.7	8.3	1.8	509		
Household incomes €/year								
Below 20 000	31.3	32.0	23.0	12.0	2.0	100	26.366	0.010
20 000 - 59 999	27.2	38.5	19.1	11.2	3.9	356		
60 000 - 99 999	34.7	36.3	14.7	10.0	4.2	259		
More than 99 999	41.1	39.1	12.2	7.6	0.0	197		
Case region type								
CC	36.7	36.7	15.3	9.8	1.6	450	11.457*	0.022
HSA	31.6	36.8	17.7	10.0	3.8	209	1.636**	0.802
LSA	26.6	38.3	18.6	12.0	4.4	274		

* Chi square statistics between the CC and suburban areas (HSA and LSA)
** Chi square statistics between the different suburban areas.

Table 2 indicates that significant model-fits are close to the 0.2 level that is commonly accepted as an acceptable fit. The higher the Nagelkerke R^2 statistic is the better the fit. These statistics also help to identify the clearest differences between the variables. In general, employment and removal services have the greatest differences whereas the use of online auction services has the lowest fit except in the case of HSA. This may be interpreted as well-off areas having more persons able to purchase and participate in auctions. Overall, the low Nagelkerke R^2 statistics indicate that the differentiation may not be straightforwardly interpreted.

To summarize the result section in terms of its relevance to the e-government and e-commerce dichotomy the following key-findings can be identified. First, the study provided interesting results concerning differentiation according to socio-spatial and demographic categories. Considering the differences between public e-services and commercial ones, there are significant spatial results: the applied income-based

residential area categorization experienced approximately the same statistical significance levels and score-values. However, the variable 'willingness to prioritize e-services' had clearly more impact on e-commerce than public e-services. This may be regarded as a result of the content of the services: public e-services are designed to be usable and accessible regardless of socio-economic status in the first place, or they are in fact targeted at low-income groups, and therefore this result is supporting an expected outcome (cf. Akman et al. 2005). Second, the results indicate that public e-services are applied and their group usage-patterns are defined by standard socio-economic (demographic) variables. This is also due to the essence of the e-services: for example, the use of public e-services offering unemployment and social assistance is logically more pronounced in low-income areas than it is in high-income areas.

In broader societal context, the results indicate traditional social stakes and logic as lower income residential areas experience a clear difference to higher ones. This phenomenon is also related to housing policies. For example, the city of Helsinki has a long tradition in the 'balancing policy' referring to that different socio-economic groups should be present in all residential areas (Vaattovaara, 2002). Therefore, the survey results may be interpreted also to entail issues of areal segregation towards polarizing development verifiable also through e-service use. However, as the analyses shows, the differentiation is not exceedingly strong yet as there are numerous non-significant differences between the variables.

Three key features constantly came up in the survey analysis. First, it confirms results from earlier studies that age, education (to some extent) and income are still determining factors in the overall use of ICTs and e-services regardless whether or not they concern the public or private domains. Second, the regional categorization indicated that the most well-off areas and particularly respondents from those areas with the formal education highest degrees and incomes are the most active users (and also the beneficiaries) of the e-services. Thus, spatial differences are clear according to the analysis. Particularly, the differences between the CC and the suburban areas (HSA and LSA) were shown to be statistically significant. The results also indicated that e-service adoption is not always straightforwardly connected to higher income, but might in fact be more to do with the urban lifestyle and mind-set of willingness – not necessarily dictated by

demographic variables – to use digitalized services. This is an interesting interpretation as "urban lifestyle" is often associated with the adoption of new e-services, such as food bike deliveries order through the internet and e-applications (Pigatto, Machado, Negriti, & Machado, 2017). This provides a venue for future studies to combine conceptual definitions of urban lifestyle with e-services and applications. Similarly, these findings and their interpretations follow the logic, in which the observed willingness and socio-economic condition of the respondent is combined with spatial characteristics in the three residential areas. These indicate that technology adoption, available services and their targeted customer and user groups, and the observed levels of e-service use are fundamentally connected to spatial (e.g. society level) contexts. These encompass the construction of life styles and willingness (individual decisions) that become visible in socio-economic and demographic variables. These variables are then aggregated to spatial categories such as the applied neighborhood categorization. This continuum can also be interpreted to be an example of spatial scaling towards aggregated data categories (e.g. cities or countries). As an example, income related services (electronic tax forms and e-commerce) show a steady decline when moving from the high-income CC (adopters: 91.3% of respondents) to high-income suburban (84.7%) and finally to low-income suburban areas (82.6%). Evidently, the understanding of the results requires a combination of all relevant data sources ranging from individuals to spatial categories.

Third, the analysis indicates that the personal feeling of the willingness to prioritize e-services over traditional means of service delivery (postal mail. telephone or reception desk) is the single most important factor explaining e-service adoption. Moreover, since a person's age is also among the most significant factors explaining attitudes towards using and the actual use of e-service, the recognition of the needs of different age groups is important: as observed also in earlier studies (e.g. Friemel 2016), the oldest age category is the least prone to adopt e-services. An interesting development in the provision of public services in Finland is a national government initiative aiming to provide an e-mailbox for (government) communication for all citizens. This would mean that traditional post delivered communications (e.g. taxation documents and passport notifications) would be substituted with e-communications, which has raised critical arguments of the societal ubiquitous of e-services and the overall penetration of the use levels and adoption as a national

standard (cf. Blank and Dutton 2012). According to this study there is an approximately 10% gap in the population that is not willing or is strongly against full e-service adoption. In terms of public service provision, this figure is particularly significant for the elderly.

5 CONCLUDING REMARKS

The key findings of this paper can be summarized as follows. First, there are differences in the use of public and private e-services according to distinct socio-spatial settings: the use of services online is more common in the CC of HMA compared to suburban city-region types. Second, demographic variables also influence the use of public and private services in varying ways: the oldest age groups included in the survey were the least likely to adopt e-services, education (somewhat) increased the use of e-services, income levels affected the use of e-services in different ways depending on the utility of the e-service (high-income respondents were more likely to use e-commerce. while low-income respondents were more likely to use e-government services related to social welfare and unemployment), while men were still (but only) marginally more willing to adopt e-services than women. The study results, thus, clearly indicate that e-service use has still statistically differentiated user profiles, particularly if considered in a spatial setting. However, the individual willingness (not necessarily related to socio-spatial or demographic background variables) of the respondents to prioritize e-services was still the clearest indicator, particularly in terms of e-commerce, predicting actual use of services online.

In conclusion, the socio-economic residential area approach, applied in this study as a research design, provided significant results. There are number of recommendations both for policy making and academic research. First, the information society policy should still give focus on providing egalitarian possibilities for all socio-economic groups to benefit from new emerging e-services. This would benefit all stakeholder parties (consumers, providers and administrators) via improved customer/user satisfaction and increased customer/user rates. Second, based on this paper several interesting and important research questions can be identified for future research. For example, applying new and more fine-grained regional classifications

and particularly Geographical Information System (GIS) data in the analysis of e-service use will provide an interesting platform for studies for years to come. Additionally, comprehensive international comparisons in terms of regional impacts of e-service use are still very few. These include both producer and end-user analyses. Finally, as a general point, a critical evaluation of the e-service provision networks is essential. The current condition in which a limited number of global service providers are responsible for collecting both personal data as well as company data through their cloud services requires more attention. These are practical issues of intellectual property rights agreements and the role of company responsibilities exceeding private-public categories. For example, some public authorities have started to use these commercial services as support tools in their service provision. The aspect of the boundaries of service provision arrangements and national legislations will be an important and significant study field in the coming years as technologies develop with an accelerating pace.

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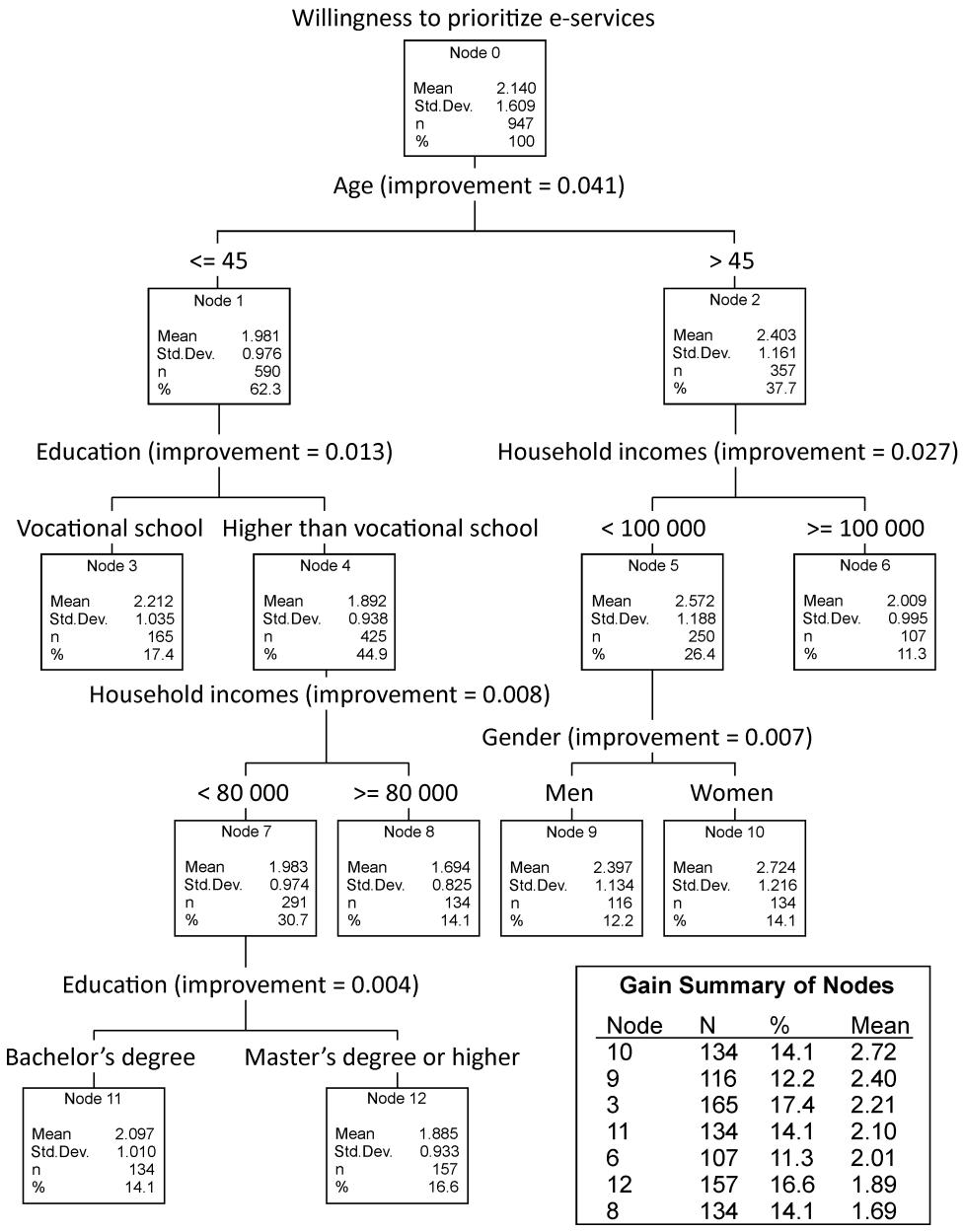
Appendix. 1 Classification tree explaining nodes for willingness to prioritize e-services and their relative importance.



Gain Summary of Nodes

Node	N	%	Mean
10	134	14.1	2.72
9	116	12.2	2.40
3	165	17.4	2.21
11	134	14.1	2.10
6	107	11.3	2.01
12	157	16.6	1.89
8	134	14.1	1.69