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" THE DIFFUSION OF PUBLIC ESERVICES IN EUROPEAN CITIES"

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The diffusion of public eServices in European cities

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Abstract

Using a novel dataset on the diffusion of public eServices at the city level in EU 15, this paper contributes to extant empirical literature in three ways. First, it extends the coverage of public eServices beyond eGovernment, investigating four service categories: Infomobility, eProcurement, eGovernment and eHealth. Second, it provides information for both a cross-country and cross-municipality comparison. Third, on the methodological side, it also extends the literature on composite indicators at a municipal level. Cities exhibiting the highest diffusion of public eServices are found to be medium-large, highly endowed with well-educated human capital, and characterised by a lively industrial atmosphere favoured by a reasonable number and variety of production and service activities. The relative performance of the European cities helps identify plausible directions to be taken for policies aimed at favoring the diffusion of public service innovation in Europe.

Keywords: Innovation, eGovernment, Public eServices, Information Policy, ICT

JEL: O33, O38, L96, H83

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1. Introduction

The digital revolution has been affecting the public sector over the past three decades.
While an increasing number of studies have produced evidence on the development of new digitalised public services using a variety of methods (Arduini & Zanfei, 2014; Wirtz & Daiser, 2016) comparative analyses across and within countries are still facing substantial data limitations and are largely based on surveys and benchmarking analyses.
Three research gaps can be observed in extant empirical literature. First, public eService delivery has been mainly examined with reference to a relatively narrow set of eGovernment services, that is most often circumscribed to the use of ICT for the development of general government. Other important public eService areas, such as eHealth, eTransportation/Infomobility, and eProcurement have received much scantier attention. This implies a limited understanding of the actual and potential impact of new technology on public sector, which is erroneously identified with a single, albeit important, range of services provided by public entities through the web.
Second, current research on eGovernment does account for some heterogeneity, but this is mostly captured at the national level, while subnational differences are more rarely considered, mainly due to lack of reliable evidence. Once again, this is an important limitation, as substantial sources of heterogeneity at the local, and particularly at the city level, are not considered. A key dismal implication is that, based on relatively aggregate data and analyses, public policies tend to be designed at the national levels, leading to "one for all" recipes that might be inappropriate for different areas within countries, and eventually lead to wasteful and ineffective allocation of resources for the development of digital society.
Third and related to the limitations mentioned above, quantitative analyses have mainly identified factors associated with new service development, which can be measured at the national level. Hence, most empirical research largely fails to capture a wide array of subnational level characteristics affecting, or correlated with, this phenomenon. The relatively high level of aggregation of data on public eService thus impedes to exploit the increasing availability of rich and detailed statistical information on regions and cities wherein such services are deployed and used, significantly reducing the interpretive power of empirical analyses.
As we shall illustrate in details, there has been a proliferation of studies partially addressing these limitations, but to the best of our knowledge, there is no work tackling them all together. Some works have extended the subnational detail of analysis, even reaching the municipality level of analysis; but this at the expenses of the variety either of eServices covered, or of comparability across countries. Other research streams have increased the coverage of services but normally focusing on single countries due to the lack of comparable data sources.
This paper contributes to jointly filling the three gaps we have just mentioned. In fact, it relies on a unique dataset (the EIBURS-TAIPS database) that offers a detailed quantitative evidence on web-based services availability for 15 EU member countries in 2013, at the local level and across different public eService categories. This dataset is combined with Eurostat Cities Database (formerly Urban Audit) that provides information on structural and socio-economic characteristics of municipalities wherein the observed public eServices are offered.
From a methodological point of view, we compute a Composite Indicator that allows capturing the level of public eService availability for each individual service category and for the whole set of examined eServices at the national and subnational level. Furthermore, a principal component analysis is used to identify a set of variables that are associated with the development of public eServices, and cluster analysis is carried out to single out groups of homogeneous cities responsible for different levels of public eService development.

The structure of the paper is the following. Section 2 briefly surveys extant empirical literature on public eService diffusion to highlight better the state of the art and research gaps in the field. Section 3 presents the data and the methodology adopted to compute the CI index. Section 4 illustrates the evidence on public eService diffusion based on the CI index at national and municipal level, and highlights structural and socio-economic characteristics of EU municipalities that are associated with such diffusion. Section 5 concludes.

2. Background empirical literature

Extant empirical literature on public services appears to be characterised by two main drawbacks: (a) low coverage of public eService categories other than eGovernment; (b) low albeit increasing level of geographical disaggregation of data on the diffusion of public eServices.

As far as service variety is concerned, empirical research in this field has mainly concentrated its attention on the diffusion of eGovernment strictly identified with digitalized general government services (Sá et al., 2016; Yildiz, 2007; Heeks & Bailur, 2007). This *per se* corresponds to a narrow definition on the concept of eGovernment, which has prevailed in empirical and conceptual studies (Zhang et al., 2014; Arduini & Zanfei 2014; Bannister & Connolly, 2015)[1]. Other service categories have been largely disregarded or included as a minor subset of eGovernment activities as in the case of the Capgemini monitoring of public eServices since 2001 and the proliferation of studies on eProcurement (Huntgeburth et al., 2012; Cattaneo et al., 2013; Nurmandi & Sunhyuk, 2015). By contrast, the consideration of other eServices is scantier, as in the case of Infomobility (Yatskiv et al., 2013), and of eHealth (Hyppönen et al., 2013).

These studies generally focus on country level data with limited or no subnational details.

Comparative studies on different categories of public eServices as well as subnational details are normally circumscribed to individual countries. See for example Homburg (2013) for the diffusion of personalized eservices in Netherlands; Reggi et al. (2014) for an analysis of regional performance in the diffusion of four categories of public eServices in Italy; Reddick (2004, 2009) for eService availability in US municipalities; Gilbert et al. (2004) for the case of British municipalities, Engström, et al. (2009) for Swedish municipalities; Huntgeburth et al. (2012) for German municipalities. Indeed, there have been attempts to overcome both limitations – low coverage of service variety and low geographical details – yielding some interesting, although not easily comparable, results. Bertelsmann Foundation (2002) proposed a balanced eGovernment index on three service categories: eDemocracy, eAdministration and eServices, contemporarily analysed in the US, Canada and Europe at both national and local level. However, this attempt is based on information collected through case studies (60 online portals) and illustrates best practices rather than the general state of affairs.

Since 2003, the National Center for Public Performance at Rutgers University has provided a worldwide comparative analysis at the municipal level (Holzer & Manoharan, 2016). The delivery of eServices, citizen participation, together with the degree of security and usability are assessed through the evaluation of the largest cities websites (around 80) of the 98 countries ranked highest in the percentage of internet user. While this study provides a very rich set of longitudinal data on internet based public governance, its main use has been to

[1] The World Bank adopts a broader definition of eGovernment as the use by the government of information technologies (such as Wide Area Networks, the Internet and mobile computing) for different ends: "better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management". Accordingly, eGovernment would cover mainly three dimensions (Mahmood, 2013, p.103): eDemocracy, eAdministration and eServices.

construct a ranking of the top urban and metropolitan areas in the world, which largely coincide with capital cities. Unfortunately, this data source offers very limited details on the nature and characteristics of services provided through their official websites.
Pina et al., (2007) produce a benchmark to examine internet usage in the governance of sub national institutions- at the regional and local level- for 15 EU countries. Through a website analysis, transparency, interactivity, usability and website maturity are assessed for 319 entities, but the focus is exclusively on eGovernment.
European Commission promoted surveys allow to compare the availability of public eServices that loosely relate to eGovernment, including public procurement, with some limited subnational focus and with details on the degree of sophistication in their provision (Capgemini, 2012). While these surveys do provide valuable information on the relative position of countries in eService delivery, they shed very little light on the socio-economic conditions underlying the diffusion of these services.
A few surveys do provide broad pictures of both demand and supply-side characteristics affecting eService diffusion at the country level. This is for instance the case of analyses carried out on a regular basis by Brown University[2] since 2000, which have offered a ranking of 198 countries based on eGovernment performance according to information availability, number and types of services delivered, and access rates by different categories of users. In a similar vein, Accenture[3], since 2001, has been scrutinizing 22 countries (distributed in North America, Europe and Asia), accompanying the assessment of online service availability with indicators of service sophistication, and of citizens' participation and satisfaction.
Nevertheless, while these studies do offer sweeping overviews of global patterns of public eService delivery and of the structural conditions favouring or impeding their diffusion at the national level, they can hardly capture diversities within countries and the variety of services offered.
In summary, empirical research has more and more extensively assessed the development of digitalised services by public administrations. However, the more data are comparable across countries, the less the details on services delivered and on subnational patterns of diffusion. Quite symmetrically, in-depth analyses of web-based service provision and of the socio-economic conditions underlying their diffusion can hardly be conducted in comparative terms. The ensuing empirical analysis is an attempt to overcome this trade-off that has so far impeded to capture the heterogeneity of this phenomenon, shedding more light on the national and subnational patterns of digital innovation diffusion without missing details in the variety of public eServices provided.

3. Data and methodology

This study combines the EIBURS-TAIPS Dataset (University of Urbino, Italy) on public eServices available in the largest municipalities of EU15 member countries, with Cities (formerly Urban Audit) Dataset produced by Eurostat on structural and socioeconomic characteristics of the top cities in Europe.
The former dataset measures the degree of implementation and sophistication of public internet based services identified by exploring the websites of local governments in 2013. It covers four service categories (see Table A1-A4): Infomobility, eHealth, eProcurement and eGovernment characterised according to standard classification methodologies adopted in previous surveys conducted on these service categories.
As for *eGovernment* we rely on the methodology used to conduct EU eGovernment surveys. This yearly basis survey, started in 2001, takes into account 20 public services, delivered by

[2] http://www.insidepolitics.org/egovtdata.html
[3] https://www.accenture.com/us-en/insights/public-service/government-as-a-platform

the general government. By considering a standard taxonomy of municipal functions, we consider a subsample of nine services (see Table A.1) targeted to both individuals and enterprises[4]. Following Capgemini et al (2010a), the availability (online presence) and the sophistication level (using a 4/5-stage model)[5], specific for each service (see Table B.1), are analyzed.

Following the methodology introduced by Deloitte & Ipsos Belgium (2011), we extend the coverage of our analysis to a key service area only marginally covered by surveys on eGovernment, i.e. the health service domain, whose importance is growing given the aging of European population. In particular, we measure and explain levels of availability of eHealth applications and services in public hospitals via 8 out of the 13 original indicators (Table A.2.) covering three main fields: electronic health records, health information exchange, teleHealth[6]. Differently from the Deloitte & Ipsos Belgium approach we focus on public general hospitals (excluding specialized clinics) and we collect the data by means of manual web surfing (and not through Computer Aided Telephone Interviewing).

In line with the EU emphasis on sustainable development, we also cover *Infomobility* services and extend the approach adopted by DigitPA et al. (2011), for Italian main cities. Data are collected on digitalization of services supplied by public transportation carriers to their end users as well as web-based services offered by public entities to users of private transportation systems (Table A.1).

A further service category taken into account is *eProcurement* here treated as a separate bundle of public sector activities, different from Capgemini et al. (2010a) which has traditionally considered this service domain as a subset of eGovernment. Three main aspects are scrutinized (Table A.3.): the level of visibility, the pre-award services (eNotification, eSubmission, eAwarding) and post-award services (eOrdering, eInvoicing and ePayment).

As a geographical unit of observation, we identify a sample of 229[7] cities in EU15 member states, representing a subset of 322 cities monitored by Eurostat Cities (formerly Urban Audit) Database. In the case of eHealth the sample size exceeds 229, and data are collected for a total of 274 public hospitals. In fact, three public hospitals instead of one are observed for capital cities in each country[8].

4. eServices: an index to measure public sector performance at the municipality level

To provide a ranking of European municipalities, based on public eService development across different domains, following Reggi et al. (2014), a synthetic indicator of public eService development is proposed. This is calculated as the average performance of each city in the four service domains (eGovernment, eHealth, Infomobility and eProcurement).

The availability is expressed as a dummy (1 when the service is delivered, 0 otherwise) and quality of eServices provided is expressed as weights increasing with quality indicators as

[4] Differences in the distribution of powers among government levels do not assure that all nine services are provided at the municipal level in all countries.

[5] The five stages considered are: information, one-way interaction, two-way interaction, transaction, and targetization. The fourth and fifth levels can be considered expressions of a full development of the service online.

[6] Given our focus on services, the other five indicators originally monitored by the Deloitte&Ipsos survey are neglected as they mainly refer to infrastructural aspects.

[7] The sample is consistent with the overall statistical representiveness criteria adopted by Eurostat to carry out data collection for the Cities Dataset: 1- the coverage of approximately 20% of the national population, 2-correspondence with geographic distribution within the country (peripheral, central) and 3-correspondence with the size distribution of cities within the country(both medium and large sized towns)

[8] For capital cities, given the high numbers of hospitals, the selection is based, on the "World Hospitals' ranking on the Web" (http://hospitals.webometrics.info/en/Methodology)

specified below. For each service domain, an index is computed as a normalized weighted average of the services considered, to ensure the comparability of the scores of each city across the four domains. Specific weights are assigned to position services under observation in the quality scale[9]. In particular, each service included in the eGovernment category is evaluated according to its level of "sophistication" (0, 1, 2, 3, 4 or 5, where 0 equals to no interactivity and 5 equals the highest interactivity) assuming that each quality level is associated to a 20% incremental weight. Equal weights are used for eProcurement, where the three phases analyzed participate by one third each to final average. Multiple correspondence analysis, especially suited for categorical variables (Asselin, 2009), is used to compute the eHealth index. Non-linear principal component analysis is used for the two sub-indexes: Public informed mobility and Private informed mobility and the Infomobility index is then obtained as the result of the average of the two aforementioned components.

*3.1 Heterogeneity across and within countries: a comparison based on a synthetic index***.**
A high degree of heterogeneity can be observed when looking at the diffusion of eServices in Europe. Here the Composite Indicator is calculated for all eService categories, as a mean of all weighted scores of municipalities aggregated at the country level for each of the EU15 member states (see Table 1)

Table 1 eServices diffusion in EU macro regions

	Overall Index	*eGovernment*	*Infomobility*	*eHealth*	*eProcurement*
Northern countries	**0,62**	**0,76**	**0,58**	**0,35**	**0,78**
IE	0,56	0,68	0,53	0,16	0,88
UK	0,62	0,82	0,48	0,42	0,75
SE	0,70	0,88	0,77	0,32	0,83
DK	0,80	0,77	0,71	0,79	0,91
FI	0,42	0,65	0,44	0,08	0,53
Central countries	**0,48**	**0,59**	**0,57**	**0,12**	**0,66**
BE	0,38	0,49	0,65	0,13	0,27
FR	0,47	0,47	0,43	0,16	0,80
AT	0,49	0,56	0,55	0,20	0,65
LU	0,56	0,60	0,74	0,00	0,88
DE	0,44	0,49	0,62	0,06	0,59
NL	0,57	0,91	0,44	0,16	0,75
South countries	**0,36**	**0,50**	**0,30**	**0,14**	**0,51**
EL	0,21	0,29	0,23	0,09	0,23
ES	0,45	0,74	0,37	0,15	0,52
IT	0,40	0,61	0,36	0,16	0,49
PT	0,39	0,36	0,27	0,14	0,80
EU15	**0.48**	**0,62**	**0,47**	**0,19**	**0,64**

Source: Authors' elaborations on EIBURS-TAIPS Dataset

[9] Proxies of service quality are used for eGovernment, in terms of interactivity levels (table B.1), and in terms of presence or absence of specific service features or phases in the cases of Infomobility and eProcurement (table B.2). Quality levels are not measured in the case of eHealth as a hierarchy across services is not generally acknowledged in this service domain.

The standard core-periphery hierarchy is confirmed in the public eService domain. Northern countries exhibit the highest level of eService development, generally scoring higher than the EU15 average (0.48), with the only exception of Finland (0.42). There is indeed a high variability within this group of countries as well, with Denmark (0.8) and Sweden (0.7) performing much better than the UK (0.62), Ireland (0.56), and of course Finland (0.42). Mediterranean countries instead systematically score below the EU15 average (Greece: 0.21; Portugal: 0.39; Italy: 0.40; Spain: 0.45), with a substantial difference between the lower bound represented by Greece and partially by Portugal, and better performing countries (Italy and Spain) with the latter exhibiting an eService diffusion rate closer to EU15 average. Central European countries score in between the two other groups of EU member states, some performing above the EU15 average (Austria: 0.49; Luxembourg: 0.56 and Netherland: 0.57) and some slightly below (Germany 0.44 and France: 0.47).

In particular, by replicating the analysis for each single eService category, the panorama becomes even more articulated. While Sweden and Denmark are best performers in almost all services, United Kingdom, although always above the EU15 average figures, is less performing in eProcurement and Infomobility.

Among the Northern countries, the profile of the weakest countries, Ireland and Finland, is quite variegated. Ireland, in fact, with 3 out of 4 services, above the EU average, is particularly well performing in eProcurement, while Finland, with only one service (eGovernment) above the EU average, is among the worst performing in eHealth.

Among the Mediterranean countries, generally characterized by a poor performance in most eServices, Spain and Portugal show excellent values of the index respectively in eGovernment (Spain: 0.74) and eProcurement (Portugal: 0.8).

Central European countries also exhibit quite heterogeneous patterns of specialisation. Indeed, if the Netherlands is the absolute best performer among European countries in the eGovernment domain (0.9), Luxembourg is among the best performers in the domains of Infomobility and eProcurement.

In general, data on the four eService domains confirm a large diffusion of eProcurement (0.64) and eGovernment (0.62), followed by Infomobility (0.47). This result is interesting as it supports the idea that eServices are more diffused in the domains in which the influence of national policy is more substantial.

Table 2 sheds some further light on the heterogeneous patterns of eService development in Europe, by highlighting the variance in eService availability within countries (i.e. across cities belonging to the same country) and between countries (i.e. across countries whose eService availability is obtained by aggregating data collected at the city level). The dispersion is on average not very high within countries (0.01 when all EU15 countries are considered) and it is lower than between countries (0.02). The low variability within EU15 countries (considered on average) partly reflects the fact that, very small cities are excluded from the Eurostat Cities (formerly Urban Audit) database. By disregarding small cities and towns, heterogeneity within countries is substantially reduced especially in the case of those countries in which the share of national population in small size municipalities is particularly high.

Nevertheless, substantial differences emerge when specific countries and specific services are considered.

Table 2 Variances: Between and within

	eGovernment	eProcurement	eHealth	Infomobility	Index
Within Variance					
AT	0,01	0,05	0,08	0,01	0,01
BE	0,00	0,02	0,05	0,05	0,01
DE	0,01	0,04	0,02	0,04	0,01
DK	0,00	0,01	0,00	0,06	0,00
EL	0,02	0,03	0,01	0,02	0,00
ES	0,03	0,02	0,04	0,03	0,01
FI	0,03	0,05	0,01	0,03	0,01
FR	0,02	0,02	0,03	0,04	0,01
IE	0,01	0,00	0,05	0,00	0,00
IT	0,03	0,02	0,06	0,06	0,02
LU	0,00	0,00	0,00	0,00	
NL	0,00	0,03	0,03	0,03	0,01
PT	0,01	0,05	0,03	0,01	0,01
SE	0,00	0,01	0,13	0,01	0,01
UK	0,03	0,04	0,08	0,02	0,02
Average Within Variance					
EU15 average	0,01	0,03	0,05	0,03	0,01
Between Variance					
	0,03	0,05	0,04	0,03	0,02

Source: Authors' elaborations on EIBURS-TAIPS Dataset

First, *on average* within country dispersion is much higher in some EU member states than in others, with Italy and the UK exhibiting the highest within country heterogeneity, while Denmark and Greece exhibit the lowest dispersion. Second, the within country dispersion is very high for some services, as in the case of eProcurement and eHealth, while it is relatively tiny in the case of eGovernment. The latter result is consistent with the fact that eGovernment has a relatively longer history of implementation, best practices have by now diffused across countries, and most cities have by now moved in the direction of providing at least part of their general government activities online. This finding further reinforces our argument that focusing only (or mainly) on eGovernment, disregarding other eService domains, does not permit to capture a very substantial part of heterogeneity both across and within countries.

4.2 Municipalities: a comparison across homogenous clusters

Spatial correlation and heterogeneity (within and between countries) introduce substantial complexities in comparative analysis. The solution proposed here is a three-step approach:

1. to identify few "summary variables" (components) that can be held to be representative of different aspects of municipalities, drawing data from Eurostat Cities (formerly Urban Audit), by using principal component analysis (PCA);
2. to identify the clusters of municipalities based on the components mentioned above;
3. to proceed in making the comparative analysis, based on the availability and sophistication of eServices, at cluster level.

The aim of this procedure is to identify homogenous groups of European cities, regardless of the country they belong to, and to check how such clusters are characterised in terms of

eService availability. Then after having pointed out the cluster of best performers, their structural and socio-economic variables allow to understand better the determinants of eServices development

4.2.1 First step: identification of the variables for the PCA

To investigate differences in eService availability across clusters of comparable cities, we proceed to identify specific features according to which municipalities can be grouped. We particularly focus on distinctive characteristics of cities discussed in two main strands of literature, which have addressed respectively: 1- the adoption of innovation and, in particular, of public innovation at the city level (Simon&Nardinelli, 2002; Kankanhalli et al., 2017; Bianchi et al., 2018); 2- urban growth and urban smartness (Caragliu & Del Bo, 2012; Caragliu et al. 2011).

Drawing from these streams of contributions and relying on the available data (Eurostat Cities, formerly Urban Audit Database), we consider variables reflecting the following five main municipal aspects: the size and density of urban areas, their industrial structure, their financial and human capital endowments, social constraints and facilitators to (digital) innovation, and infrastructural development.

As for the *size and density of Municipalities*, we consider the *Number of inhabitants* in a given municipality and *Total resident population by square km*. These indicators may well capture factors affecting innovation on both the demand and the supply side. On the demand side, large cities are likely to be characterised by stronger pressures from well-organised users of new technology and services (Ho & Ni, 2004). This is especially true when geographic concentration of population can favour information leakages and imitation among users, influence their collective behaviour, and facilitate large-scale adoption of innovation (Choudrie et al., 2005). On the supply side, the size of the municipality is associated with greater endowments of skills and capacities on the supply side (Norris & Moon, 2005). The larger the municipalities, the larger the availability of resources for innovation projects, hence the greater the likelihood that large-scale innovation is undertaken.

The most credited factor positively affecting innovation based on the Schumpeterian legacy is then *Industrial structure*. A potentially relevant, albeit rough, indicator in this respect is represented the *Number of active firms*. More qualitative indicators of the composition of manufacturing and service activities in the local economy are also included: *Number of persons employed in provision of ICT services*, *Share of employment in financial and business services* -NACE Rev.1.1 J-K. An indirect measure of how advanced industry structure is might be represented by the attention paid by the municipality to environmental issues, proxied by *Annual amount of solid waste (domestic and commercial) that is recycled*. This indicator helps capture how "green" the culture of a local production system is, which is inter alia one of the alleged key elements of "city smartness", and can be expected to positively affect innovation.

Then, we use the *Gross Domestic Product per inhabitant* in PPS as a proxy of *Financial resources* and the Share of qualified workers (*working age population qualified at level 5 or 6 ISCED*), and the Share of low educated population (*Persons aged 25-64 with ISCED level 01 or 02 as the highest level of education*) as different socio-economic indicators of the composition of working population, representative of *Human capital at the municipality level*. Indeed, the literature supports the idea that a poor budget[10] and unskilled citizens[11], translate into low quality users and suppliers of services, and this may impede or slow down

[10] See in particular Moon et al. (January 2005); Singh et al. (2007); WEF (2011).

[11] According to Wood (2006), higher skilled population, especially if involved in knowledge-intensive services, can be expected to positively affect urban performance, being able to create new knowledge and to use more creatively existing technology.

the innovation process and constrain urban growth (Azad et al., 2010; Berry & Glaser, 2005; Simon & Nardinelli, 2002).
We also consider some variables capturing the *Social constraints and facilitators to (digital) innovation*, that are the core of digital divide: the share of elderly population (*Persons over 65*) and the unemployed working age people (*Unemployment rate*). These indicators of course complement (on the negative side) measures of financial and human capital and of the composition of manufacturing and service industry. Among the potential facilitators of innovation, the literature on Smart cities has emphasised the role of participation to local democratic processes, here proxied by the *Participation rate at city elections*, and by the *Number of female elected as city representatives*, which can be expected to have some impact to innovation in decision-making and governance.
Finally, measures of *Infrastructural development* are introduced, including indicators such as the *Length of public transport network/land area* and the *Percentage of households with Internet* (Caragliu & Del Bo, 2012). Infrastructural development plays a leading role both in the literature on urban and regional growth (particularly the first variable) and in the one on eGovernment diffusion and adoption (UN Public Administration Programme, 2010). A relatively "soft" component of infrastructural development is represented by tourist accommodation capacity, as measured by *Total annual tourist overnight stays in registered accommodation.* The touristic capacity of a municipality contributes to the attractiveness of human capital and affects urban performance (Rosentraub & Joo, 2009; Narayan et al., 2010).

A principal component analysis, computed on the aforementioned variables, is then applied. The usual preliminary check of the relation cases to variables[12] (at least 5 to 1) and the existence of substantial correlations (positive and higher than 0.3) among the variables have been considered. We proceed through several rounds in deleting variables either if they do not respect the KMO Measure of Sampling Adequacy for each variable[13] (> 0.5), or if they show a low communality[14] or if their factor loadings reveal a complex structure[15]. At the end of this process, 5 variables and 164 observations remain. A single component (eigenvalues greater than 1.0), explaining 85.5% of the total variance is then extracted. The significance of the Bartlett Test and the sample adequacy with the KMO test (equal to 0.83) assure the correctness of the process. We repeat then the analysis by splitting the sample randomly into two halves and computing the principal component analysis in each half again. The validation process confirms the results previously presented. Although we observe the presence of outliers[16] (cases with a factor score larger than ±3.0), they do not affect the results obtained. Indeed, the PCA, computed by excluding those cases, confirms the pattern of communalities and the factor loadings found for the full dataset.
The PCA helps identify the key variables associated with public eService development, factors that were expected in the literature to positively affect innovation, such as: the size of municipalities (Population), the activity rate of manufacturing and service industries (Number of companies), and our (rough) indicator of attractiveness of the local area (Tourists

[12] At this stage, it was necessary to drop the variables, which cause the largest loss of observations: public transport networks and solid waste recycling. In this way, the number of total observations is 88 with a ratio case variable equal to 11.
[13] Working age population qualified at level 5 or 6 ISCED, proportion of local companies producing ICT, and unemployment rate are the variables dropped because the score on the anti-image correlations was too low.
[14] Communalities represent the proportion of the variance in the original variables that is accounted for by the factor solution. In the case of *Proportion of employment in financial services*, the factor solution explains only 0.047 of the original variable variance in respect of the optimum represented by at least half of each original variable's variance.
[15] Density has high loadings or correlations (0.40 or greater) on more than one component.
[16] Paris, Berlin, Rome and Madrid represent the outliers in our sample.

overnight); as well as some clear inhibitors of (digital) innovation, such as the share of elderly population (Over 65) and of low qualified working age population (ISCED level 0, 1 or 2)

4.2.2 Clusters identification

As our primary target is to find homogenous groups of municipalities, based on the factor score, we use cluster analysis to identify groups of municipalities highly similar within each group but contemporarily highly dissimilar across clusters. We compare then the results coming from a hierarchical[17] and non-hierarchical (k-means) clustering method. By adopting the Calinksi and Harabasz index[18] (and the Duda and Hart index for the hierarchical method), as formal stopping rule, we observe that both rules point to 7 groups as the best clustering for the two methods[19]. We then proceed by observing the results of the two methods. Although the partition is not completely different, the hierarchical method generates clusters quite disproportionate in size[20], so we adopt the K-means partition. In general, the seven groups show different sizes. We consider the factor score as a measure of development, with score increasing with improvements in the combination of innovation enhancers (e.g. industry structure, municipality size and area attractiveness) with innovation inhibitors (e.g. elderly people and low qualified working age population). From this perspective, we observe a progressive increase from cluster 1, representing the medium size, less industrialized, with less educated population and poor municipalities, to Cluster 7, collecting mainly the biggest European capitals.

We then proceeded to characterise each of the 7 clusters in terms of public eService performance, measured in terms of our composite indicator computed as described in section 4.1. Contrary to the expectations, the highest score regarding eService diffusion is reached by cluster 6 and not by cluster 7. In other words, eService development does increase when moving from clusters at the lower bound towards the upper bound, but this occurs in a non-linear way. Indeed, the average eService index by clusters (see Fig.1) increases from the bottom level to upper clusters, identified by an increasing development/social complexity (factor score), it reaches its maximum in cluster 6 and soon diminishes thereafter.

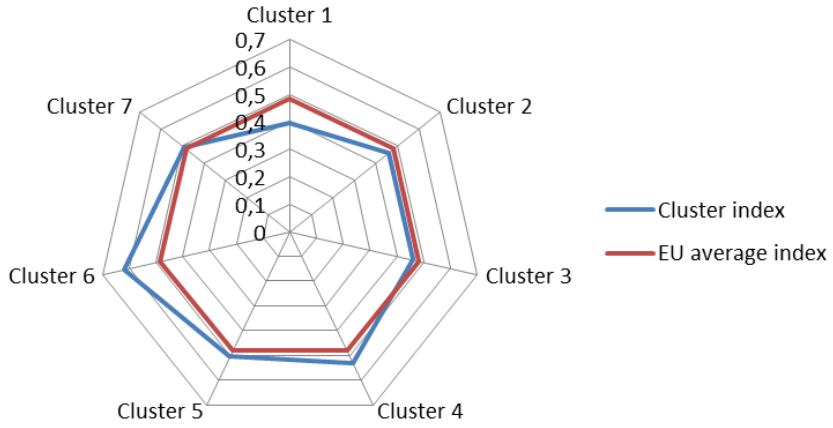

Fig.1 eService index: comparing clusters

[17] In this case, it is assumed the Euclidean distance, as a similarity measure, and the average linkage, as agglomeration method. According to Everitt et al. (2001) this method, as confirmed by many simulation studies, would be reasonably robust and less affected by problems that hamper other methods like chaining, sensitivity to outliers, reversal points.

[18] Two of the best stopping rules, see also Milligan and Cooper (1985).

[19] Results are available at request.

[20] Hierarchical size groups: 103, 37, 11, 5, 4, 2, 2. Kmean size groups: 54, 23, 16, 4, 4, 46, 17.

(*Source: Authors' elaborations on EIBURS-TAIPS Dataset and on Eurostat Cities Database)*

It thus appears that the combination of factors characterising cluster 7, albeit consistent with an overall socio-economic and innovation performance that is the highest in EU15, does not guarantee a top performance in terms of public eService development.
Looking at the value of indicators characterizing clusters 6 and 7 (see Table 3), one may venture saying that perhaps the most important distinctive feature that helps explain their different performances in terms of eServices is indeed the quality of human capital, that appears to be higher in the case of cluster 6 than in cluster 7. Another striking difference is the average size of cities, which is much higher in the case of cluster 7. Given that the level of financial resources appears to be quite similar in the two cases, a much larger size of cities in cluster 7 might be interpreted as a signal of greater complexity and higher coordination costs, which are dealt with relatively limited resources, possibly hindering the development of effective eServices.

Table 3 Differences among cluster 6 and 7

	Social constraint (% of pop. above 65)	Infrastructural development (Tourists overnight)	Financial resources (GDP in pps)	Industrial structure (no. companies)	Demographic aspects (Total population)	Human capital (%of pop. with ISCED 0-2)
Cluster 6	19.6%	8,825,767.8	39,275.0	106,977.5	1,600,688.8	20.4%
Cluster 7	18.6%	21,668,455.0	41,675.0	216,909.2	2,925,866.0	18.8%

(*Source: Authors' elaborations on Eurostat Cities Database)*

4.2.3. Services index: a cluster analysis

Digging inside each cluster, we immediately notice that while eService performance is on average the lowest in Cluster 1 (0,4 as compared to higher scores in the case of the other clusters, and an average score of 0.5 for EU15, see Fig. 2) the heterogeneity is highest within this cluster. Indeed, Cluster 1 collects both the worst absolute performer (Volos) and the best absolute performer in Europe (Umeå). Twelve municipalities out of the 54 in this cluster exhibit an index larger than the EU15 average, and these are located in NL(6), SE(3) and UK (2) and one of them is a capital city (Luxembourg city), with an index larger than the EU15 average and cluster average. All the other municipalities, mainly coming from Mediterranean countries (IT: 10; ES: 3; EL: 6; PT: 4), have very poor performances.
On the other side of the clusters spectrum, Cluster 7 (Fig.3) includes a much lower number of cities whose performance in terms of eServices is indeed quite similar.
The cluster gathers the main European capitals (Rome, Berlin, Paris, and Madrid) [21].
They certainly benefit from their position as capital cities of highly developed countries, at least in terms of most indicators of socio-economic performance in general, but they perform much lower in terms of public eServices. Berlin appears as the most advanced (0.55), closely

[21] London, Helsinki, København and Dublin are lost during the PCA process either because of several missing in the considered variables or because of the absence of a right reference in Cities. This said, if they are considered as a separate cluster, all show index figures above the EU-15 average. In particular, København (0.86) and London (0.79) are really advanced.

followed by Rome (0.54) while Madrid is the lowest performer (0.40), with an index below the EU-15 average and the average cluster (0.49).

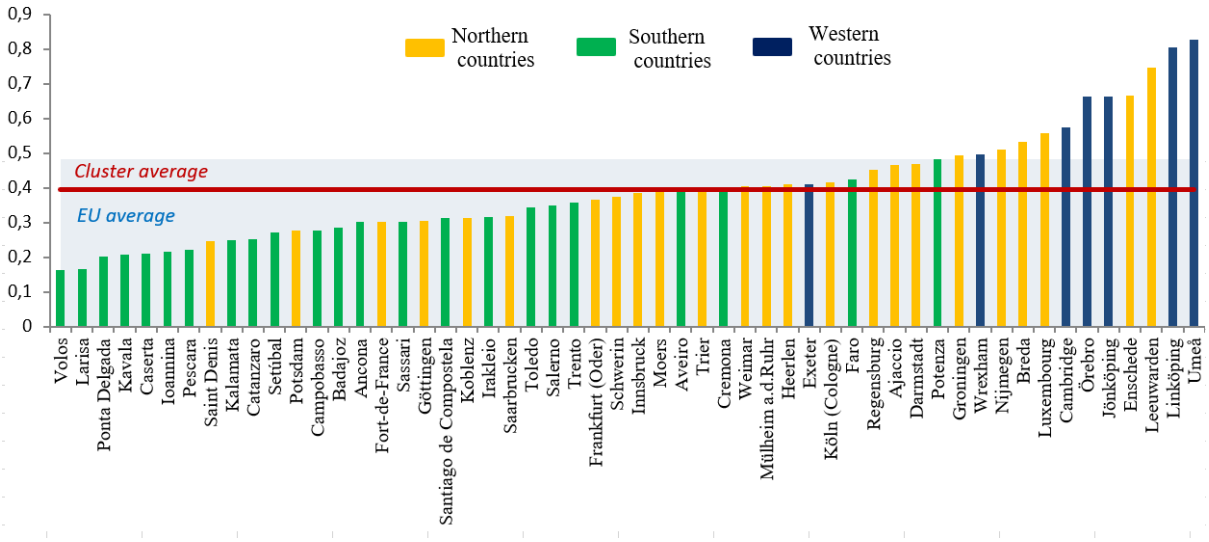

Fig 2 eServices index distribution: Cluster 1
(*Source: Authors' elaborations on EIBURS-TAIPS Dataset and on Eurostat Cities Database)*

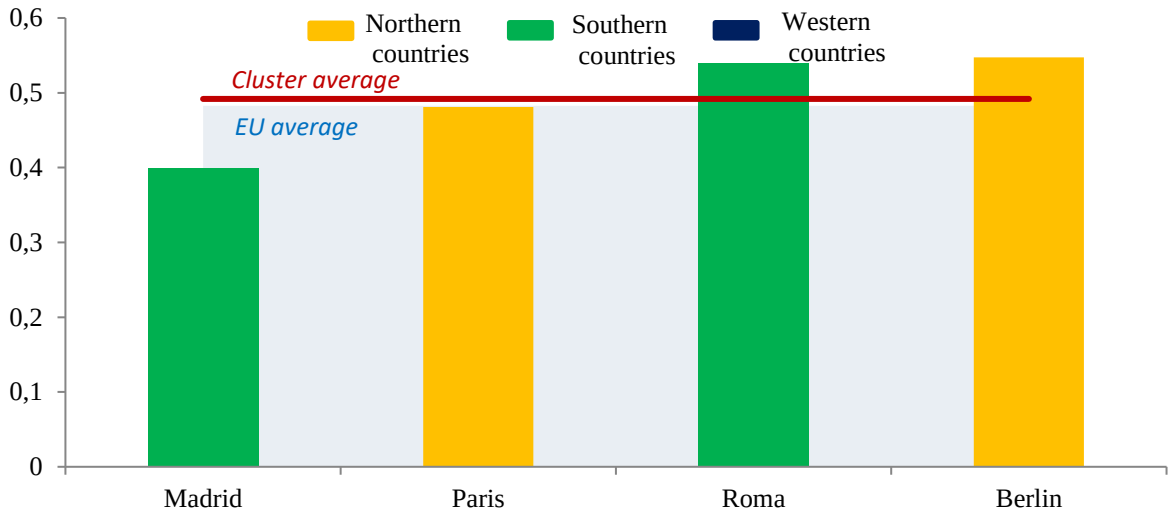

Fig 3 eServices index distribution: Cluster 7
(*Source: Authors' elaborations on EIBURS-TAIPS Dataset and on Eurostat Cities Database)*

The other European capitals are distributed between cluster 5 (Fig. 4) and 6 (Fig. 5). In both cases, they are not the best performers in their groups, and they show performance mostly above the EU average (except Athina: 0.29) and above their cluster average (except Bruxelles in cluster 5 and Wien in Cluster 6). The best performers of these two clusters are instead Milan (0.73) in Cluster 6 and Birmingham (0.70) in Cluster 5. Hambourg and Palermo (0.26) are instead the correspondent lowest performers. Cluster 6 is the only one with all municipalities with an index above the EU average.
Cluster 2, 3 and 4 (Fig. 6-8) represent respectively the most industrialized among the medium-size municipalities, the poorest and the richest among the large municipalities.

While the first two clusters are characterized by average indexes lower than the EU average, cluster 4, exhibits the second highest average index with 60% of its municipalities (10 out of 17).

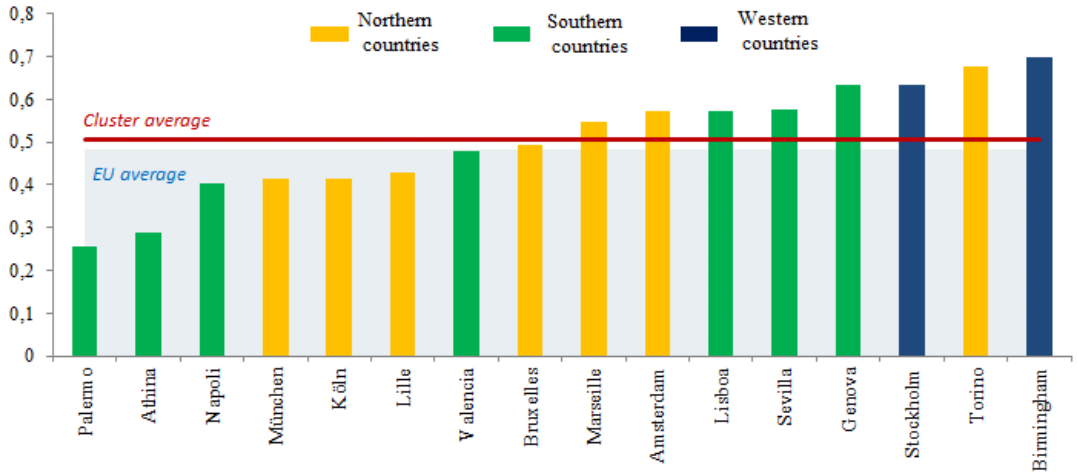

Fig.4 eServices index distribution: Cluster 5

(*Source: Authors' elaborations on EIBURS-TAIPS Dataset and on Eurostat Cities Database)*

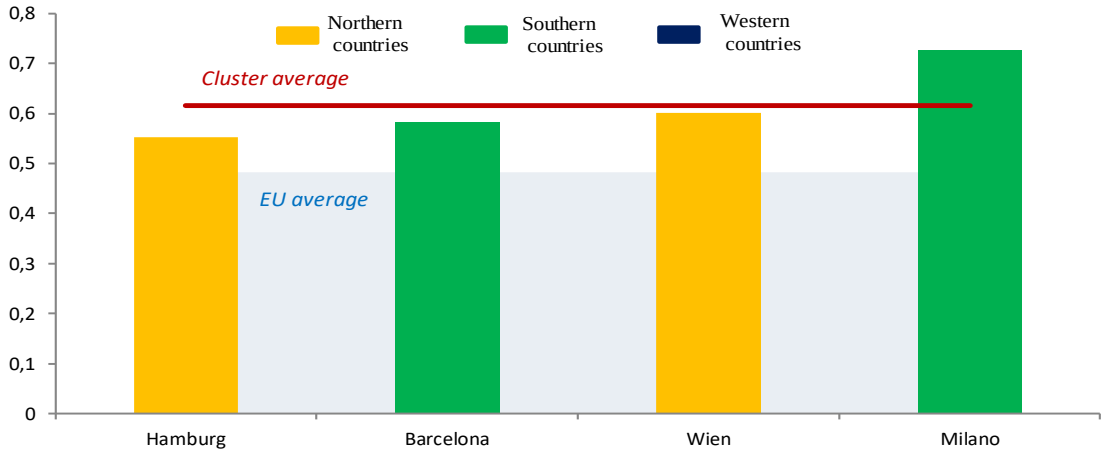

Fig.5 eServices index distribution: Cluster 6

(*Source: Authors' elaborations on EIBURS-TAIPS Dataset and on Eurostat Cities Database)*

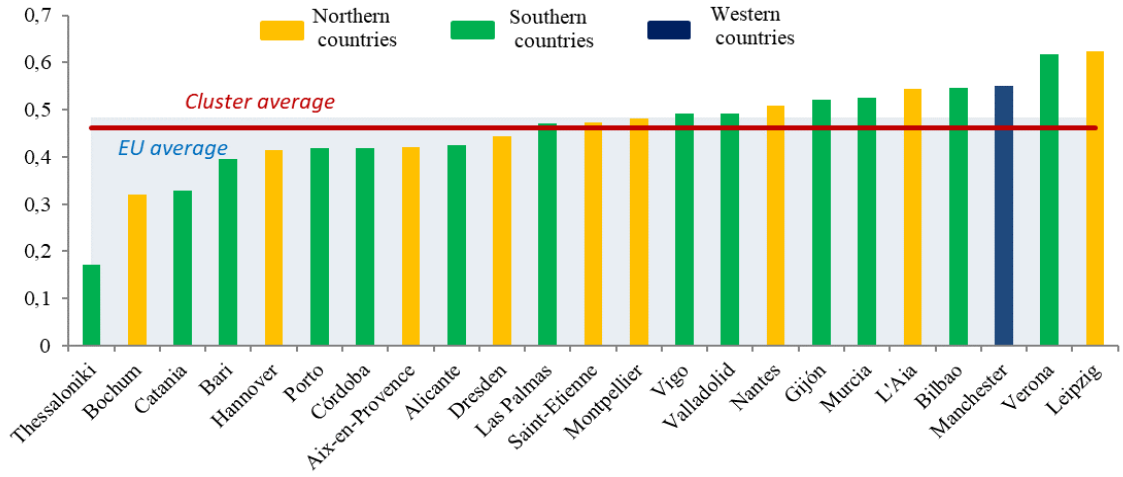

Fig.6 eServices index distribution: Cluster 2
(*Source: Authors' elaborations on EIBURS-TAIPS Dataset and on Eurostat Cities Database)*

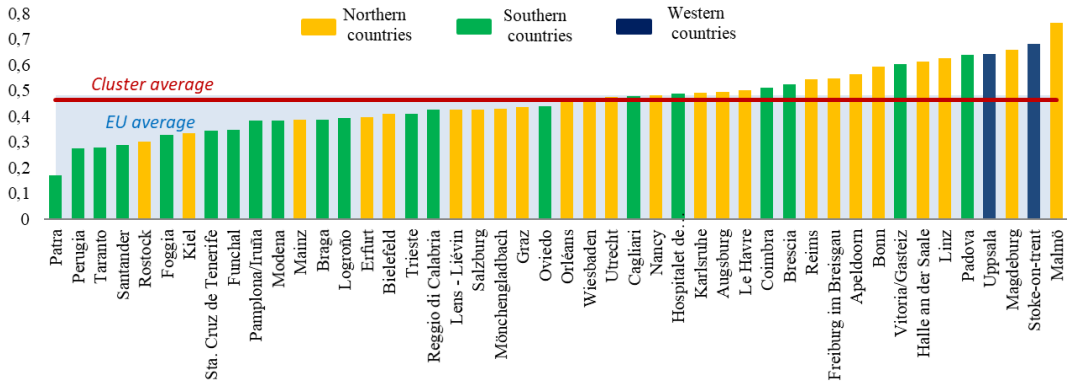

Fig.7 eServices index distribution: Cluster 3
(*Source: Authors' elaborations on EIBURS-TAIPS Dataset and on Eurostat Cities Database)*

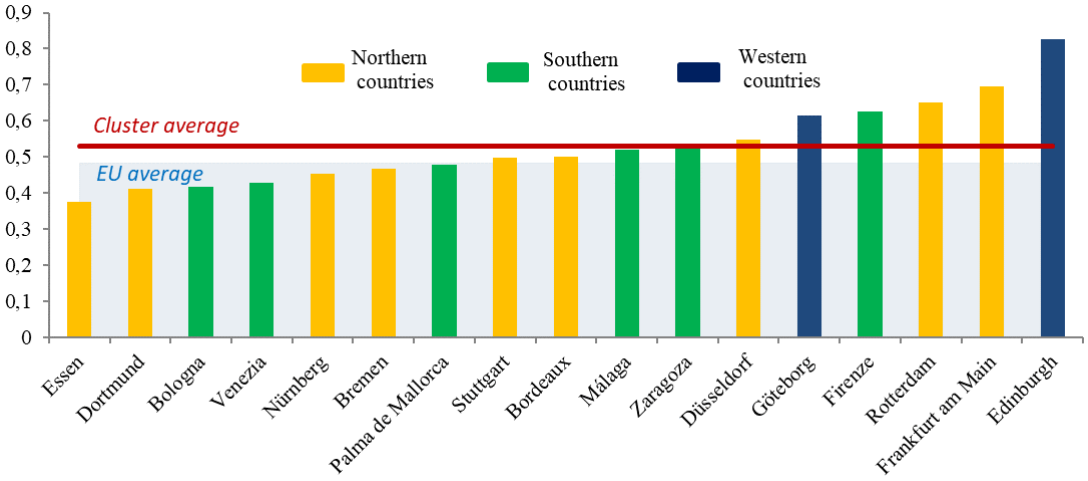

Fig.8 eServices index distribution: Cluster 4
(*Source: Authors' elaborations on EIBURS-TAIPS Dataset and on Eurostat Cities Database)*

5. Conclusions

While an increasing number of studies have produced evidence on the development of new digitalised public services using a variety of methods, comparative analyses across countries are still facing substantial data limitations and are largely based on surveys and benchmarking analyses.

This article expands existing literature extending the coverage of public eServices beyond eGovernment, allowing not only a cross-country but also a cross-municipality comparison at the municipal level in 15 EU member states.

The overall picture of Europe which emerges exhibits some rather usual traits in terms of broad aggregates of nations: Northern countries, although with exceptions, show a much higher rate of diffusion compared to the Mediterranean countries, with Central European member states performing in between.

However, a substantial heterogeneity in the patterns of public eService development can be observed both across and within countries, especially when different service domains are explored. The largest diffusion of eServices can be expected in those categories more under the influence of national policy: eProcurement and eGovernment exhibit the highest diffusion rates, closely followed by Infomobility, while eHealth scores less than one-third of the previous ones. Moreover, the largest share on heterogeneity across and within countries is observed in domains other than eGovernment, where more investments ought to be allocated.

Moving to the municipal perspective and concentrating on clusters of homogenous municipalities, our analysis helps identify the profile of cities that are best performers in this specific area. A roughly sketched identikit of best performing cities includes a medium-large size in terms of population, a high endowment of qualified, well educated and trained human capital, and a lively industrial atmosphere favoured by a reasonable number and variety of production and service activities. By contrast, congestion and coordination problems associated with very large metropolitan areas and overcrowded industrial districts might generate more administrative problems than those that digital technologies may help tackle. For each cluster, a ranking by eService performance is possible and consequently the municipalities, where further improvements are needed, can be detected. Based on this exploratory effort, future research can be undertaken in the direction of further exploring the characteristics of cities that can favour public eService development.

Appendix A. Domain sources and characteristics

Table A.1. ITS/Infomobility (ITIC-Between, 2010)

Unit of analysis	LOCAL PUBLIC TRANSPORT COMPANIES		
Service list			
	Public Informed Mobility	*Online info to users while travelling*	Public transport companies providing online information to users (e.g. waiting times, strikes, delays, failures, etc.)
		Online time table consultation	Public transport companies offering the possibility to consult the online timetable of public transport network
		Online travel planning	Public transport companies offering timetables with route planning (travel planner) on the web
		Online ticket purchase	Public transport companies offering web based payment systems
	Private Informed Mobility		
		Info to car drivers while travelling	Public transport companies providing online information to travelers about traffic or parking
		Electronic road or parking toll	Public transport companies offering a electronic ticketing system of parking spaces

Table A.2. eHealth (Deloitte & Ipsos Belgium, 2011)

Unit of analysis	HOSPITALS	
Service list	*Videoconferencing/ Video consultations between patients and doctors*	Dedicated and formal use of facilities such as consultations between patients (either at home or outside the hospital) and hospital medical staff (for clinical purposes)
	Electronic Patient Records (EPR)	A computer-based patient record system, which contains patient-centric, electronically maintained information about an individual's health status and care. The system allows online access to patients
	e-booking	Electronic appointment booking system
	Online clinical tests	Computer-based system for electronic transmission of results of clinical tests. The system allows online access to patients
	e-referrals	Hospitals offering the possibility to external health actors to make appointments for their patients
	Telemedicine service (tele-homecare/tele-monitoring)	The provision of social care at a distance to a patient in his/her home, supported by means of telecommunications and computerized systems
	Online chronic disease management	Home care services using ICT can contribute to the management of long duration/slow progression diseases
	Online ticket payment	Hospitals offering web based payment systems for visits and clinical tests

Table A.3. eProcurement (Capgemini et al., 2010b)

Unit of analysis	MUNICIPALITY	
	eProcurement Visibility	
	Publication of general information on public procurement	General information on public procurement made available on the municipality websites
	Publication of notices to official electronic	Official electronic board on the municipality

Service list	*notice boards*	websites where procurement notices are made
	Link to e-procurement services	Link to a web page (owned by the municipality or by external parties) providing eProcurement services
	eProcurement (Pre-Award Phase)	
	e-NOTIFICATION	Publication of tenders and procurement notices on the web
	Online registration of supplier	Creation of user accounts and profiles with related roles
	e-mail alerts for suppliers	Possibility for the suppliers to receive email alerts about forthcoming calls and notices of their interests
	e-SUBMISSION	Submission of proposals online
	Assistance services to the supplier	E-mail, chat, audio/videoconferencing communication for Question and Answer sessions between eProcurement operators and bidders
	Online supplier help session	help services to assist suppliers in the preparation of online tender
	e-AWARDS	Publication of awarded contracts
	Online information about awarded contracts	The website publishes the contracts awarded and their winner
	e-auctions	Availability of tools to carry out real-time price competitions
	eProcurement (Post-Award Phase)	
	e-ORDERING	Automatic placement of orders online
	e-catalogues	Online order from e-catalogues through eProcurement website
	Electronic market	Electronic market hosted by the eProcurement website, for online interaction between buyers and suppliers
	e-INVOICING	Delivery of electronic invoices
	e-invoicing service	E-invoicing services managed by the eProcurement website
	e-PAYMENT	Online payment of contracts
	e-payment service	Online payment services, managed by the eProcurement website

Table A.4 eGovernment (Capgemini et al., 2010a)

Unit of analysis	MUNICIPALITY	
Service list	*Online local taxes*	Declaration, payment, notification of assessment
	Online registration school	Standard procedure to register children at kindergarden
	Online registration of residence	Standard procedure to register the residence in a local area of town
	On line payment fines	Standard procedure to pay fines at municipal police office
	Online personal documents	Standard procedure to obtain an international passport and an identity card
	Online public library	Standard procedure to consult the catalogue(s) of a public library to obtain specific information regarding a specific carrier (Book, CD, etc)
	Onlinebirth/marriage certificates	Standard procedure to obtain a birth or marriage certificate
	Online registration of a new company	Standard procedure to start a new company

Appendix B. Services supplied by government level and their sophistication

Table B.1 Sophistication levels by service

SERVICES	Sophistication levels considered
Local taxes	0-1-2-3-4-5
Libraries	0-1-2-3-4-5
Kindergarden registration	0-1-2-3-4
Certificates	0-1-2-3-4
Application for building permission	0-1-2-3-4
REgistration of a new company	0-1-2-3-4
Identity card request	0-1-2-3-5
Fine payment	0-1-4-5
Residence registration	0-1-2-4

Sources: Capgemini et al., (2010a)

Table B.2. Measuring service availability and quality

	QUALITY
eHealth	Not measured
Infomobility	Presence/absence of quality features: multi-channel delivery, advanced functions and applications
eProcurement	Presence/absence of quality features associated with each phase: visibility, pre-award, post-award phases.
eGovernment	Interactivity stages

References

Arduini, D., & Zanfei A. (2014). An overview of scholarly research on public e-services? A meta-analysis of the literature. *Telecommunications Policy, 38(5),* 476–495.

Asselin, L. M. (2009). *Analysis of Multidimensional Poverty: Theory and Case-Studies*. Springer

Azad, B., Faraj, S., & Goh, J. F. (2010). What Shapes Global Diffusion of eGovernment: Comparing the Influence of National Governance Institutions. *Journal of Global Information Management, 18 (2),* 85–104.

Bannister, F., & Connolly, R. (2015). The great theory hunt: Does e-government really have a problem?. *Government Information Quarterly, 32(1),* 1–11.

Berry, C. R., & Glaeser, E. L. (2005). The Divergence of Human Capital Levels across Cities. *Papers in Regional Science, 84(3),* 407–444.

Bertelsmann Foundation (2002). *E-Government–Connecting Efficient Administration and Responsive Democracy*.

Bianchi, A., Marin, G., & Zanfei, A. (2018). New perspectives in public service innovation. In Gallouj, F. & Djellal, F. (Eds.) A research agenda for service innovation (pp. 166–186). Cheltenham: E.Elgar Publishing Co.

Capgemini, Rand Europe, Idc, Sogeti & Dti (2010a). *Method paper 2010 Preparing the 9th Benchmark Measurement*.

Capgemini, Rand Europe, Idc, Sogeti & Dti (2010b). *Digitizing Public Services in Europe:*

Putting ambition into action.
Capgemini (2012). *eGovernment benchmark framework 2012*–2015, *Method paper*.
Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology, 18 (2)*, 65–80.
Caragliu, A., & Del Bo, C. (2012). Smartness and European urban performance: assessing the local impacts of smart urban attributes. *The European Journal of Social Science Research, 25(2)*, 97–113.
Cattaneo G., Lifonti R., Aguzzi S., Bardellini, M., & Sadee, C. (2013). *D2 e-Procurement State of Play Report*.
Choudrie, J., Weerakkody, V., & Jones S. (2005). Realising e-government in the UK: rural and urban challenges. *Journal of Enterprise Information Management, 18 (5)*, 568 – 585.
Deloitte & Ipsos Belgium (2011). *eHealth Benchmarking III, SMART 2009/0022*. (Final Report).
DigitPA, Dipartimento per la digitalizzazione della PA e l'innovazione tecnologica, and Between S.p.a. (2011). *Rapporto Italia2010 e-Gov*. Roma: Edizioni Forum PA.
Everitt, B.S., Landau, S., & Leese, M. (2001). *Cluster Analysis*. (4th ed.) New York: John Wiley & Sons.
Gilbert, D., Balestrini, P., & Littleboy, D. (2004). Barriers and benefits in the adoption of e-government. *International Journal of Public Sector Management, 17(4)*, 286–301.
Heeks, R., & Bailur, S. (2007). Analyzing e-government research: Perspectives, philosophies, theories, methods, and practice. *Government Information Quarterly, 24(2)*, 243–265.
Ho, A. T.K., & Ni, A. Y. (2004).Explaining the adoption of e-government features. A case study of Iowa County treasurers' offices. *The American Review of Public Administration, 34 (2)*, 164–180.
Holzer, M., & Manoharan, A. (2016), *Digital Governance in Municipalities Worldwide (2015-16), Seventh Global E-Governance Survey: A Longitudinal Assessment of Municipal Websites Throughout the World*, the National Center for Public Performance, Rutgers University.
Homburg, V. (2013). Diffusion of personalized e-government services among Dutch municipalities. *Tékhne, 11 (2)*, 83–91.
Huntgeburth, J., Parasie, N., Steininger, D., & D. Veit (2012). Increasing the Adoption of E-Procurement Services at the Municipal Level, *e-Service Journal, 8(3)*, 3–23.
Hyppönen, H., Faxvaag, A., Gilstad, H., Hardardottir, G. A., Jerlvall, L., Kangas, M., Koch, S., Nøhr, C., Pehrsson, T., Reponen, J., Walldius, Å., & Vimarlund, V. (2013). Nordic eHealth Indicators: organisation of research, first results and the plan for the future. *Studies in Health Technology and Informatics, 192*, 273–7.
Kankanhalli, A., Zuiderwijk, A., & Tayi, G. K. (2017). Open innovation in the public sector: A research agenda, *Government Information Quarterly, 34 (1)*, 84–89.
ITIC-Between (2010). *Infomobilità- Il contributo dell'ICT alla mobilità privata* (Secondo Rapporto). Rome.
Mahmood, Z. (2013). *E-government implementation and practice in developing countries*. Hershey: IGI Global.
Milligan, G. W., & Cooper, M. C. (1985). An examination of procedures for determining the number of clusters in a data set. *Psychometrika, 50 (2)*, 159–17.
Moon, M. J., Welch, E. W., & Wong, W. (January 2005). What Drives Global E-governance? An Exploratory Study at a Macro level. *Proceedings of the 38th. Hawaii International Conference on System Sciences*.
Narayan, P.K., Narayan, S., Prasad, A., & Prasad, B.C. (2010). Tourism and economic growth: a panel data analysis for Pacific Island countries. *Tourism economics, 16(1)*, 169-183.

Norris, D. F., & Moon, M. J. (2005). Advancing EGovernment at the Grassroots: Tortoise or Hare?. *Public Administration Review, 65(1)*, 64–75.
Nurmandi, A., & Sunhyuk K., (2015). Making e-procurement work in a decentralized procurement system. *International Journal of Public Sector Management, 28(3)*, 198–220.
Pina, V., Torres, L., & Royo S. (2009). E-government evolution in EU local governments: a comparative perspective. *Online Information Review, 33 (6)*, 1137–1168.
Reddick, C. G (2004).A two-stage model of e-government growth: Theories and empirical evidence for U.S. cities. *Government Information Quarterly, 21(1)*, 51–64.
Reddick, C. G. (2009). Factors that explain the perceived effective-ness of E-government: A survey of United States city government information technology directors. *International Journal of E-Government Research, 5(2)*, 1–15.
Reggi, L., Arduini, D., Biagetti, M., & Zanfei A. (2014). How advanced are Italian regions in terms of public e-services? The construction of a composite indicator to analyze patterns of innovation diffusion in the public sector. *Telecommunications Policy, 38(5-6)*, 514–529.
Rosentraub, M.S., & Joo, M. (2009). Tourism and economic development: which investments produce gains for regions?. *Tourism management, 30(5)*, 759–770.
Sá, F., Rocha, Á., & Cota, M. P. (2016). From the quality of traditional services to the quality of local e-Government online services: A literature review, *Government Information Quarterly, 33(1)*, 149–160.
Simon, C. J., & Nardinelli, C. (2002). Human capital and the rise of American cities, 1900-1990. *Regional Science and Urban Economics, 32*, 59–96.
Singh, H., Das, A., & Joseph, D. (2007). Country-Level Determinants of EGovernment Maturity, *Communications of the Association for Information Systems, 40*, 632–648.
UN (2001-2018) *E-government survey.*
UN Public Administration Programme (2011). *United Nations E-Government Global Reports*.
WEF (2010). *The Global Information Technology Report 2009-2010*.
Wirtz, B.W., & Daiser, P. (2016). A meta-analysis of empirical e-government research and its future research implications. *International Review of Administrative Sciences*, 84(1), 144–163
Wood, P. (2006). The regional significance of knowledge-intensive services in Europe. *Innovation: The European Journal of Social Science Research*, 19(1), 51–66.
Yatskiv, I., Kopytov, E., & Case, D. (2013), Benchmarking and assessment of good practices in public transport information systems. Transport and Telecommunication, 14 (4), 325–336.
Yildiz, M. (2007). E-government research: Reviewing the literature, limitations, and ways forward. *Government Information Quarterly, 24 (3)*, 646–665.
Zhang, H., Xu, X., & Xiao, J., (2014). Diffusion of e-government: A literature review and directions for future directions. *Government Information Quarterly, 31(4)*, 631–636.

Web links (Dicember 2018)

http://www.insidepolitics.org/egovtdata.html

https://www.accenture.com/us-en/insights/public-service/government-as-a-platform

http://hospitals.webometrics.info/en/Methodology