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Smart development in the making: Links between commuting, digital technologies and the demand for e-government applications in Hungary

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CITATION

Kaiser T. (2024). Smart development in the making: Links between commuting, digital technologies and the demand for e-government applications in Hungary. *Journal of Infrastructure, Policy and Development*. 8(9): 7042. <https://doi.org/10.24294/jipd.v8i9.7042>

ARTICLE INFO

Received: 11 June 2024
Accepted: 8 July 2024
Available online: 3 September 2024

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Abstract: Although various actors have examined the user acceptance of e-government developments, less attention has so far devoted to the relationship between attitudes of certain commuter groups against digital technologies and their intention to engage in productive time-use by mobile devices. This paper aims to fill this gap by establishing an overall framework which focuses on Hungarian commuters' attitudes toward e-government applications as well as their possible demands of developing them. Relying on a representative questionnaire survey conducted in Hungary in March and April 2020, the data were examined by a machine learning and correlations to identify the factors, attitudes and demands that influence the use of mobile devices during frequent commuting. The paper argues that the regularity of commuting in rural areas, as well as the higher levels of qualification and employment status in cities show a more positive, technophile attitude to new ICT and mobile technologies that strengthen the demands for digital development, with special regard to optimising e-government applications for certain types of commuting groups. One of the main limitations of this study is that results suggest a picture of the commuters in a narrow timeframe. The findings suggest that developing e-government applications is necessary and desirable from both of the supply and demand sides. Based on prior scholarly knowledge, no research has ever analysed these correlations in Hungary where commuters are among the European citizens who spend extensive time with commuting.

Keywords: commuter groups; multi-tasking; attitudes; mobility; user acceptance

1. Introduction

Recently, continually emerging internet technologies and the mobile revolution has had a fundamental societal impact transforming the modes, their devices, as well as communication and mobility in terms of transport. The proliferation of mobile devices has brought about fundamental changes in the way people commute on a daily basis with far-reaching implications with regard to attitudes that influence their satisfaction and productive use of travel time (Clark et al., 2020; Ettema et al., 2012; Jang and Ko, 2019; St-Louis et al., 2014; Ye and Titheridge, 2017).

Previous studies have found that the application of mobile devices in everyday routines not only influences communication patterns, but improves the quality of public transport services and expands the travel-related activities, specifically for certain groups of commuters. As a result, travel time has come more productive by adding value to the physical presence in the form of multitasking (Julsrud and Denstadli, 2017; Ma and Ye, 2019; Singleton, 2018). Consequently, the rapid proliferation of smartphones and other mobile devices affects the attitudes, choices, expectations and demands of commuters (Bednar and Welch, 2020; Choi, 2016; Malokin et al., 2019).

However, it is very much unclear, which groups of commuters spend their travel engaged productive activities, as well as according to which criteria and motivational factors the given group adheres. The general purpose of this paper is to enrich the conventional grouping of commuters by providing new insights, aspects and correlations based on the assumption that two extreme segments of commuters, namely technophilic technophobic clusters can be distinguished in terms of user attitude. Specifically, reasons for the correlations between the frequency of commuting, place of residence, and labour market status with regard to Internet usage were sought as well as a comparison of the attitudes adopted by certain groups of commuters towards digital technologies made. In this case, it is presumed that multitasking commuters are especially in need of productive time management based on e-government services.

In the light of this, the present paper seeks to answer three key questions. Firstly, what kind of factors influence the knowledge and regularity concerning the use of mobile devices while frequently commuting. Secondly, to what extent attitudes to digital technologies are influenced by the type of and the reason for commuting. Thirdly, what role does daily commuting and several related factors play in triggering the demand for e-government applications. While public sector organizations try to become more efficient by using multichannel and online management applications, from the perspective of end-users, the usefulness and ease of use of new mobile communication technologies are crucial (Fási 2019, Pieterse and Ebbers, 2020). However, this kind of approach raises further questions and research directions concerning whether e-government developments should be optimised for groups of commuters who spend a significant proportion of their time travelling. The research was conducted by reanalyzing a previously published dataset (Kaiser and Gadár, 2023), with contributions from the author of this article.

The afore-mentioned questions were answered empirically by surveying the people concerned (Kaiser and Gadár, 2023). According to our prior knowledge, the TAPI (Tablet Assisted Personal Interviewing) included all the aspects related to the main topics. People with similar characteristics were grouped together according to their technological interests and commuting patterns using the appropriate clustering method. Relationships between demographic characteristics, technophilic behaviour, internet usage in terms of productivity and administrative habits were sought, thereby exploring the factors that have contributed towards the demand for e-government. Among these factors, commuting was the focus of our attention along with gaining a better understanding of the characteristics and attitudes of commuters.

Building on the empirical evidence on these matters, the paper seeks to explore the main drivers of e-governmental developments, with special attention on commuting and mobility. However, within this overall framework, the scope of the observations is limited on commuters, which involves large number of social groups with particular interests. In this context, we assume that different commuter groups are driving forces of the demand for e-government applications that serve both as an indicator and enabling factor from the viewpoint of diffusion of digital technology.

In the following sections we introduce the main factors of the demand for e-governmental developments with investigation of relationships between variables. We ranked the variables on their prediction power of outcome variable. By this, we

determined the most relevant variables which can be counted as a potential cause. At last, we investigated the demand for e-government development among people with positive digital attitude and compared it with commuting and non-commuting groups, using a similar logic to the case control studies. Overall, we find that commuting increases the likelihood of demand for e-government applications, but is not correlated directly with demand for them.

2. Previous research and models on diffusing and accepting ICT technologies

In order to understand as well as explain the reasons, drivers, nature and socio-territorial aspects of commuting in addition to ICT, this paper takes into consideration the main findings from a sociotechnical perspective. Within this, the Social Construction of Technology (SCOT) approach is built on three pillars, namely interpretive flexibility, relevant social groups and technological frames (Bijker et al., 1987, Elle et al., 2010). Interpretive flexibility explains how a technology is socially constructed by creating an appropriate language, ideas and communication tools. This is strongly interconnected with different perceptions of relevant social groups concerning the usage of digital technologies. Due to the broad interpretative framework, a solid technological frame is crucial in terms of facilitating, explaining and shaping the acceptance of new technologies by a society. The interplay between the three pillars is an indication that technological developments cannot be adopted in the absence of wide-ranging social embeddedness.

The Diffusion of Innovation Theory (DOI) as an analytical concept can be classified according to two overarching themes: the first are the variables that influence the diffusion process and the second is the evaluation process that the receivers of such an innovation are subjected to. The process of diffusion of an idea and/or technology relies on key variables, such as innovation, adopters, communication channels, time and social systems. Under the umbrella of the characteristics of adopters, further variables are included, such as age, social status, educational background and attitude towards risk. Such characteristics can determine the perception of a potential adopter with regard to the value of an innovation and the feasibility of its adoption. Individuals can be classified into the following categories on the basis of when they are likely to adopt new innovations: innovators, early adopters, early majority, late majority and laggards. These categories consist of individuals with a similar degree of innovativeness. Innovators are the first, most innovative and venturesome adopters who import innovations into wider systems. Early adopters are the individuals that follow innovators and often serve as opinion leaders and role models for the early majority who adopt the innovation after them. The late majority adopt the innovation just before the final group which consists of laggards with lengthy innovation-decision processes (Rogers, 2010). In this categorisation, the innovativeness of individuals is measured by behavioural profiles such as personality variables and communication behaviours.

In response to critics of DOI, who highlight the fact that it lacks a systematic evaluation, the Technological Acceptance Model (TAM) seeks to measure attitudes towards technology acceptance and adoption in terms of 'perceived usefulness' and

'perceived ease of use', which are closely related to each other (Davis, 1989; Taylor and Todd, 1995; Van de Ban and Hawkins, 1988). To put it simply, the easier a technology is to use and the more useful it is perceived to be, the more positive one's attitude towards and intention to use the technology will (Dwivedi et al., 2017).

The Unified Theory of Acceptance and Use of Technology (UTAUT) was an attempt to combine different models of technology acceptance (Venkatesh et al., 2003). This comprehensive model is comprised of four core determinants of intention and usage (performance expectancy, effort expectancy, social influence, facilitating conditions) as well as four moderators (gender, age, experience, voluntariness of use). Recently, the original UTAUT model was refined to explain why users accept or refused new technologies in specific contexts (Al-Shafi et al., 2009; Chan et al., 2010; Venkatesh et al., 2016; Vargáné Dávid, 2024).

As the main driver behind the introduction of e-government is to improve the quality of public services, it is crucial to understand the attitudes, expectations and behaviors of citizens toward services provided by e-governments (Mensah, 2020). Due to the lack of an e-government-specific model, a Unified Model of Electronic Government Adaptation (UMEGA) was developed on the basis of the basic elements of UTAUT (Mensah, 2020). Lately, the model was extended by the addition of extra variables, namely perceived service quality, trust in government, and facilitating conditions, which are key determinants of the willingness to adopt e-government services (Fási, 2019; Mensah et al., 2020).

These theories and models offer different interpretative frameworks of ICT acceptance and usage behaviour based on different factors such as stages of technological development, attitudes of individuals and user groups as well as other contextual elements. Above all, it confirms our hypothesis for the relationship between attitudes, behavioural intention and user acceptance.

3. Materials, methods and contextual factors

E-government services, in broader terms, include any form of information and communication technologies used in public administration with an aim of building connections among citizens, business and government agencies. Among the growing number of developments, services and customer portals, the most important are the application for a driver's licence or personal identity card, the opportunity of submitting income taxes, using digital banking and digital signatures. The benefits of e-government features are numerous for citizens and businesses, with special regard to the reduction in the time and costs taken conducting day-to-day administration. From an overall perspective, the concept of the so-called 'good government' addresses this kind of phenomena, and provides digital administrative opportunities, thereby increasing citizen satisfaction. Accordingly, since the beginning of the New Millennium, a large number of governments have launched significant development programmes and made investments in the field of e-government (Mensah et al., 2020). However, many technical and non-technical barriers hinder the successful development of e-government (Al-rawahna et al., 2019; Rosenbaum et al., 2018).

In the eye of the Hungarian government, the digital transformation of public administration and public service delivery has been one of its key priorities since 2014.

The main elements of the reform programmes have been incorporated into the within the framework of the Hungarian Public Administration and Services Development Operational Programme (PADOP), which was implemented between 2014 and 2020 with an aim of establishing a professional, cost-effective service-provider state. In addition to the efforts serving the reduction of bureaucracy of businesses and citizens, the large part of the development projects of the PADOP—financed by the cohesion policy of the European Union—provided the basis for electronic administration. Among them, the development of the Government Customer Service mobile app was of particular importance that supports electronic administration options for citizens, which makes services of the client gateway popular and convenient by enabling reservations of appointments, indication of the type of case, preparing administration and tracking the processes (Government of Hungary, 2021).

As a successor of the PADOP, Hungary's National Digitalisation Strategy 2021–2030, approved in 2021 focuses on four key pillars: digital infrastructure, digital skills, digital economy, and digital state. It has a comprehensive vision that extends to digital skills, digitisation of business processes, and increased use of e-government services. In doing so, the strategy aims to cover 95% of households with gigabit networks, digitalise over 30% of business processes, and have 90% of inhabitants use e-government services by 2030 (Ministry of Innovation, Technology and Ministry of Interior, 2020).

However, despite the country's commitment to digitalisation, in the 2022 county report on the level of digital development published by the European Union, Hungary is ranked overall 22st out of the 27 EU Member States in the Digital Economy and Society Index (DESI). It means that the country moved up one place compared to its score in 2020. There has been substantial progress on the demand side of e-government as internet users in Hungary increased by 3.2% between 2021 and 2022. Among them, 81% of internet users engaged with public administration online in 2021. For comparison, only 64% of the citizens engaged with the government through digital means in 2019. This is far better than the EU average of 65% in 2021. Despite a steady improvement in the country's performance in the sphere of digital infrastructure, the quality of the services provided by the government for citizens and businesses as well as society's digital skills and businesses' digital preparedness remained relatively low (European Commission, 2022).

In order to unravel the complex issue of digital development, this multi-purpose study empirically explores the human factors concerning the diffusion of digitalisation tools, in particular the use of e-government applications in a case of Hungary. This allows us to fill the research gap in the literature on the spread of digitalization among commuters. The research was conducted by reanalyzing a previously published dataset, with contributions from the author of this article (Kaiser and Gadár, 2023).

The multi-purpose representative TAPI survey on the perceptions of citizens was conducted with an aim of understanding the relationships between demographic characteristics, including skills, habits, digitalization and public administration. It was based in a nationwide, address-list survey of the Hungarian adult population. Importantly, the Hungarian public administration is vertically structured with essential differentiation between the area- and settlement categories. It consists of seven statistical-planning regions, 19 counties as territorial self-governments, which have

additionally state-administration functions, 197 districts fulfilling state administration duties and 3155 settlements (cities, towns, large villages and villages). In relation to the total population of the country (9996, 3 million), the role of the capital, Budapest, is crucial, having an estimated population of 1780 in 2024, as well as it forms the centre of the Budapest metropolitan area which has a population of 3303 (World Population Review, 2024). In this classification, large villages and villages represent rural areas and towns represent small urban areas. However, many small urban areas have rural rather than urban characteristics, such as decreasing and ageing population, changing economic structure and labour market demands, poor access to public services as well as rich cultural heritage and untapped development potential.

Taking the above into account, the survey is representative of gender, age, educational attainment and type of municipality among the population over the age of 18. Participants in the survey were selected using proportional stratified probability sampling. The data collection took place between 7 March and 15 April 2020 with a personal inquiry at the address of the respondents. A representative sample of 2,500 people was surveyed. Half of the sample (1250 persons) were interviewed in three separate thematic bloc including: practical use of the internet, getting involved in the world of technology; the use of administrative channels; the use of tools and applications for travel and daily life as well as attitudes related to them. A set of variables describing the conditions of commuters in demographic and technological terms was analysed in this article by paying particular attention to the factors that might explain the need for developing e-government.

The data from the representative sample can be used to examine correlations between commuting, the use of digital technologies, and the demand for e-government applications. Firstly, the patterns of answers provided by respondents with regard to commuting were examined and grouped them according to their extent of commuting by following a data-driven approach. Secondly, the affinity for and behaviour related to digital technology as well as the usage of devices including the purposes for using the Internet, were examined. It was our aim to make a distinction between productive, communicative, consumer, and/or mixed Internet users. The examined set of variables were extended by identifying groups that prefer a different administration channel.

In doing so, correlations between 41 variables measured in the questionnaire were sought (Kaiser and Gadár, 2023). Based on this, the use of mobile devices, attitudes towards digital technologies, productive use of Internet as well as how these variables are related to commuting were focused on. The relationships between variables were characterized using the Cramer's V index, which is widely accepted in social science because it can be used to measure the degree of association and its significance tested by the chi-squared test (Acock and Stavig, 1979).

Finally, data science was used to investigate the drivers of demand for developing e-government applications and measure the importance of commuting as a potential influencing factor. The demands for developments by separating groups that require most, some and none of the features offered by digital applications were measured. A Random Forest machine learning algorithm investigated the reasons for belonging to groups with different levels of demand as an outcome variable (Breiman, 2001). Relying on this powerful analytical tool, the most important factors from 41 variables that predict and strongly influence membership in each group were sought. The

outcome variable in the study was the demand for e-government applications, with the other variables serving as explanatory predictors. In the Random Forest method, the sample was split into a training set and a test set with a 75%–25% split. Parameters were adjusted using bootstrap sample validation to avoid overfitting. The aim of the study was to highlight the most important explanatory variables, for which the Random Forest feature importance function was appropriate.

Our investigation was proceeded by a cohort study (Song and Chung, 2010). Cohort studies look at the appearance of outcome variables in exposed and unexposed groups. In case-control studies, groups are separated according to the presence or absence of the outcome, and treatment is examined as a possible causal factor. In both types of studies, the effect of treatment on the outcome variable is examined by comparison, and significant differences are observed. The machine learning study is quasi equivalent to the case-control study in that it returns the variables, as exposure, most associated with the presence or absence of an outcome.

We investigated the need for e-government technologies in the presence of three digital technology-related proxy variables (use of online banking, Internet is the preferred channel in administration, user of customer portal for administration) and the co-occurrence of commuting as exposure and compared them with not commuting groups as ‘unexposed’ citizens. The cohort study shows, whether the group with high digital affinity have significantly increased demand for e-government development in association with commuting. In order to compare the groups, association rule mining was applied.

4. Results and discussion

Our aim is to determine the main drivers of e-governmental developments by paying special attention to commuting and mobility within the context of digital and e-governmental development in Hungary. However, our observations are limited to commuters who belong to a wide range of social classes with particular interests, although specifically analysed driving forces of the demand for e-government applications are an indicator of the diffusion of digital technology.

In the following subsection, the main factors of the demand for e-governmental developments are introduced by investigating the relationships between variables. The variables were ranked on their predicative power with regard to outcome variables, thereby determining the most relevant variables which can be counted as potential causes. Finally, the demand for e-governmental development among people with a positive digital attitude was examined, thereafter compared to commuting as well as non-commuting groups in a similar manner to control studies. Overall, although it was found, that commuting is likely to increase the demand for e-government applications, not directly correlated.

4.1. Characterisation of commuters

Regarding the characteristics of commuters, 69.0% (1740 people) of the representative sample (2520 people) live in Budapest, the capital of Hungary or in one of the county seats. According to the 2020 register of the Ministry of Interior, the proportion of them who are permanent residents in the capital and county seats as a

proportion of the total population was 66.1% (Ministry of the Interior, 2020). The 31.0% of the sample, moreover, live in rural and small urban areas were asked about the regularity of their monthly trips to the nearest town, sub-regional centre, or county seat. Using an appropriate clustering approach, social groups can be distinguished based on frequency of commuting and destinations (Kaiser and Gadár, 2023). Based on this, commuters can be divided into three main groups: non-commuters (69 respondents, which accounts for 2.7% of the sample, 8.8% of rural residents), rare commuters (544 people, that accounts for 21.6% of the respondents, 69.7% of rural residents), and frequent commuters (167 respondents, which accounts for 6.6% of sample, 21.4% of rural residents). The rare and frequent commuters can be further split into four and three groups respectively. The groups are divided according to destination (county seat, subregional centre, or nearest settlement) and frequency (weekly, several times a week, every working day or even more regularly) of their commutes. Rural residents who do not commute were referred to as Group 1, while those, who commute infrequently were assigned to groups 2–5. Lastly, regular commuters were placed in groups 6–8.

4.2. Demographic characteristics of commuters

The relationship between demographic variables and commuting is shown in **Table 1**. The table also includes the minimum number of variable categories, as the assessment of relationship strength depends on the number of categories due to the specifics of the Cramer’s V statistical method. A numerically smaller Cramer’s V already indicates a strong stochastic relationship with regard to increased values. Although no correlations with the gender, nor number of children of the participants were detected, correlations with the educational background and marital status were observed. In terms of the other demographic variables, the correlation is moderately strong.

Table 1. The association between demographic variables and commuting.

Demographic variable	Cramer’s V	Min. category	Strength of association
Gender	0.090	2	negligible
Number of children	0.104	4	negligible
Education	0.151	4	weak
Marital status	0.164	5	weak
Income	0.171	5	moderate
Age	0.203	6	moderate
Labour market status	0.209	8	moderate
Region	0.223	8	moderate
County	0.288	8	almost strong

Source: the author’s own compilation.

Regular commuters account for 21.4% of respondents (Groups 6–8). Importantly, when examining subgroups with specific characteristics, differences are observed. Although, no correlation was found between commuters and their number of children,

but it was observed that the proportion of regular commuters increases as their number of children rises. However, this trend breaks down for three or more children.

According to the data of the survey, commuting is mostly related to labour market activity, learning and regions. Frequent commuting is most common among those in active employment (31.0% of them), entrepreneurs (33.3% of them) and students (48.8% of them). Counties that have a strong economic centre are more likely to attract commuters. The regional effect is most pronounced in relation to the capital city's metropolitan area, as 44.3% of its residents regularly commute. The influence of economic considerations in the context of commuting is underpinned by the fact, that the income and employment status are closely related to each other. The proportion of regular commuters increases proportionally to rises in income. In particular, 50.0% of the highest earners, 45.5% of the well-off, 28.3% of the middle-income earners, 14.8% of the low-income earners and 4.4% of the lowest earners commute.

What is clear is that commuting is necessary, when the location of a student's school or an employee's workplace differs to that of their home. Presumably commuting is related to higher earning potential, a job outside one's place of residence that is better matched to their educational background, and the lack of schools in the hometown of students.

4.3. Technological properties of commuters

The survey measured several factors that can be used to infer the attitudes of respondents towards technology and their behavioural characteristics with regard to digital technologies. In terms of technophilic attitudes, four groups could be distinguished, namely innovator, early adopter, late adopter and laggard. Distinction can be made between productive, content consumer and passive groups in terms of the reason behind Internet use. The usage of mobile internet, the number of registrations and activities in the customer portal of public administration were also examined. However, without a customer portal, online administration cannot be conducted. As a proxy indicator, the use of online and digital banking were measured, which are indicators of openness to digital applications. In terms of preferring channels of administration, five groups could be identified, two of which prefer to do business online. Finally, the demand for development of digital e-governmental applications was evaluated. **Table 2** shows the correlations between commuting and technology-related variables. To evaluate Cramer's V values, it is necessary to know the number of categories in the variables, as the strength of the relationship depends on this. Therefore, the number of categories is included in the **Table 2**.

The stochastic correlations hide the fact, a significantly higher proportion of frequent commuters—around 80% of them—are productive internet users, e.g., for work or shopping activities.

Among those who use the Internet productively, the proportion who are regular commuters is 37.7%, which is significantly higher than the equivalent figure of 21.4% in the sample. However, the proportion of regular commuters among those, exhibiting consumer behaviour is 22.2%. Among the passive internet users (no productivity at all, communicate a few times a week, read the news once a week), the proportion of frequent commuters is 16.8%.

Table 2. The association between technology-related variables and commuting.

Technological like variables	Cramer's V	Min. category	Strength of association
Technophilic attitude	0.208	4	medium
Productive use of the Internet	0.159	8	weak
Mobile Internet user	0.258	2	weak
Customer portal for administration	0.198	2	weak
Active user of a customer portal	0.243	2	weak
Online banking	0.180	2	weak
Digital banking	0.177	2	weak
Preference for an administration channel	0.161	5	weak
Demand for digital developments	0.139	8	weak

Source: the author's own compilation.

4.4. Factors explaining the demand for e-government applications

In this research, the demand for e-governmental development was measured among rural residents in order to analyse the role of commuting in particular. All the findings apply exclusively to rural and small urban populations.

A model with up to 40 measured explanatory variables was built to predict the level of demand for e-government applications. The most important explanatory factors are summarised in **Figure 1**:

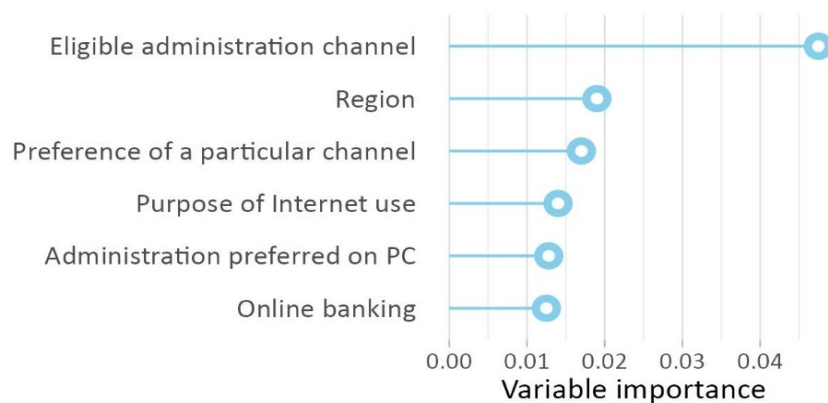


Figure 1. Most important predictors need for the development of e-government applications.

Source: the author's own compilation.

The more important the ability to choose the channel of administration is, the stronger the demand for e-governmental developments. It is very interesting that the regional level emerged as important explanatory factor. In all likelihood, this is mainly due to the high mobility of the agglomeration of a capital city. In the case of Internet preference, those who prefer doing business online instead of in person, are more in need of application development. In terms of the purpose of Internet use, the demands of productive internet users (who work or shop online) are very high. In terms of the device used to do business, the need of those, who prefer PCs is stronger compared to using mobile devices (Android, iOS). This could be an indication for the development

of mobile applications. Those, who already use other online applications, e.g., online banking, prefer to manage public administrative matters online and, therefore, require more digital developments. These factors are also well reflected in **Table 3**, where the stochastic relationships between the variables are shown, including the extent to which they are related to commuting.

Table 3. The association between important predictors, and the demand for e-governmental applications and commuting. The minimum number of categories and the rating of the strength of the association is given in brackets.

Important predictors	Demand for e-government apps	Commuting
Eligible administration channel	0.290 (3; moderate)	0.119 (4; weak)
Region	0.242 (3; moderate)	0.223 (8; moderate)
Preference for a channel	0.346 (3; strong)	0.161 (5; weak)
Purpose of Internet use	0.377 (2; strong)	0.159 (2; weak)
Administration preferred on PC	0.337 (2; moderate)	0.159 (2; weak)
Online banking	0.309 (2; moderate)	0.180 (2; weak)

Source: the author's own compilation.

Taking the number of response categories of the variables into account, the correlations are moderately strong or strong. The strength of the relationship measured by Cramer's V differs slightly from the importance of the predictors. May be the prediction is not with a single variable, but with combinations of responses when machine learning is implemented, thereby mutually reinforcing the effects that could occur.

The demand for developments for e-government applications, measured by only a pairwised Cramer's V, is most strongly correlated with factors listed below. These variables closely align with important factors identified by Random Forest machine learning method

- the purpose of Internet use (productivity) ($V = 0.377$)*,
- having and using a customer portal for public administration ($V = 0.357$),
- preference for an administration channel ($V = 0.346$)*,
- doing business on a PC ($V = 0.337$)*,
- technophilic-technophobic behaviour ($V = 0.326$),
- using an online bank ($V = 0.309$)*.

The points denoted by an asterisk are also shown in **Table 1**. The use of a customer portal for the purpose of public administration and the expression of technophilic behavior have both emerged as important factors concerning the demand for e-governmental applications. The key determinants of the intention to develop e-government applications are related to technological attitudes.

4.5. Commuting an explanatory factor

Commuting is not one of the main explanatory factors. However, given the active lifestyles of commuters and their need to use time productively, it is worth investigating whether or not they envisage an opportunity to develop e-government applications to make their lives easier. It is also essential whether could they benefit

from the use of d. In order to address these issues, cohort-type observational studies were used to compare the outcome variables, that is, for different combinations of variables, the likelihood of the need for development was examined. The results are presented in **Figure 2**.

In this research, 37.0% of the representative sample would require developments to be made in e-government applications as denoted by the horizontal red line in **Figure 2**. Those who prefer online administration, namely 54.5% of the representative sample, are in need of applications, as denoted by the green line). Those who use a customer portal for public administration, i.e., 54.7% of the representative sample, are likely to require developments to be made, as denoted by the yellow line. When considered in the context of commuting, those who do not commute or rarely commute from the rural population are less likely to require e-government application developments, however, frequent commuters are more likely to require them. The anomalous result of commuters in Group 3 commuters can also be explained by the fact that they are predominantly residents in small towns, which also explains why they rarely commute as their workplaces and schools are situated locally.

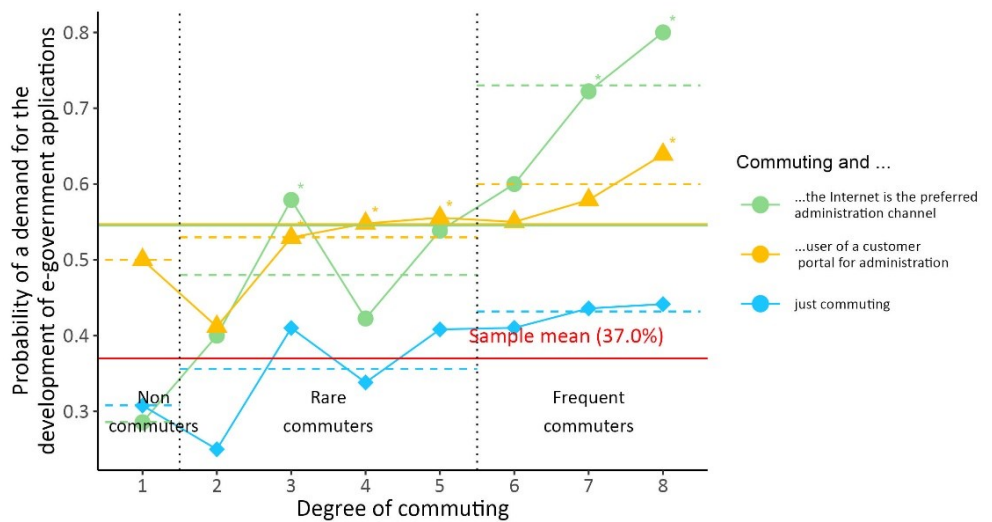


Figure 2. The effect of commuting on the probability of a demand for e-governmental developments to be made a significant difference when compared to the sample average. Solid line: sample average, dotted line: the averages of the groups who do not commute, rarely commuting, frequently commute. Dots represent the commuting groups.

Source: The author’s own compilation.

It can be concluded that the groups that commute regularly are more likely to require digitalisational developments. If someone commutes regularly and prefers to do business online, they are very likely (80.0%) to be in need of such developments. Commuters who are technologically open show a higher demand for e-commerce applications compared to non-commuters who are also technologically open.

Respondents whose preferred administration channel is the internet or who is a user of a customer portal for administration 55%–56% likely to require e-government application development on average. Among these respondents, those who commute regularly stand out. Referring to the characteristics of case-control studies, as

described in Chapter 3, we observed the outcome (the need for development of e-government applications) in different groups while considering the commuting characteristic as the “treatment”. We measured the need for e-government applications as an outcome variable among those who do not rarely commute and those who commute regularly. It was found that daily commuting significantly increases the need for development of e-government applications.

5. Discussion

The aim of this paper was to empirically investigate the relationship between the use of mobile devices, the affinity for digital technologies, and commuting as drivers raising the demand for e-governmental developments. Crucially, it was built on the presumption that a lack of time is most characteristic of commuters, which enhances the need to spend their travel time productively. As a result, they are more receptive to e-government technologies in the light of their expected benefits. Highly intense and productive usage of the Internet characterize regular commuters, which are closely linked to their positive attitude towards the development of digital technologies. Portable devices can help rural commuters and residents in small urban settlements to use their travel time productively. Commuters definitely have active lifestyles, and it is vital for them to carry out administrative duties efficiently. Moreover, using the out-of-office administration channels of other (public) service providers can help them to save time in possession of the devices and skills necessary to use such features.

However, the best way to carry out administration should be based on the capabilities, skills, trust and preferences of the customer. Since financial resources for development are limited, as far as impact assessments, demand assessments and a thorough understanding of customers are required before tailoring the methods by which administrative duties are carried out.

The results of this empirical research show that technophilic attitudes and their proxy indicators, namely online banking, preference for online administration and productive usage of the Internet, fundamentally affect as well as accelerate the rate of diffusion of technological innovations. The educational background and employment status of rural residents who regularly commute increases their need to use digital applications, including e-governmental services.

From the digital point of view, governments will have a role to play in the future, as now evident from the development of e-government applications. The characteristics of the target group have been described in previous models. In this paper, it is shown that commuting also plays a role in the diffusion of digital innovations.

It is suggested that the needs of commuters should be taken into account when making policy decisions on e-governmental development. Their demographic characteristics are indicative of whether they are students, workers or entrepreneurs. Their demand for e-government tools among digitally receptive commuters is greater than among those who do not commute, possibly because commuters can expect more benefits from using e-government applications. It is recommended, that the user needs of commuters should be addressed when developing applications. Furthermore, co-

production in terms of e-governmental development could be cooperatively as have done others in different areas of development.

The literature on multitasking and productive time management is extensive. However, the penetration of e-government applications into the scope of tasks to be performed has essentially been unexplored until now. Our research provides empirical evidence that the demand for digital government administration is increased by commuting regularly.

The results are particularly important in areas where the process of deurbanisation is taking place, possibly in parallel with the development of public transport. The number of commuters is increasing and the use of public transport could provide opportunities for productive time usage even for the purpose of governmental administration. The current direction and the results of this study have provided an overarching model for further research, within which the complex phenomena of productive time-use could be examined more directly, in connection with the usage of mobile devices and e-government applications.

Funding: TKP2021-NKTA-51 has been implemented with the support provided by the Ministry of Culture and Innovation of Hungary from the National Research, Development and Innovation Fund, financed under the TKP2021-NKTA funding scheme.

Conflict of interest: The author declares no conflict of interest.

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