

ICT and Innovation in the Provision of Public Services: The Case of Slovakia

Veronika Černáková*

Faculty of Economics, Technical University of Košice, 32 B. Nemcovej, 040 01 Košice, Slovakia

This paper discusses factors which determine the adoption of information and communication technology (ICT) in public services. The provision of online public services is becoming increasingly utilized as a means to streamline and facilitate contact between citizens and public-sector bodies. The implementation of decentralization process also makes the accessibility of public services to citizens simpler. In this paper, the online services and factors which determine the level of such services are analyzed using the data set of 1216 services provided by municipalities in Slovakia. Special attention is paid to the examination of financial indicators which describe financial independence of local governments with respect to the assumption that local governments with higher level of expenditure covered by the revenue coming from proper taxes display more effective behavior in the field of public services. Thereafter, based on the results of econometric model and statistical methods key factors affecting the provision of online services are determined. The results of the model show that a higher level of ICT adoption in public services is achieved by larger municipalities which are district seats and which are financially autonomous. This is an important lesson for the policy as the process of fiscal decentralization appears to be a very important means of narrowing the gap between the developed and transition economies.

Keywords: computer technology; innovation; online services; public services; financial autonomy

1. Introduction

The use of ICT in the provision of public services is an example of a successful innovation. Until the end of the twentieth century, offering government services to citizens through electronic media was essentially a new idea, and hence a new practice in the public sector (Potnis, 2010). Currently, the provision of online public services is becoming increasingly used in order to streamline and facilitate contact between residents and public-sector bodies.

Despite the popularity of using ICT in the provision of public services around the world, empirical evidences (Azad, Faraj, Goh, & Feghali, 2010; Ifinedo & Singh, 2011; Singh, Das, & Joseph, 2007) indicate that transition economies lag behind developed countries with the use of the ICT facilities in public sector. According to Douček and Nedomová (2011), the efficiency of Slovak ICT sector is very low; about a half of the efficiency of developed European countries and about a quarter compared with the most efficient European ICT sector. In other words, transition by itself has not led to a full convergence with the developed countries in Europe (Piatkowski & van Ark, 2005). The question remains, to what extent the use of ICT can contribute to narrowing the gap between transition and developed economies. The experiences of developed countries highlight the positive impact of ICT use in businesses and

*Email: veronika.cernakova@tuke.sk

Piotr Soja is the accepting Editor for this article.

government on increasing productivity, efficiency and competitiveness (Venturini, 2009). The literature suggests (Azad, Faraj, Goh, & Feghali, 2010; Ifinedo & Singh, 2011; Torres, Pina, & Acerete, 2005) that slow adoption of ICT in transition countries could be caused by poor infrastructure, high costs and various social and political barriers.

Therefore, it is essential to identify factors which affect the implementation of ICT in public sector. Some empirical studies (Vanderlinde & van Braak, 2010) indicate that the financial independence of municipalities, and thus their position in the system of decentralized public administration, is one of the factors influencing the adoption of computer technology in the provision of public services. Like most other transition economies in Eastern Europe, Slovakia has undertaken comprehensive reforms of fiscal systems with the aim to strengthen the financial autonomy of local authorities in providing public goods. Almost all transition economies started their decentralization process from a highly centralized system of public finances with local governments acting mainly as administrative units with a little fiscal responsibility. The main argument for fiscal decentralization is based on the assumption that fiscal decentralization increases local influence over public sector. Within this framework this paper aims to examine factors affecting the maturity of online services provided where financial autonomy is considered to be a contributing factor to prospective ICT adoption in Slovakia.

The paper is organized as follows. Section 2 presents a synthesis of different streams of literature in order to identify key factors which can help to explain the adoption of innovation in public services. It also reviews some empirical studies dealing with the issue of using ICT by municipalities. Section 3 illustrates the examined data sets and discusses the used methodology. In Section 4, the results of the econometric model are described. In Section 5, lessons learned are discussed and the concluding remarks are finally given in Section 6.

2. Theoretical background

The research into innovations in the private sector has been done for more than 40 years (Evangelista, Sirilli, & Smith, 1998; Gallouj & Weinstein, 1997; Hipp & Grupp, 2005; Miozzo & Soete, 2001; Tether & Hipp, 2002). On the contrary, despite the fact that public-sector innovations are a key contributor to national growth and to the welfare of individual citizens, very little research has been conducted into public-sector innovations to date (Windrum, 2008). Innovations in public sector are, on the one hand, exposed to different forms of pressure, interests, restrictions and demands. On the other hand, motivating factors for their development are very low while the uncertainty in their implementation is very high (Albury, 2005). In public services, this uncertainty is multiplied by a higher level of public criticism as innovations in public sector significantly affect the quality of life of individual citizens and a society as a whole. Donahue (2005) emphasizes the fact that public-sector bodies are affected by the interests of public and often deal with important social issues resulting in the necessity of innovations in public sector. Mulgan and Albury (2003) suggest several reasons supporting the assumption of necessity of public-service innovations. These are (1) the need for effective response to changing public needs and rising expectations – it is not appropriate to use the one-size-fits-all approach; (2) the need to increase production efficiency and cost savings, in particular with regard to budget constraints; (3) the need to improve distribution channels and outcomes of public services and (4) the need to use the potential of ICT to its maximum.

In many countries, government and private sector cooperate to support innovative activities, especially in the ICT sector. However, in particular the area of information technology represents significant differences between innovation in public and private services. Public-sector innovations are created by public-sector employees on behalf of the government and become the property of the state. Public-sector bodies are funded from budget items; there is no

venture capital to fund public-sector innovations. Public-sector finances innovations through budget surpluses or cost savings, which are very rare. Difficulties associated with these funding sources consist mainly in their irregularity. Public-sector employees are paid fixed wages and in comparison to the private sector, employees cannot get any bonuses. In other words, rewards for successful innovation in the public sector are significantly lower than those in the private sector (Borins, 2001).

In addition, inefficient public spending limits the possibilities of financing public services sufficiently and in adequate quality. Public organizations are constantly faced with shortage of funds for the provision of services. A possible way to deal with this shortage is to reduce costs. According to Kinder (2010), an implementation of E-government can reduce operating costs of public sector.

The importance of using ICT in the provision of public services has been emphasized by a number of other studies. The authors, however, highlight different factors as key ones for the adoption of ICT in the public sector. A survey of 130 E-government projects implemented in Norway (Bygstad & Lanestedt, 2009) indicates that innovations in public services based on the use of ICT are not related to the actual progress of the project in terms of costs, time and quality of the project or the qualification of project management. Rather it concludes that successful innovations have been implemented in the public-sector organizations which have shown strong interaction with the service users. Results of the study confirmed the assumption that demand push innovations in the public sector can improve the quality of public services, especially because they take into account specific preferences of residents. However, the end users are often unwilling, or unable, to accept such innovations.

Rogers (1995) argues that perceived attributes of each innovation are important explanations of the rate of adoption of innovations. Following this assumption, Al-Gahtani (2010) stresses the role of five attributes of innovation toward computer technology adoption in developing countries namely: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability and (5) observability. According to the author, these factors explain up to 87% of the rate of adoption. This finding should help decision-makers in underdeveloped countries to cultivate the positively correlating factors to enhance computer technology adoption.

Another important factor affecting successful implementation of innovation in the public sector has been identified by Babcock, Bush, and Lan (1995) on a sample of 262 representatives of the State of Arizona, USA. The study concludes that a positive approach to ICT by managers significantly determines the process of adoption of technological innovations in public-sector organizations.

With the aim to conceive the differences between the municipalities in their inclination for the implementation of E-government, an examination of 1176 Italian municipalities was conducted (Arduini, Belotti, Denni, Giungato, & Zanfei, 2008). The study confirmed that adoption of E-government is often affected by spatial factors such as geographic proximity and knowledge accumulation. There is a strong evidence of inter-regional variations in the generation and adoption of new technologies, revealing that innovations tend to be geographically conditioned.

A complex analysis of determinants of E-government maturity in the transition economies of Central and Eastern Europe was performed by Ifinedo and Singh (2011). Panel data analysis of 16 transition countries showed that resources (e.g. national wealth, human capital development, technological infrastructure and the rule of law) matter in accelerating a country's ability and willingness to advance its E-government initiatives with features that promote citizens' participation and engagement.

The above-mentioned empirical studies focused on the explanation of the role of social, economic and geographic variables in assessing the innovations in public sector. However, there are very few studies examining the role of the fiscal federalism and financial position of local governments in

providing public services (Carlsen, 2005; Charney, 1993). Among different financial indicators it is highly interesting to examine the role of taxes and subsidies from the state budget.

Some empirical studies dealing with the effectiveness of the public-service provision (De Borger & Kerstens, 1996; De Borger, Kerstens, Moesen, & Vanneste, 1994; Vanden Eeckaut, Tulkens, & Jamar, 1993) point to the fact that local governments which are less dependent on the central budget achieve greater efficiency in the provision of public services. These studies also demonstrate a positive correlation between a higher income from taxation and the increasing efficiency of public services so it can be assumed that the implementation of the decentralization process also makes the accessibility of public services to citizens simpler. For example, an examination of 262 Italian local governments (Boetti, Piacenza, & Turati, 2010) researches the dependence of efficiency in the provision of public services on the degree of decentralization. Authors conclude that municipalities with a higher proportion of costs covered by the revenue from their own taxes exhibit more effective behavior in the provision of public services.

3. Data description and methodology

This section presents the data and methods which were used to examine factors affecting the maturity of online services provided by Slovak municipalities. The dependent variable is a composite indicator expressing the maturity of online services provided via websites of individual municipalities.

3.1. Research sample

The research sample covers 168 Slovak municipalities with more than 4000 inhabitants due to the fact that in case of smaller municipalities we faced difficulties with data availability. The resultant sample of examined municipalities, therefore, includes 152 municipalities (16 municipalities with no relevant data available on their websites have been excluded from this sample). In each municipality, 8 services were examined so the final data set used for this study comprises 1216 online services. The econometric model is based on data for both local public administration bodies and regional context. Input data for analysis were obtained from the Regional Database of the Statistical Office of the Slovak Republic as well as from websites of all the 152 examined municipalities. The municipalities' websites data were used both to identify the dependent variable as well as to obtain financial indicators describing each municipality.

3.2. Hypotheses formulation

Based on the results of the above-mentioned studies, our main research question was to find out how the online service maturity is influenced by financial autonomy of municipalities. With regard to this question, hypotheses were formulated and independent variables were selected. The main research question is included within hypotheses *H1* and *H2*. In addition, based on the results of prior studies, we were also interested in the role of demand from the population (Bygstad & Lanestedt, 2009), which is included within hypothesis *H3*, as well as the role of regional context of a particular municipality (Arduini et al., 2008), which can be found within hypotheses *H4* and *H5*. Hypotheses are formulated as follows (Figure 1):

H1: Online service maturity is positively correlated with the amount of per capita income of local governments.

H2: Online service maturity is positively correlated with the degree of financial autonomy of local governments.

H3: Online service maturity is positively correlated with the demand measured by population of local government.

H4: Online service maturity is positively correlated with innovation capacity of a corresponding region.

H5: Online service maturity is positively affected by activities of surrounding municipalities.

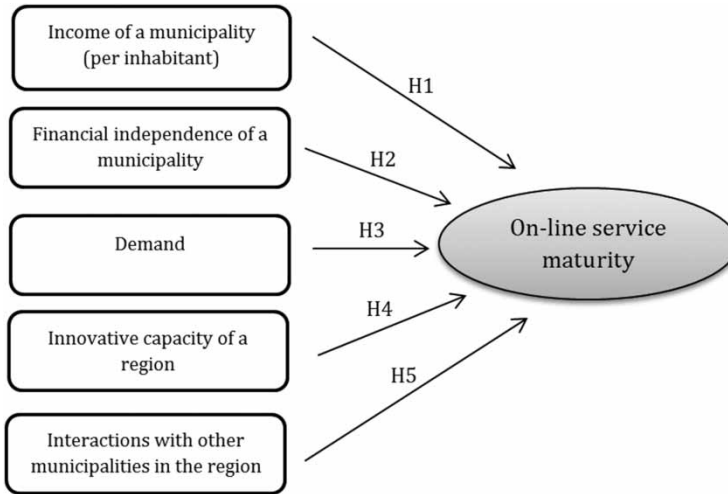


Figure 1. The research model and hypotheses.

3.3. Dependent variable

The dependent variable in the model is defined as a composite indicator that reflects the accessibility and the level of interaction of online services provided by individual municipalities. In case of each municipality, eight services were investigated. Altogether 1216 services provided by municipalities via their websites were examined. Each of the selected services represents an area which arises under the original competencies of municipalities namely: (1) spatial urban planning and building regulation, (2) administration of birth record and population register, (3) social service, (4) nature protection, (5) pre-school education, (6) culture (libraries), (7) local taxes and (8) website availability.

Data collection was carried out in the form of a detailed review of the website of each municipality in order to be able to clearly identify the level achieved in particular services. Each of the examined services could achieve none or all of the specified levels ranging from one to four¹ (Table 1). Therefore, in creating the composite indicator, it was necessary to deal with the issue of determining the weight of each possible level of online services. As the most appropriate method to do this we applied Saaty’s method. This method deals with the consistency of pairwise comparison matrix $S(S_{ij})$, where $i, j = 1, 2, \dots k$. Matrix elements S_{ij} are interpreted as estimates of the weights of the i th and j th criterion. After the establishment of a hierarchical structure at all levels of evaluation, different alternatives or criteria are compared. The decision is made through verbal explanations and numerical values as set out below:

- 1: criteria i and j are of equal importance;
- 3: criterion i is weakly preferred to criterion j ;

- 5:** criterion *i* is strongly preferred to criterion *j*;
- 7:** criterion *i* is very strongly preferred to criterion *j* and
- 9:** criterion *i* is absolutely preferred to criterion *j*.

Table 1. Description of the online services level.

Level	Description of the online service level
0	No website or no information about current service
1	Informative level: a public website with basic information available to citizens; for example contact (postal or electronic address), office hours, etc.
2	One-way interaction level: the citizen can download forms or other documents necessary for the initiation of administrative procedure for a particular service via publicly accessible website
3	Two-way interaction level: using a publicly accessible website, mutual communication (interaction) between service recipient and service provider is possible. The service recipient can download forms and other documents and submit the form via the same website. This requires the service recipient's authentication. A processed document has to be picked up personally or received per post
4	Transaction level: The service recipient has the possibility to completely electronically process the relevant service (including monitoring, decisions and implementation of financial transactions) via publicly accessible website. The provided service is executed without any personal contact between service recipient and service provider

The values of 2, 4, 6 and 8 are degrees between these values. In order to ensure the transitivity rule (Bonissone, 1998) criteria summarized in Table 2 were selected. Based on calculations, weights were set as follows:

$$\text{score} = 0.067L_1 + 0.133L_2 + 0.267L_3 + 0.533L_4, \tag{1}$$

where L_i ($i = 1, \dots, 4$) is a binary variable equal to one when service *s* acquires specific characteristic. L_1 reflects the situation when examined service achieves level 1 according to the classification in Table 1, L_2 when the service reaches level 2, etc. According to the level achieved by a particular service it was possible to compute the score of each of the 1216 services. Subsequently, the composite Online Service Indicator (*OSI*) was identified for each municipality by adding the scores received for the services it provides so that *OSI* represents both a number of the provided services as well as their maturity. In other words, *OSI* expresses how many services a municipality offers online and to what extent these services are interactive. The frequency of online services at particular levels is summarized in Table 3. It should be noted that the highest, i.e. the fourth level (the possibility of processing the entire transaction online), was reached only in case of five services provided by the capital.

Table 2. Determining weights based on Saaty's method.

S_{ij}	L_1	L_2	L_3	L_4	$\prod_{j=1}^4 S_{ij}$	$R_i = \left[\prod_{j=1}^4 S_{ij} \right]^{1/4}$	$w_i = \frac{R_i}{\sum_{i=1}^4 R_i}$
L_1	1	1/2	1/4	1/8	0.0156	0.354	0.067
L_2	2	1	1/2	1/4	0.25	0.707	0.133
L_3	4	2	1	1/2	4	1.414	0.267
L_4	8	4	2	1	64	2.828	0.533
<i>Sum</i>						5.303	1

Table 3. Frequency of online services at particular levels.

Online service level	Number of services
Level 0	78
Level 1	390
Level 2	571
Level 3	172
Level 4	5
Total	1216

3.4. Independent variables

The selection of independent variables which can be divided into three groups (Table 4) was based on the synthesis of theoretical knowledge. The first group consists of financial indicators. Public institutions are constantly faced with the lack of funds for the provision of public services; we assume that the availability of funds for municipalities is a key factor in decision-making on adoption of E-government in public services. Financial indicators entering the analysis represent fiscal conditions of local governments which are expressed, on the one hand, by means of indicators reflecting the revenues and expenses of municipalities *per capita*, and, on the other hand, by means of indicators representing financial autonomy of local authorities and their independence from the state budget. The supposed impact of financial possibilities and constraints of local governments on the maturity of online services was examined in the example of the following indicators: (1) current revenue per capita (CRpc), (2) tax revenue per capita (TRpc), (3) ratio between the current revenues and the current expenditures (R/E), (4) self-financing ratio (SF_RATIO) and (5) financial independence which is an indicator reflecting the degree of autonomy and economic stability of local public administrations (for definition see Table 4).

The second group of variables involves factors which identify municipalities in terms of their size and position namely: (1) municipality size (MUNI_SIZE), (2) distance from the capital (DIS_CAP), (3) distance from a regional capital (DIS_REG_CAP) (the “distance” indicators were designed to examine the dependence of innovation on spatial factors, such as geographic proximity and knowledge accumulation) (4) dummy variable “district” (DISTRICT) and (5) dummy variable “county” (COUNTY). Both dummy variables were included in the examination in order to find out whether the adoption of online services achieves higher levels in cases where a municipality fulfills the function of a regional center.

The third group of variables consists of regional dummy variables (Table 4). The role of regional variables is to examine if regional context affects the adoption of online services in a particular municipality. In other words, it examines whether the economic level and innovation capacity of a region have an impact on the maturity of online services in municipalities located in the respective region. The composition of dummy variables was based on the approach of Müller, Jappe, Héraud, and Zenker (2006) namely on the typology of regions based on their innovation capacity. This approach aims for an integration of various components of the innovation capacity at the regional level due to the fact that the socioeconomic development of the region is, at least partially, conditioned by its innovation capacity. This resulted in a division of regions into five groups based on their innovation performance. The original approach operates within the NUTS² II regional level. For the purposes of this paper it was, however, more appropriate to formulate regional variables at the NUTS III level with the aim of a more detailed examination of regional differences. Moreover, in Slovakia, the NUTS II division of regions is purely administrative. Hence the original methodology was applied to the conditions in

Table 4. Independent variables.

Variable	Description	Source of data
Group 1 – Financial indicators		
Current revenue per capita (CRpc)	current revenue / population	Final accounts of municipalities
Tax revenue per capita (TRpc)	tax revenue / population	Final accounts of municipalities
Current revenues to current expenditures (R/E)	current revenue / current expenditure	Final accounts of municipalities
Self-financing ratio (SF_RATIO)	own revenue / current expenditure	Final accounts of municipalities
Direct financial independence	(ReTR + CNR) / current revenue	Final accounts of municipalities
Indirect financial independence	(ITR + CNR) / current revenue	Final accounts of municipalities
Group 2 – Size & position indicators		
Municipality size (MUNL_SIZE)	population	Statistical Office of Slovak Republic
Distance from the capital city (DIS_CAP)	Natural logarithm of the distance of a particular municipality from the capital city (Bratislava), expressed in absolute terms	Output from the program R
Distance from the regional capital (DIS_REG_CAP)	Natural logarithm of the distance of a particular municipality from the regional capital, expressed in absolute terms	Output from the program R
Dummy variable „district“ (DISTRICT)	Dummy variable acquiring a value of 1 if a particular municipality is a district town	Statistical Office of the Slovak Republic
Dummy variable „county“ (COUNTY)	Dummy variable acquiring a value of 1 if a particular municipality is a county town	Statistical Office of the Slovak Republic
Group 3 – Regional dummy variables		
	Dummy variables representing types of Slovak regions according table 4;	Own calculations
Regional dummy variables (DUMMY_REG)	<ul style="list-style-type: none"> • DUMMY_REG_A is a dummy variable acquiring a value of 1 when examined municipality is located in the region A; • DUMMY_REG_C is a dummy variable acquiring a value of 1 when examined municipality is located in the region C; • DUMMY_REG_D is a dummy variable acquiring a value of 1 when examined municipality is located in the region D. 	

ReTR, Real estate Tax Revenue; CNR, Current Non-tax Revenue; ITR, Income Tax Revenue

Slovakia and a classification of Slovak regions at the NUTS III level has been done. The final classification of Slovak regions along with their definitions is set out in [Table 5](#).

3.5. Testing spatial dependencies

Previous studies (Arduini et al., 2008) show that there is strong evidence of inter-regional variations in the generation and adoption of new technology, revealing that innovation tends to be

Table 5. Classification of Slovak self-government regions.

Region	Type of region	Description according to Müller, Jappe, Héraud, and Zenker (2006)
Bratislava SGR	Region A	Region A: <i>capital region</i> defined by a high level of knowledge creation, high proportion of employment in high-tech services, and a much higher level of GDP/capita than any other group
Trnava SGR	Region D	
Trenčín SGR	Region C	Regions C: <i>skilled production platform regions</i> are defined by intermediate strength in knowledge creation and high proportion of employment in manufacturing industries
Nitra SGR	Region D	
Žilina SGR	Region D	Regions D: <i>industrially challenged regions</i> are those with very limited knowledge and technology-related activities, defined by low knowledge creation and strong employment in manufacturing industries
Banská Bystrica SGR	Region D	
Prešov SGR	Region D	
Košice SGR	Region C	

Note: SGR, self-government region.

geographically conditioned. Therefore, the first issue to be examined was the way in which the selected municipalities influence each other. In other words, we examined whether there is a stronger interaction between municipalities which are geographically closer to each other. We were interested to find out if there is a correlation between the distance of two municipalities and their values achieved in the *OSI* indicator. The easiest way to examine the correlation between two variables is to define the correlation coefficient within each county. The input data were distances between individual municipalities obtained from the program R^3 with reference to their geographical coordinates. The second variable was presented by the matrix describing the absolute value of the difference between the pairs of municipalities in the *OSI* indicator. After data processing it was possible to define the correlation coefficients expressing the mutual relationship between the respective variables at the regional level (Table 6). The results show that the null hypothesis assuming independence of the variables cannot be rejected in any case. In order to verify this result, we carried out Moran's test. Moran's I is a measure of spatial autocorrelation based on both feature locations and feature values simultaneously. Moran's test is a test for spatial autocorrelation using a spatial weights matrix, where the null hypothesis states that there is no spatial clustering of the values associated with the geographic features. The test proved that the variable *OSI* shows no spatial autocorrelation (Moran $I = -0.0157$). Based on these results, hypothesis $H5$ assuming that online services maturity is positively affected by the activities of surrounding municipalities is not supported.⁴

Table 6. Correlation coefficients.

Region	Number of observations	Pearson's r	Spearman's ρ	Kendall's τ
Bratislava SGR	45	-0.052	-0.076	-0.109
Trnava SGR	171	0.049	0.032	0.047
Trenčín SGR	231	-0.007	0.035	0.050
Nitra SGR	210	0.033	0.031	0.044
Žilina SGR	231	0.010	0.006	0.010
Banská Bystrica SGR	231	-0.111	-0.063	-0.096
Prešov SGR	210	0.110	0.044	0.065
Košice SGR	105	0.028	-0.013	-0.017

Note: SGR, Self-government region.

3.6. Econometric model

To investigate the determinants of the maturity of online services, we used a linear regression model with dummy explanatory variables. The model is specified as follows:

$$y_i = \beta_0 + \sum_{i=1}^k \beta_i X_{ij} + \sum_{i=k+1}^m \beta_i U_{ij} + u_i, \quad (2)$$

where β_i are parameters, X_{ij} are explanatory variables, U_{ij} are dummy explanatory variables achieving either value 0 or value 1 and u_i is a random error. We included the whole set of variables in the model. Testing of the standard assumptions of the linear model showed the presence of multicollinearity. To eliminate it, we removed basic variables (CRpc, TRpc) which caused unacceptable Variance Inflation Factor values of composite indicators. Table 7 summarizes the results of this model. Subsequently, the reduced model was tested on the assumptions of the linear model. The results show that the null hypotheses assuming normality of residuals, homoscedasticity, no autocorrelation and no multicollinearity cannot be rejected in any case.

Table 7. Statistically significant variables.

Variable	Estimate	Std. error	p-Value
Intercept	1.3046	0.3305	0.0001
SF_RATIO	1.1785	0.4701	0.0133
R/E	-1.0262	0.4013	0.0116
MUNL_SIZE	0.0094	0.0021	1.39e-05
log10(DIS_REG_CAP)	0.2032	0.2270	0.3722
log10(DIS_CAP)	-0.2207	0.1016	0.0933
DISTRICT	0.4291	0.1381	0.0023
COUNTY	-0.4370	0.3746	0.2454
DUMMY_REG_A	0.1791	0.2581	0.4890
DUMMY_REG_C	-0.0387	0.1370	0.7782

Note: Multiple R^2 : 0.4818; Adjusted R^2 : 0.4379.

4. Results

Results of the model show the effect of financial possibilities and limitations of municipalities on the level of online services they provide. Six financial indicators were considered significant in this model. However, out of these, only two indicators really were significant namely the *self-financing ratio* and the *ratio between the current revenues and the current expenditures*. The indicators CRpc and TRpc had to be removed from the model as they caused multicollinearity. Due to this fact, hypothesis *H1* assuming a positive correlation between online service maturity and the amount of *per capita* income of local governments could not be evaluated.

The *self-financing ratio* appears to have the strongest influence on the dependent variable. It indicates the ability of a municipality to cover the current expenses from its own revenue thus being independent from grants and subsidies obtained from the state budget. If the value of *self-financing ratio* is greater than 1, the municipality can use available funds for development projects such as informatization of the local government. If the value is lower than 1, the municipality needs to cover current expenses from other sources, i.e. subsidies through state budget. It also becomes less autonomous. Moreover, in the latter case, the municipality lacks funds for further development. *Self-financing ratio* shows a positive dependence; a higher value of

self-financing ratio tends to cause a higher level of online services provided by particular municipalities.

The second indicator, which is statistically significant in the model, is the *ratio between the current revenues and the current expenditures* of a municipality. This indicator shows a negative dependence in relation to the dependent variable.

The simultaneous impact of both variables⁵ on the dependent variable evokes a result that, in terms of online service maturity, it is optimal for the municipalities to achieve a higher degree of self-financing and, at the same time, lower the ratio between the current revenues and the expenditures. This is the case when a municipality is able to cover as much as possible of the current expenditures from its own revenue and is not dependent on transfers from the state budget.

Resulting from the model, we can assume that a higher degree of decentralization is achieved by individual municipalities and, the more autonomous the municipalities are in financing their current expenses, the higher is the maturity of online services they provide. Based on these results, hypothesis *H2* appears to be supported.

From the second group of variables, two variables appear to be significant, namely *municipality size* and dummy variable *district town*. The *municipality size* indicator shows a positive dependence in relation to the explained variable. The model shows that the size of a municipality significantly affects the demand for a higher level of online services. A larger number of inhabitants represents a higher demand for quality of public services, and subsequently for their innovations in public services, while small municipalities are assumed to be characterized by easier and more frequent inter-personal interaction. The latter often face problems such as availability of computers, access to the Internet and poorer computer literacy in general resulting in a lower demand for online services. Indeed, the municipality size is not the only crucial criterion in terms of demand for online services. An important criterion is, e.g. the rurality of the area and hence the related access to the Internet and technical infrastructure. However, according to OECD typology (2010), Slovakia's predominantly urban region is restricted to the territory surrounding the capital. The remaining area is predominantly rural or intermediate where the differences between regions are not so significant. In Slovakia, the most vital criterion of settlements' typology remains to be their size. Based on the model, we can assume that larger municipalities tend to meet the demand and hypothesis *H3* is supported.

Another indicator displaying a positive dependence is the dummy variable defining whether a municipality is a *district town* or not. The model suggests that if a municipality is a district town it achieves better results in the provision of online services. Apparently, district towns fulfill the function of regional centers and, in most cases, they also achieve a higher maturity of online services.

From the third group, no variable shows statistical significance. The impact of the regional context on the maturity of online services has been not confirmed; thus hypothesis *H4* is not supported.

5. Discussion and lessons learned

The above-mentioned results allow us to evaluate the set of five research hypotheses that emerged (Table 8). The relation between the size of a municipality and the probability of adopting an innovation has been studied previously (Musso, Weare, & Hale, 2000; Weare, Musso, & Hale, 1999) with the result that adopters are usually a larger population than non-adopters. Billon, Marco, and Lera-Lopez (2009) stress that in countries registering lower levels of ICT adoption (e.g. transition countries), the digitalization pattern is explained i.a. by the urban population. Moon and deLeon (2001) point to the fact that larger local governments may be more sensitive than smaller ones to external pressures to make the government more efficient.

Table 8. Evaluation of the hypotheses.

Hypothesis	Result
H1 Online service maturity is positively correlated with the amount of <i>per capita</i> income of local governments	Could not be evaluated
H2 Online service maturity is positively correlated with the degree of financial autonomy of local governments	Supported
H3 Online service maturity is positively correlated with the demand measured by the population of local governments	Supported
H4 Online service maturity is positively correlated with innovation capacity of a corresponding region	Not supported
H5 Online service maturity is positively affected by activities of surrounding municipalities	Not supported

Moreover, larger municipalities often have the advantage of greater administrative, technical and financial resources than smaller local governments in seeking alternative innovations (Moon, 2002). As shown in Table 8, the positive relation between demand measured by the size of the municipality and the online service maturity is supported. This indicates that larger municipalities are more likely to be adopters of ICT in the provision of public services than smaller ones.

Seifert and Bonham (2004) highlight both citizens' demand and decentralization to be the key factors by introducing E-government in transition democracies. Some prior studies highlight the role of decentralization in adoption of ITC in the public sector, e.g. in local education (Bryderup & Kowalski, 2002) or the local health-care system (Bossert, 1998). Zakareya and Zahir (2005) point out that central government funding is an important barrier to the adoption of E-government. Mentioned studies suggest policy recommendations for adjusting decision space and incentives which stimulate local authorities to introduce new and innovative approaches to provision of public services. However, to our best knowledge, no research explicitly dealing with the relation between financial autonomy of municipalities and maturity of online services they provide has been done to date.

The detection that financial autonomy seems to be a key factor in the adoption of ICT in public services is an essential lesson for the policy in transition economies. The decentralization process appears to be an important means of narrowing the gap between developed and transition countries and our research contributes to this assumption. The problem of transition economies is that the decentralization process has not been entrenched enough and persistent macroeconomic instability and changes in the national government generate restrictions of competencies in the lower levels of government.

The results of our research show that many municipalities still achieve either level one or level two of online services (Table 3). Overall, the current level of online service maturity is still very low. Our findings allow local governments to better understand the process of adoption of ICT in public services and may encourage them in their efforts to ensure the highest possible financial independency. Generally, there are several possibilities regarding how to increase financial autonomy of local governments. A suitable possibility is to increase the revenue from municipal property based on the use of an appropriate property and land policy. Another reasonable option is to reduce the current expenditures by rationalization, for example, by obtaining economies of scale through joining the provision of certain public services with other municipalities or by contracting services to the private sector and implementing public-private partnership projects, none of which are a common practice in transition economies.

However, the econometric modeling clearly has its limitations. On the one hand, a prerequisite for statistically significant models is to acquire underlying data of acceptable quality. The dependent variable *OSI* is constructed as the assessment of efforts on municipalities' websites and the views of citizens are not represented which may be a limiting factor. It should also be noted that it was not possible to include all variables with an expected impact on the dependent variable and so we focused only on the variables which corresponded with our research question. The model used in the analysis, however, is not intended to serve as forecasting. It only assesses statistical significance of the examined factors. On the other hand, there are several other factors affecting the adoption of ICT in public services, which is very difficult or rather impossible to quantify. Prerequisites for finding new solutions and modernization of traditional forms in provision of public services are factors such as personal motivation, organizational culture and focus on success. In other words, critical assumptions in the adoption of ICT are presented by questions such as how are people motivated, what is the culture of the organization and the overall working environment and what is people's attitude toward challenges and change (Burn & Robins, 2003; Ho, 2002). According to Borins (2001), 50% of the public sector innovations arise from the middle management and front office staff. Soft skills such as maturity of the management and their education, and the resulting ability to secure additional financial resources for municipalities are partially reflected in the examined financial indicators describing the financial autonomy of local governments which has been proved as significant in the model.

6. Conclusion

Support and adoption of ICT in the public sector in Slovakia, in particular at the local level, is an important issue; however, little attention has been paid to this question to date. On the basis of the sample of 152 Slovak municipalities, we have dealt with the issue of ICT adoption which we defined as provision of public services online via municipalities' websites.

After examining the factors affecting the maturity of online services, several conclusions can be drawn. First, according to the results of the model, it appears that a municipality's financial independence from the central budget has a positive impact on the development of innovation in providing online services to its residents. Results from the second group of indicators show that the maturity of online services is higher in larger cities than in small villages. This is particularly true when a municipality is a district town. To summarize, with reference to the results of the model we can assume that a higher level of ICT adoption in public services is achieved by larger municipalities which are district seats and which are financially autonomous.

This lesson is particularly essential for transitive economies, where the decentralization process has not been entrenched yet. Persistent macroeconomic instability and changes in national government generate restrictions of competencies and financial autonomy of lower levels of government. Constraining the powers of municipalities leads to decreasing local influence over the public sector and thus over adoption of ICT in the local public services, as well.

Note

1. Over the last decade, numerous studies have been dealing with the issue of E-government models, e.g. United Nations and American Society for Public Administration (2001), Layne and Lee (2001), Moon (2002), Siau and Long (2005) and Andersen and Henriksen (2006). The implementation of E-government models differs with respect to the range of achievements and complexity. In our study we use a model which is officially used in the implementation process of the National Project *Electronic services* (Ministry of Labour, Social Affairs and Family of the Slovak Republic, 2009) in Slovakia. This model is an application of the UN's five-stage model. We only use four stages due to the fact that the fifth stage has not been achieved by any kind of service yet.

2. NUTS – Nomenclature of Territorial Units for Statistics (from French: *Nomenclature des Unités Territoriales Statistiques*)
3. R is a language and environment for statistical computing and graphics (<http://www.r-project.org/>).
4. Testing spatial dependencies before arranging the econometric model is important in terms of choosing correct model type. Due to the spatial location of the dependent variable *OSI* occurrence of spatial autocorrelation can be assumed, which would require the formulation of spatial regression models. As Moran's test proved independency of residuals we can formulate the linear regression model.
5. It should be noted that between variables SF_RATIO and R/E no multicollinearity was detected.

Notes on contributor

Veronika Černáková is an assistant professor at the Faculty of Economics, Technical university of Košice. She holds a Ph.D. (2012) from the Faculty of Economics, Technical university of Košice, where she studied financing of innovations in public services. Her research activities are focused on innovation in public sector, mainly on the adoption of ICT in the public sector as well as on the local and regional development.

References

- Albury, D. (2005). Fostering innovation in public services. *Public Money & Management*, 25, 51–56.
- Al-Gahtani, S. S. (2010). Computer technology adoption in Saudi Arabia: Correlates of perceived innovation attributes. *Information Technology for Development*, 10, 57–69.
- Andersen, K. V., & Henriksen, H. Z. (2006). E-government maturity models: Extension of the Layne and Lee model. *Government Information Quarterly*, 23, 236–248.
- Arduini, D., Belotti, F., Denni, M., Giungato, G., & Zanfei, A. (2008). *Technology adoption and innovation in public services: The case of e-government in Italy* (Working Papers Series in Economics, Mathematics and Statistics, 2008/04). Retrieved April 8, 2012, from http://ideas.repec.org/p/urb/wpaper/08_04.html
- Azad, B., Faraj, S., Goh, J. F., & Feghali, T. (2010). What shapes global diffusion of e-government: Comparing the influence of National Governance Institutions. *Journal of Global Information Management*, 18(2), 85–104.
- Babcock, T., Bush, M., & Lan, Z. (1995). Executive use of information technology in the public sector: An empirical examination. *Journal of Government Information*, 22, 119–130. Retrieved from <http://www.sciencedirect.com/science/journal/13520237>
- Billon, M., Marco, R., & Lera-Lopez, F. (2009). Disparities in ICT adoption: A multidimensional approach to study the cross-country digital divide. *Telecommunications Policy*, 33, 596–610.
- Boetti, L., Piacenza, M., & Turati, G. (2010). *Decentralization and local governments' performance: How does fiscal autonomy affect spending efficiency?* (Working Paper No. 11). Retrieved March 23, 2012, from <http://web.econ.unito.it/prato/papers/n11.pdf>
- Bonissone, P. P. (1998). *Determination of weight vector (cardinal ratio scale) from pairwise comparisons*. Retrieved February 7, 2012, from <http://homepages.rpi.edu/~bonisp/fuzzy-course/99/L5/saaty.pdf>
- Borins, S. (2001). Encouraging innovation in the public sector. *Journal of Intellectual Capital*, 2, 310–319.
- Bossert, T. (1998). Analyzing the decentralization of health systems in developing countries: Decision space, innovation and performance. *Social Science & Medicine*, 47, 1513–1527.
- Bryderup, I. M., & Kowalski, K. (2002). The role of local authorities in the integration of ICT in learning. *Journal of Computer Assisted Learning*, 18, 469–479.
- Burn, J., & Robins, G. (2003). Moving towards e-government: A case study of organizational change processes. *Logistics Information Management*, 16(1), 25–35.
- Bygstad, B., & Lanestedt, G. (2009). ICT based service innovation – a challenge for project management. *International Journal of Project Management*, 27, 234–242.
- Carlsen, F. (2005). Migration plans, local fiscal variables, and local economic conditions. *Finanzarchiv*, 61, 154–177.
- Charney, A. (1993). Migration and the public sector: A survey. *Regional Studies*, 27, 313–326.
- De Borger, B., & Kerstens, K. (1996). Cost efficiency of Belgian local governments: A comparative analysis of FDH, DEA, and econometric approaches. *Regional Science and Urban Economics*, 26, 145–170. Retrieved from <http://www.sciencedirect.com/science/article/pii/0166046295021272>
- De Borger, B., Kerstens, K., Moesen, W., & Vanneste, J. (1994). Explaining differences in productive efficiency: An application to Belgian municipalities. *Public Choice*, 80, 339–358.

- Donahue, J. D. (2005). *Dynamics of diffusion: Conceptions of American federalism and public-sector innovation*. Retrieved June 29, 2012, from <http://www.innovations.harvard.edu/cache/documents/6771.pdf>
- Douček, P., & Nedomová, L. (2011). Porovnání ICT sektorů v České republice a Slovenské republice. [Comparing the ICT sector in the Czech Republic and Slovak Republic]. *Acta Oeconomica Pragensia*, 5, 68–86.
- Evangelista, R., Sirilli, G., & Smith, K. (1998). *Measuring innovation in services* (IDEA Paper Series No. 6). Retrieved May 16, 2012, from <http://survey.nifu.no/step/old/Projectarea/IDEA/Idea6.pdf>
- Gallouj, F., & Weinstein, O. (1997). Innovation in services. *Research Policy*, 26, 537–556. Retrieved from <http://www.sciencedirect.com/science/journal/00487333/26/4-5>
- Hipp, C., & Grupp, H. (2005). Innovation in the service sector: The demand for service – specific innovation measurement concepts and typologies. *Research Policy*, 34, 517–535.
- Ho, A. T. (2002). Reinventing local governments and the e-government initiative. *Public Administration Review*, 62(4), 434–444.
- Iñedo, P., & Singh, M. (2011). Determinants of eGovernment maturity in the transition economies of Central and Eastern Europe. *Electronic Journal of e-Government*, 9, 166–182.
- Kinder, T. (2010). E-government service innovation in the Scottish criminal justice information system. *Financial Accountability & Management*, 26, 21–41.
- Layne, K., & Lee, J. (2001). Developing fully functional E-government: A four stage model. *Government Information Quarterly*, 18, 122–136. Retrieved from <http://www.sciencedirect.com/science/journal/0740624X/18/2>
- Ministry of Labour, Social Affairs and Family of the Slovak Republic (2009). National Project Electronic services. Retrieved from <http://www.itapa.sk/data/att/460.pdf>
- Miozzo, M., & Soete, L. (2001). Internationalization of services: A technological perspective. *Technological Forecasting and Social Change*, 67, 159–185. Retrieved from <http://www.sciencedirect.com/science/journal/00401625>
- Moon, M. J. (2002). The evolution of E-government among municipalities: Rhetoric or reality? *Public Administration Review*, 62, 424–433.
- Moon, M. J., & deLeon, P. (2001). Municipal reinvention: Municipal values and diffusion among municipalities. *Journal of Public Administration Research and Theory*, 11, 327–352. Retrieved from <http://jpart.oxfordjournals.org/content/11/3/327.full.pdf+html>
- Mulgan, G., & Albury, D. (2003). *Innovation in the public sector*. Strategy Unit, Cabinet Office. Retrieved March 12, 2012, from <http://www.cabinetoffice.gov.uk/strategy/pubinov2.pdf>
- Müller, E., Jappe, A., Héraud, J.-A., & Zenker, A. (2006). *A regional typology of innovation capacities in new member states & candidate countries* (Fraunhofer ISI Working Papers No. R1/2006). Retrieved March 8, 2012, from http://www.isi.fraunhofer.de/isi-media/docs/p/de/arbapap_unternehmen_region/ap_r1_2006.pdf
- Musso, J., Weare, C., & Hale, M. (2000). Designing web technologies for local governance reform: Good management or good democracy. *Political Communication*, 17(1), 1–19. Retrieved from <http://www.usc.edu/dept/LAS/SC2/pdf/newweare.pdf>
- OECD (2010). *OECD regional typology*. Retrieved October 25, 2013, from <http://www.oecd.org/regional/regional-policy/42392595.pdf>
- Piatkowski, M., & van Ark, B. (2005). *ICT and productivity growth in transition economies: Two-phase convergence and structural reforms* (TIGER Working Paper Series No. 72). Retrieved June 16, 2013, from <http://mpr.ub.uni-muenchen.de/29398/>
- Potnis, D. D. (2010). Measuring e-Governance as an innovation in the public sector. *Government Information Quarterly*, 27, 41–48.
- Regional database of the Statistical Office of the Slovak Republic*. Retrieved from <http://px-web.statistics.sk/PXWebSlovak>
- Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York, NY: The Free Press.
- Seifert, J. W., & Bonham, G. M. (2004). *The transformative potential of E-government in transitional democracies*. Retrieved November 24, 2013, from http://faculty.maxwell.syr.edu/gmbonham/Transformative_Potential_of_E-Government.pdf
- Siau, K., & Long, Y. (2005). Synthesizing E-government stage models – a meta-synthesis based on meta-ethnography approach. *Industrial Management + Data Systems*, 105, 443–458.
- Singh, H., Das, A., & Joseph, D. (2007). Country-level determinants of E-government maturity. *Communications of the Association for Information Systems*, 20, Article 40. Retrieved from <http://aisel.aisnet.org/cais/vol20/iss1/40>

- Tether, B. S., & Hipp, C. (2002). Knowledge intensive, technical and other services: Patterns of competitiveness and innovation compared. *Technology Analysis and Strategic Management*, 14, 163–182.
- The R Project for Statistical Computing (2.15.3) [Computer software]. Retrieved from <http://www.r-project.org>
- Torres, L., Pina, V., & Acerete, B. (2005). E-government developments on delivering public services among EU cities. *Government Information Quarterly*, 22, 217–238.
- United Nations and American Society for Public Administration. (2001). *Five stages of E-government*. Global survey of E-government. Asia Oceania E-business marketplace alliance. Retrieved September 23, 2013, from <http://www.ncc.gov.ph/files/UN-ASP5StagesEGovt.pdf>
- Vanden Eeckhaut, P., Tulkens, H., & Jamar, M. A. (1993). Cost efficiency in Belgian municipalities. In H. O. Fried, C. A. Knox Lovell, & S. S. Schmidt (Eds.), *The measurement of productive efficiency: Techniques and applications* (pp. 300–334). New York, NY: Oxford University Press.
- Vanderlinde, R., & van Braak, J. (2010). Implementing an ICT curriculum in a decentralised policy context: Description of ICT practices in three Flemish primary schools. *British Journal of Educational Technology*, 41, 139–141.
- Venturini, F. (2009). The long-run impact of ICT. *Empirical Economics*, 37, 497–515.
- Weare, C., Musso, J., & Hale, M. (1999). Electronic democracy and the diffusion of municipal web pages in California. *Administration and Society*, 31(1), 3–27.
- Windrum, P. (2008). Innovation and entrepreneurship in public services. In P. Windrum & P. Koch (Eds.), *Innovation in public sector services. Entrepreneurship, creativity and management* (pp. 3–20). Cheltenham: Edward Elgar Publishing.
- Zakareya, E., & Zahir, I. (2005). E-government adoption: Architecture and barriers. *Business Process Management Journal*, 11, 589–611.

Copyright of Information Technology for Development is the property of Taylor & Francis Ltd and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.