

## The development of E-government at the county and city levels in the United States

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**Abstract:** A three-stage model (publishing, interaction and transaction) was employed in order to better understand the development of e-government via the websites of local governments in the United States. Using data from a survey of local governments, a tobit regression model were then used to test the influence of supply, demand and structural factors on each of the three stages of e-government. The results suggest that supply side factors are significant for all stages. In terms of demand, education and internet hosts are increasingly significant and have larger impacts for the first two stages of e-gov. However, in the final (transaction) stage, only education is significant and slightly less so than in previous stages. It is argued that as technological applications become more sophisticated so does the importance of education. Finally, central localities are shown to have an advantage over suburban and independent localities in terms of e-government development.

## 1. Introduction

Given the pervasiveness and importance of information and communication technologies (ICT's) in today's society, a growing body of research explores its application to government, or e-government (egov). Proponents argue that there are three major opportunities to be realized in this regard. Firstly, e-gov can improve communication and delivery of public services through technologies such as the Internet. Secondly, it can improve the efficiency of government operations. This can occur through the redesign and simplification of organizational processes, the improved flow of internal information, the integration of government departments and standardization and unification of services (Heeks, 2001). Finally e-gov through the larger rubric of e-democracy provides the opportunity for good governance through more transparent and participatory decision-making (Norris, 2001; Seifert & Bonham, 2004).

The application of e-gov is relevant to all levels of government. However, while there has been much emphasis on investigating the development and efficacy of e-gov initiatives at the international (e.g. UNDESA, 2005) or national levels (see for example the latest annual e-gov report on the US by West, 2006), less research has been directed at the local level. In fact, it is at this level, the impact of egov can be even more significant given the relative smaller distance between citizen and government (Ferdinand, 2000). This paper seeks to understand the factors that influence the development of e-gov at the local (county and municipality) level in the United States. The next section (2) provides a cursory review of the some of the literature in this area as well as a discussion of the relevant concepts. Section 3 presents the data and methods used while section 4 provides a discussion and analysis of the results. Finally, section 5 offers some concluding thoughts.

## 2. E-government: the demand, supply and structural dimensions

Different approaches have been postulated at conceptualizing and understanding how e-gov evolves. Along one dimension e-gov can be differentiated according to its client group. Three groups are usually mentioned in the e-commerce and general business literature as citizens (or government to citizens (G2C)), business (G2B) and other government groups (G2G). Thus e-gov will develop in terms of the relevance of each group to the government in question.

Another approach is to articulate e-gov as a linear process across discernable stages of development. One such model is presented by Layne & Lee (2001) who argue that e-government passes through four stages: catalogue (online presence of information), transaction (provision of services and forms online), vertical integration (local systems linked to higher level systems – eg. state to federal) and horizontal integration (systems linked across different functions). In its annual study of e-gov across governments, UNDESA (2005) developed a five stage model based on levels of presence. The first level is emerging, or the existence of a website with basic and limited provision of information. This is followed by enhanced presence (greater provision of information using search tools but still a one way flow of information), interactive presence (greater interaction through downloadable forms, license renewal and communication options), transactional presence (online payment for services) and networked presence (participatory decision-making).

Given the argument that the development of e-government moves through several stages what then can be said about how this development takes place. What factors propel a government's egov initiative from one stage to the next? One factor could be the demand for e-gov among

citizens. From the demand side, one consideration is the extent to which the Internet is accessed and used by citizens. In the United States, Hoffman and Novak (1998) argue that education plays a critical role in Internet use. Chaudhuri, et al. (2005) conclude that the main factors explaining Internet subscription at the individual level in the US included income and education and to a lesser extent, race and marriage status.

Dimitrova & Chen (2006) suggest there are several socio-psychological characteristics that explain the use of e-gov at the individual level such as perceived usefulness and civic-mindedness. In a similar vein, Warkentin et al. (2002) suggest that the level of trust a user has of the government will influence their decision to use e-gov. This also depends on the level of intrusiveness that the e-gov service entails. Other factors include broadband use (although this has had only a marginal impact) and the type of information being sought (Horrihan, 2004).

On the supply side, we can identify several factors internal to the government in question that can influence e-gov development. For example, in an evaluation of e-gov across several countries Accenture (2004) suggests that for countries to move from one stage of e-gov to the next depends on where they currently are. For example, countries at preliminary stages that focus on the provision on high-demand services and those at intermediary stages that focus on the transformation of service delivery and not automation develop faster and more effectively. Another factor that explains the level of e-gov services provided is the extent to which the government in question is aware of the needs of its citizens (Accenture, 2005).

Other factors to consider relate to the development of any information system and include the technical and planning capacity of the organization in question. Also, the financial resources available to the local government are also relevant (Weare, Musso, & Hale, 1999). Finally, the system will be enhanced if it is guided by an effective policy or strategy.

Another set of factors that could be described as structural in the sense that they are external to the government organization in question. In a study of local government systems in the Netherlands, Leenes & Svensson (2002) argue that the size of the government will influence the development of e-gov. Additionally, in their analysis of the International City/County Management Association's (ICMA) 2000 survey of local governments in the United States, Holden et al. (2003) contend that the type of government and city status helped to explain e-gov adoption by local governments. Reddick (2004) notes that council manager/administrator types of government are more receptive to e-gov deployment. Finally the concentration of socio-economic elites and voter registration levels have also been argued to be significant factors in this regard (Weare, Musso, & Hale, 1999).

Given the factors that can influence e-gov development at the local level outlined above, this study addresses three related hypotheses. Firstly, it is hypothesized that local jurisdictions with higher levels of income and education will tend to have more advanced levels of e-gov. Secondly, we hypothesize that higher levels of the supply-side factors of capacity, strategy, and awareness will be positively related to levels of e-gov development. Third, following previous studies, we hypothesize that the structural factors of council manager/administrator and central localities are related to more advanced levels of e-gov than other types of government systems.

### 3. Methodology and Data

Based on the literature, e-government has been defined in many ways to emphasize the different themes that it encompasses. For our purposes, we will focus on the use of the Internet as a tool in improving the functioning of government. Thus the emphasis will be on the use of websites by local governments as part of their egov initiatives. The data set used in this study was the 2002 survey of e-government administered by the ICMA. This is part of a series of surveys conducted by the ICMA at the local government level in the United States. The survey consisted of some 4,123 respondents from counties and municipalities across the US. The survey covered questions ranging from the type of services provided by the local government's website to the benefits of and barriers to its use. The data was used by the ICMA to develop its own report on e-gov for its members.

The analytical model employed consists of a series regression analyses to test the above hypotheses. The level of e-gov development was broken down into three separate dependent variables based on the development of three stages of e-gov. The first stage is publishing, where only a basic online presence exists for the provision of information. The second stage is referred to as interaction where greater information is provided through two-communication methods. Finally there is the transaction stage where online payments are enabled. A fourth stage is mentioned in the literature and involves greater inter-governmental integration and participatory decision-making. However, this level of egov is increasingly interdependent on concomitant institutional reforms in the wider political environment (Kluver, 2005). The measurement of such reforms was outside the scope of the ICMA survey.

The three dependent variables were constructed using three sets of dichotomous variables. These variables were chosen based on their relevance to each e-gov stage (see Table 1 below). Each set of dichotomous variables was summed to give a value for the dependent variable. Thus the dependent variables are defined as the number of instances of a particular stage of e-gov development. Higher values of a dependent variable were interpreted as greater development of a website within a particular stage of e-gov. This was reasonable given that each dichotomous variable addressed different features of the website. A similar method was used by Reddick (2004) in his study of local governments within the US using the same data set. However, the construction of his dependent variables includes a two-stage e-gov model that varies according to G2C, G2C and G2G website features.

Table 1 – Construction of Dependent Variables

Dependent Variable (Stage of egov development)	Associated ICMA 2002 Survey Questions
Publishing (egovpub) – total 7 dichotomous variables used	<ol style="list-style-type: none"> <li>1. Does your local government have a web site?</li> <li>2. On line requests for local government records</li> <li>3. On line delivery of local governments records to the requestor.</li> <li>4. Does your local government have an Intranet (a web server accessible only to local governments employees)? Does it –</li> <li>5. Provide news &amp; information</li> <li>6. Publish documents &amp; manuals online to reduce printing costs</li> <li>7. Post job openings for internal recruitments</li> </ol>
Interaction (egovinter) – total 13 dichotomous variables used	<ol style="list-style-type: none"> <li>1. Online completion and submission of permit applications</li> <li>2. Online completion and submission of business license applications/renewals</li> <li>3. Online registration for use of recreational</li> </ol>

Dependent Variable (Stage of egov development)	Associated ICMA 2002 Survey Questions
	facilities, such as reserving picnic areas, racquetball courts, and classes 4. Online voter registration 5. Online property registration, such as animal, bicycle registration 6. Forms that can be downloaded for manual completion (e.g., voter registration, building permits, etc.) 7. Online communication with individual elected and appointed officials 8. Provide employees benefit forms 9. Provide online report generation 10. Enable project teams to collaborate 11. Expand telecommuting staff access to information and data 12. Provide online training 13. Does your local government provide GIS data online to residents/businesses upon request?
Transaction (egovtrans) – total 6 dichotomous variables used	1. Online payment of taxes 2. Online payment of utility bills 3. Online payment of fines/fees 4. Online requests for services, such as pothole repair 5. Does your local government charge a fee to residents/businesses for GIS data? 6. Provide online procurement tools

In order to check the extent to which each dependent variable is actually measuring a single construct (publishing, interaction and transaction) as proposed by the model, we check the cronbach's alpha of the variable. Cronbach's alpha will usually be low if the data in question has a multi-dimensional structure. Thus we are able to indirectly test how well the proposed grouping of variables in Table 1 is appropriate. For publishing and interaction, the alpha scores are 0.8277 and 0.7561 respectively. This suggests that for example, the group of publishing variables is measuring the same underlying construct. For transaction, the alpha is 0.4268.

Although not ideal, we still employ this variable as alternative measures for transactional features on a local government's website were not available in the survey. It should also be noted that other more comprehensive methods such as factor analysis could be used to better understand the relationships between the variables used here.

Three sets of independent variables are used based on the hypotheses listed above. The first set deals with demand side variables. These are income (measured as per capita income in 1999 dollars) and education (percentage of population with at least a bachelors degree or higher). The data for these variables are from the 2000 US census and were acquired using DataFerret<sup>1</sup>. The data for these variables were provided at the county level. In some cases, the respondents of the ICMA survey were counties. However in other cases, the respondents included municipalities below the county level. I assume that the variance for income and education at the municipality level is not sufficiently different from the county level so as to change the overall results. A third variable was also included to account for access to the Internet. Using data from the Federal Communications Commission (FCC), the number of internet hosts available for each locality was included. This provides a proxy for the level of Internet use. More specific data on Internet use was not available for most of the localities in the data set.

The second set of independent variables concerns supply side factors. Capacity was measured by the existence of a separate Information Technology (IT) department responsible for e-gov. Awareness was measured by the whether or not the local government had conducted a survey to determine citizen and business online needs. Strategy was measured by the number of areas covered by web-site policies put in place by the local government.

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<sup>1</sup> <http://dataferrett.census.gov/>

The third set of independent variables deals with structural factors. The variable for type of government included in the data set was recoded into four dummy variables – mayor-council, council-manager, commission and town meeting. Mayor-council was used as the reference group. The variable for metro status was recoded into three dummy variables – central (core city or county within a metropolitan statistical area (MSA)), suburban (city/county within an MSA) and independent (city or county not in a MSA). Central was used as the reference group.

In addition, two control variables were included. Population for each locality was included based on the 2000 census and the budget that each local government had available for e-gov was included in the analysis. This was provided in terms of an ordinal level variable with seven increasing categories from none to over \$100,000.

All variables mentioned here and their respective sources are summarized in Table 2. Thus our final model consists of the three sets of independent variables mentioned above and the control variables. This model is then applied to each of the three dependent variables.

Table 2 – List of Independent Variables and sources

Independent Variable	Source
Per capita income in 1999 dollars	2000 Census
Percentage of population with at least a bachelors degree or higher	2000 Census
Internet hosts per county as at 12-2002	FCC <sup>2</sup>
The existence of a separate IT department responsible for e-gov.	ICMA data set
Survey conducted to determine citizen and business online needs.	ICMA data set
Number of web-site policies put in place by the local government	ICMA data set
Type of government	ICMA data set
Metro status	ICMA data set
Population	2000 Census
Budget category	ICMA data set

<sup>2</sup> [http://www.fcc.gov/Bureaus/Common\\_Carrier/Reports/FCC-State\\_Link/IAD/hzip1202.zip](http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/IAD/hzip1202.zip)

Table 3 provides the summary statistics for all the variables used. Of note here is the skewed distribution of the dependent variables. In all three cases, these variables consist of low mean values reflecting the fact most local governments do not have many instances of e-gov in any stage. While attempting to better understand the development of e-government it becomes important to capture the censored outcomes. The censored outcomes imply that the minimum level of e-government activities under a given e-gov stage was not met, thus giving a dependent variable score of zero. Therefore a Tobit regression model was chosen over ordinary least squares (OLS) to better accommodate the presence of this left censored data. In such instances, Tobit analyses produce more efficient and unbiased estimates (Long, 1997).

Table 3 – Summary Statistics of Variables used in model

Variable	Obs	Mean	Std. Dev.	Min	Max
Publishing	4123	1.959981	1.98248	0	7
Interaction	4123	1.609265	1.993045	0	11
Transaction	4123	.420325	.751285	0	6
Survey conducted to determine citizen and business online needs	4123	.0686393	.2528705	0	1
Number of web-site policies put in place by the local government	4123	.654863	1.053617	0	5
Budget category	4123	.6155712	1.516022	0	6
The existence of a separate IT department responsible for e-gov.	4123	.2908077	.45419	0	1
Internet hosts per county as at 12-2002	3663	7.341796	3.738228	1	20
Per capita income in 1999 dollars	4110	21115.15	5244.098	8986	44962
Percentage of population with at least a bachelors degree or higher	4110	.2115547	.088585	.05	.59
Suburban (metrostatus2)	4123	.5442639	.4980973	0	1
Independent (metrostatus3)	4123	.3461072	.4757856	0	1
Council-manager (govtype2)	4086	.6079295	.488272	0	1
Commission (govtype3)	4086	.0127264	.1121049	0	1
Town meeting (govtype4)	4086	.0413607	.1991475	0	1
Population	4123	36522.62	116200.2	2505	3072149

#### 4. Results and Discussion

We proceed by looking at the application of the tobit model to each of the dependent variables. In each case the model is significant as a whole given the likelihood ratio test values (see Table 4 below). For publishing, we see that both the control variables (population and budget category) are significant. However, the small value of the coefficient on population makes it meaningless while each categorical increase in the local government's budget is associated with a 0.205 expected increase in the number of instances of publishing. All three supply side variables are significant and have positive effects with regard to publishing. Thus conducting a survey to determine the online services demanded by citizens and businesses will increase the expected instances of publishing by 0.4 and each web site policy (eg. privacy, security, etc.) put in place by the local government increases the expected instances of publishing by 0.5. Perhaps, most important among the supply side variables is the existence of a separate IT department whose responsibilities include e-gov. This increases the expected instances of publishing by 1.3.

In terms of the demand side variables, only internet hosts and education are shown to be significant for publishing. Internet hosts has the smaller impact of the two. Each additional internet host is expected to increase instances of publishing by 0.025. However this is only significant at the 5% level. The influence of education is much higher with the expected increase in instances of publishing from each additional percentage point of the population having at least a bachelors degree being 2.9.

The first set of structural variables includes the metro status (central city, suburban and independent) of the local government unit in question. Metro-status is shown to be significant

with the expected difference in instances of publishing between suburban and central localities being -0.67. Thus central localities have 0.67 more instances of publishing than suburban ones. Similarly the expected difference in instances of publishing between independent and central localities is -0.7. In terms of types of government, only the council-manager variable was found to be significant. In other words, a council-manager system is expected to have 0.61 more instances of publishing than a mayor-council system while controlling for all other factors.

The second dependent variable is interaction. From Table 4, we find that the budget category and not population is significant for interaction. Here, the coefficient on the budget category is almost the same as under publishing. Specifically, the expected increase in instances of interaction from each categorical increase in the budget is 0.204. However, given that the range in values for interaction is greater than publishing, we can infer from these results that the local government's budget is more important for publishing than for interaction.

As with publishing, all three supply variables are significant and positive for interaction. In addition, the coefficients are also similar in size to those under the publishing model. A similar pattern can also be found in terms of the demand side variables. For example, both internet hosts and education are positive and significant while income is not significant. Additionally, both internet hosts and education are more significant at this stage. The significance and size of these demand-side variables in this stage as compared to the publishing stage could indicate a greater reliance on technology here. The instances of interaction mentioned earlier (see Table 1) imply greater familiarity with the Internet as well as more regular access. Thus variables such as education and internet hosts become more relevant at this stage.

Table 4 – Tobit Regression Results

Variable	Publishing	Interaction	Transaction
Population	0.000 (0.000)**	0.000 (0.000)	0.000 (0.000)*
Budget category	0.205 (0.024)**	0.204 (0.028)**	0.091 (0.022)**
Survey conducted to determine citizen and business online needs	0.401 (0.137)**	0.986 (0.164)**	0.406 (0.125)**
Number of web-site policies put in place by the local government	0.548 (0.035)**	0.749 (0.042)**	0.356 (0.033)**
The existence of a separate IT department responsible for e-gov.	1.361 (0.088)**	1.420 (0.107)**	0.570 (0.086)**
Internet hosts per county as at 12-2002	0.025 (0.011)*	0.056 (0.014)**	0.014 (0.011)
Per capita income in 1999 dollars	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Percentage of population with at least a bachelors degree or higher	2.987 (0.703)**	3.839 (0.868)**	1.884 (0.706)**
Suburban (metrostatus2)	-0.674 (0.143)**	-0.670 (0.172)**	-0.373 (0.132)**
Independent (metrostatus3)	-0.706 (0.151)**	-0.652 (0.184)**	-0.591 (0.143)**
Council-manager (govtype2)	0.616 (0.073)**	0.696 (0.093)**	0.250 (0.076)**
Commission (govtype3)	-0.571 (0.306)	-0.682 (0.400)	-0.831 (0.391)*
Town meeting (govtype4)	0.046 (0.172)	-0.034 (0.220)	-0.546 (0.198)**
Constant	-0.134 (0.219)	-1.685 (0.272)**	-1.882 (0.220)**
Observations	3620	3620	3620
Log Likelihood	-6142.6062	-5430.4678	-3044.564
Left censored observations	991 at egovpub<=0	1611 at egovinter<=0	2570 at egovtrans<=0
Uncensored observations	2629	2009	1050
LR chi2(13)	1788.88	1786.43	764.06
Prob > chi2	0.0000	0.0000	0.0000

Standard errors in parentheses

\* significant at 5%; \*\* significant at 1%

In terms of the structural variables, the metro status variables are also significant with central again having an advantage over both suburban and independent localities. Here the expected difference in instances of interaction between central and suburban localities and central and independent localities is -0.67 and -0.65 respectively. In terms of the type of government, again only the council-manager variable is significant with a similar effect. Thus as with publishing, there appears to be no significant difference between mayor-councils and commissions or mayor-councils and town meetings in terms of instances of interaction.

The final egov dependent variable is transaction. Here population is significant but remains meaningless given the size of the co-efficient. The budget category variable is also significant however it is now has a smaller impact than in previous stages. With regard to the supply side variables, all three are significant as before but with less impact. Most notable is the existence of a separate IT department which has a coefficient less than half that of previous stages.

The only demand-side variable to be significant at the transaction stage is education. The results show that the expected increase in instances of transactions from each additional percentage point of the population having at least a bachelors degree is 1.18.

Both sets of variables indicate the decreased importance of technological factors at this stage of e-gov. Although this might appear to be counter-intuitive, it is possible that as e-gov applications become more advanced (that is moving from websites with features of publishing/interaction to

those with transactions) then other factors such as the ability to use these applications become more important. Thus education remains significant.

In the transaction stage metro status remains a significant variable. The results show that the advantage of central localities over suburban and independent localities is 0.37 and 0.59 respectively in terms of instances of transaction. These differences are slightly lower than at previous stages. The major difference however, is in the type of government. Unlike previous stages all three government variables are significant. The co-efficient on the council manager variable is less than in previous stages but still positive. The co-efficients on commissions and town meetings are both negative. That is, mayor-council systems are expected to have 0.83 and 0.54 more instances of transactions than commissions and town meetings respectively.

The above discussion permits us to now return to our original hypotheses. In the first case, the hypothesis was that demand side factors would have a positive relationship on e-gov development. Internet hosts was only significant in the first two stages – publishing and interaction. Education was significant in all three stages with greater effect and significance in the first two. As suggested earlier, the implication here is that as we move to more advanced forms of technological use, education remains relevant relative to other demand side variables. We would have expected Internet hosts to be similarly important given the greater reliance on technology. Perhaps a more accurate measurement of Internet use (such number of persons who use the Internet) would provide a better understanding. Per capita income was not significant in any of the stages implying the limited impact of the demand variables overall. This could also be a result of the greater reliance of e-gov development on supply-side variables.

The evidence of this was the fact that all the supply-side variables were significant in all the three stages. In each case they were positively related to the various stages of e-gov, thus supporting the second hypothesis that the supply-side factors of capacity, strategy, and awareness are positively related the level of e-gov development.

The third hypothesis stated that the structural factors of council manager/administrator and central localities (metro status) are related to more advanced e-gov development over other types of government. For each stage of e-gov, it was shown that the metro status of central had an advantage over suburban and independent localities. This would support that the hypothesis that central localities are more likely to be further developed in terms of e-gov that their suburban and independent counterparts.

Council-manager systems were found to have higher instances of egov at all stages over mayor-councils. Furthermore, at the transaction stage, commissions and town meetings were found to have lower instances of transaction than mayor-council systems. However, these variables are not significant at previous stages. Thus we can only support this part of the third hypothesis – council-manager systems have higher instances egov for the transaction stage. The fact that town-meetings become significant at the transaction stage could imply that the move to more participatory forms of e-gov is facilitated by similarly participatory forms of governance. However, the sign of the regression co-efficient in this case does not support this conjecture.

## 5. Conclusion

This paper presented the results of a series of regressions to test three hypotheses related to factors that influence the development of e-gov at the local government level. Using a three stage model of e-gov development, the most significant factors were found to be supply side variables, a central metro status and education.

Several assumptions were made in developing the regression models such as the use of demand-side variables (education, income, internet hosts) at the county level as a substitute for municipality level data. Although the results from their inclusion proved useful to some extent, perhaps more accurate results could be gained from data at the municipality level where required. For example, one problem with the income and education variables was that they were highly correlated. While there are jointly significant, further research could employ other measures where an alternative is identified. Also subsequent data sets from similar surveys have been made available by the ICMA on a biennial basis. This could be employed to improve the existing study as well as investigate trends in the development of e-gov.

Another issue is that the model ignored factors that explain technology adoption at the individual level both among citizens (as mentioned earlier) and even among local government workers. While the focus was not on the individual level, the inclusion of indicators measuring relevant attitudes at the county/municipal level could be useful.

With these considerations in mind, the policy implications for a local government entity would be to focus on factors such as being aware of citizens and business online needs (for example

through surveys), ensuring that there is adequate technical capacity within the government to handle e-gov, and ensuring that adequate strategies and policies are in place to drive the development of e-gov.

Whereas these results suggest what factors are important, further research could better articulate the nature of these factors. Outside of these internal factors, local governments also need to be cognizant of the advantages of that cities and council-manager systems have in most stages of e-gov. Finally broader policy issues concern the level of education within the population.

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