Information Polity 20 (2015) 167–182
DOI 10.3233/IP-150360
IOS Press

Digital governance and public value creation at the state level

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Abstract. Digital government has been a key component on government reform strategies during the last years. Unfortunately, few research exists reporting on the impacts of electronic government in terms of the final outcomes. By using a model that links digital governance characteristics to value creation, this paper explores the impacts of electronic governance on competitiveness, government efficiency, and number of electronic transactions. We used panel data analysis to test eighteen hypotheses. Results support only one of the 18 hypotheses, and four of the hypothesis resulted statistically significant in the opposite direction. Results suggest that citizens use digital government mainly to complete electronic transactions with government. Our results also suggest that, at least at the initial stages, having two delivery channels have a negative impact on government efficiency, and against common belief, they have no impact on the competitiveness of a region. Finally, our results show that most of the value is explained by contextual variables used for control purposes. We believe that these results challenge, at least partially, some of the current guiding principles and beliefs in conducting digital governance research, and suggest the need of better theories to explain public value creation through digital governance.

Keywords: Digital governance, evaluation, public value, Mexico

1. Introduction

Information technology (IT) adoption in the Public Sector has been associated with the creation of value for the public [8,13,15,17]. Such perception of value as well as the conceptualization of IT use in government, however, have been changing over time. In the early days of computing in government, the main applications for batch-processing repetitive tasks such as the payroll were mainly oriented to create efficiencies and cost savings [1]. Later, the New Public Management type of reforms promoted, among other things, performance measurement and a results orientation that added to the original efficiency goals, measures for effectiveness, transparency or accountability [15,46]. In the last few years, the use of IT in government has also responded to the need of a policy framework involving better public services and government operations, but also citizen engagement and interorganizational collaboration with public and private organizations, involving then the themes of democracy and governance as key results of IT implementations [17]. During these last two periods of time, the terms digital government and digital governance have been used to describe the design and use of IT applications in government [17]. Although developing fine-tuned definitions distinguishing both terms goes beyond the scope of this paper, it is possible to say that digital government has been mostly associated with New Public Management

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interventions [46,48], and digital governance has been mostly associated with the later trends of Public Value Management and Joined-Up Government [17,21]. In this way – and assuming that the concept of digital governance is more comprehensive than digital government – expected benefits and impacts from digital governance on value creation involve not only the efficiencies and improvements in service, but also a wider set of impacts in improving democracy or developing a more open and sustainable society through public-private partnerships and other forms of governance.

There is a long tradition of research attempting to better understand benefits of IT applications in government. Most of this research involves the description of levels of usability or functionality of digital government systems or websites [19,50,55,59]. Some others report on the impact of direct inputs or other contextual or institutional variables on system characteristics in terms of functionality and usability [30, 34,37,49,60]. Unfortunately, very few research exists reporting on the impacts of digital governance in terms of the public value outcomes from using the systems, such as reduction in costs, improved tax collection, or improved access to services or to different forms of participation [27].

The purpose of this paper is then to contribute to previous endeavors by exploring the impacts of digital governance in public value creation. Although digital governance implies that both government and the public participate in creating value, this initial project only focuses on government initiated actions. The question guiding our research is what are the main impacts of digital governance features on public value creation? To answer the question, we use panel data from Mexican state government portals, and its impact in government efficiency, state competitiveness and government portal use as proxies for public value creation. Data about state portals describes their level of development in terms of the availability of information, on-line transactions and opportunities for public participation as well as the level of integration of services across government offices. We use secondary data describing the government efficiency, government portal use and state competitiveness. Results from data analysis suggest that Mexican state portals are mainly used to pay taxes and other government transactions. Results also suggest that spending more on the government portal impacts government efficiency in a negative way, which may be related to the duplication of on-line and off-line services. Contextual variables used as control variables are the variables explaining most of the variance on the dependent variables, which suggests that digital governance by itself has little impact on all dependent variables.

The rest of the paper is organized in five more sections after this brief introduction. The second section includes a literature review on digital government evaluation, as well as its impacts and value creation. The third section includes a description of the model and the hypothesis used in this study. The fourth section describes the procedures to obtain the data. We report the results of the analysis on section five, and finally, we discuss our findings as well as their main implications in the last section.

2. Literature review

In this section of the paper we start by relating digital governance with public value creation, and then we focus on previous research in digital governance evaluation.

2.1. Digital governance and public value creation

Two main strategic approaches have dominated the public management arena in the last decades, the traditional bureaucracy and the new public management approach. In the last years, however, a third competing approach has been emerging, and although it currently has many different names, some experts have been calling this last approach Public Value Management [10,52]. Each of these approaches

to public administration is looking for the improvement of the living conditions of the citizens, although following different approaches in the ways of setting objectives, providing leadership, delivering services and contributing to the democratic process. For example, the traditional bureaucracy prefers to deliver services through hierarchically organized organizations, the new public management prefers to provide services through the private sector, and the public value approach prefers to create ad-hoc networks of public and private actors to achieve outputs [52]. Information Technologies (IT) may play a role in supporting any of these strategies and creating value, by means of automation of rules and standard processes or by facilitating collaboration among a number of public and private entities. The goals, however, may be different accordingly to the strategic focus as we described in the introduction, going from efficiency and cost savings in the Traditional Bureaucracy [1], to effectiveness and results in new public management [10,46], and participation, development and democratic values in public value approaches [15,17,21]. Finally, the early days were characterized by an emphasis on technical issues. Institutional and organizational factors as well as democratic values such as participation and transparency have been added later in the equation [51].

The emerging literature on public value has not yet reached an agreement on what the term means, as well as its implications for public managers. According to a recent review of the literature in Public Value, it is possible to identify in the literature three different lines of thinking [10]. The first approach focuses on understanding and cataloguing relevant public values [3]. The second one is more interested in providing guiding principles to public managers that are useful in the creation of public value, such as the strategic triangle framework, which points to the relevance of aligning three interrelated processes: defining public value, building and sustaining a group of diverse stakeholders to create an authorizing environment, and mobilizing the resources from inside and outside the organization to achieve the desired outcome [4]. The third approach is very closely related to the first, but focus on the need for a continuing dialogue about rights, obligations and principles that constitute public values [7].

Because of the nature of our study, the first approach in understanding the nature of public values appears to be more relevant. In this sense, there is a wide breadth of catalogues for public values [3,6,26,43]. For example, Meynhardt [43] classifies public values in four main dimensions, related to four basic human needs: (1) Moral-ethical values, related to the need for positive self-evaluation, (2) hedonistic-aestetical values, related to maximizing pleasure and avoiding pain, (3) utilitarian-instrumental values, associated with gaining control over our surroundings, and (4) political-social values, related to the need for positive relationships. On the other hand, Beck Jørgensen and Bozeman [3], identified seven constellations or value categories, organized in terms of the relationships among politicians, public administration, public employees, citizens, the environment and the society at large. In a sense, this second categorization is less general, and more specific to public administration.

More closely related to the literature in digital government, Harrison and her colleagues [26] identified a group of values related to open government projects: efficiency and effectiveness, transparency, collaboration, public enhancements and participation. On the other hand, Bannister and Connolly [2] add to the traditional ethical, democratic, professional and public values, the duty, service, and socially oriented values in public service. Proper use of funds and accountability are closely related to the duty oriented values, responsiveness and quality of service are associated with service oriented values, and inclusiveness and fairness are the main issues in socially oriented values. Finally, Karunasena and Deng [29] apply factor analysis to a citizen survey, finding that from citizen's perspective value is created by efficiency and service delivery. Service delivery involves both quality and user orientation, and efficiency is related to openness and responsiveness. In general, public values reported in the digital governance literature and then associated with three of the seven constellations of values identified by Beck Jørgensen

and Bozeman [3]: intraorganizational aspects of public administration, relationships between public administration and its environment, and relationships between public administration and the citizens. In this sense, the literature only incorporates explicitly values in the realm of public administration activity and its relationships with the environment and the citizens, leaving out those values in the constellations that involve politicians and the society at large.

On the other hand, digital government research is also rich in identifying potential benefits from the use of IT in government. These benefits reflect the impacts of electronic government and value created by these initiatives. Most of the values presented in the literature are again related to the relationships of public administration, its internal users and public employees, as well as with the citizens. Some common benefits attributed to digital government implementations include: (1) improvements in the quality of public services [18,24,28], (2) efficiency and productivity in processes and government operations [20, 44], (3) more effective programs and policies [16,32], (4) transparency and accountability [25,45], (5) citizen participation [23], (6) a regulatory framework that supports electronic government [1], (7) a legal and regulatory framework that encourages the information society [25], and (8) transformation of government structures [22,41].

Benefits reported in the literature can be organized in three areas of impact: user value, organizational value and political value [15]. Including end users and citizens in the measurement and assessment of these variables is an important component of any evaluation process [47]. Several techniques, such as surveys, focus groups, and interviews, could be used to collect data about their perceptions of the general value created, as well as some specific results.

2.2. Digital governance evaluation

As pointed out in the previous section, value creation through the results from digital governance implementations is an important endeavor to better understand the impacts of the use of IT in government. Moreover, the value of digital governance has been questioned because of the lack of evidence to support it [29]. Some research suggests that conceptual research tend to be overoptimistic, and that empirical research is in general less optimistic in terms of digital governance value creation [49].

Several types of work are relevant to this paper. It is possible to find in the literature evaluations of the state of digital government [50,55,62], some causal models looking to explain success of digital government in terms of the levels of functionality of digital government projects [14,34,39,60], and some conceptual models guiding the evaluation process [20,40,53]. There is also research looking for relations between the impact of IT investments in economic development [9,35]. Finally, there are some other researchers that are working in defining value from the citizen's perspective [29,56]. Although digital governance is a more comprehensive concept, government portals have been considered one of the focal points and one of the foundations of digital governance efforts, being then at the heart of many of these evaluation processes [46,60].

Evaluation research is also relevant to this paper because it provides a general framework for understanding and measuring the effects of digital governance on value creation [58]. Inputs, context, outcomes, and outputs are key components of such frameworks [40,53,54]. Inputs and context are usually understood as key determinants of value creation [36,40]. Outcomes are usually conceived as immediate results in form of levels of functionality or characteristics of technology implementations, and outputs (or final results) constitute public value from digital government projects. In many senses these models contribute to the creation of a theory guiding the evaluation process, a theory involving a set of inputs and contextual factors that contribute to the creation of a set of digital government applications that will

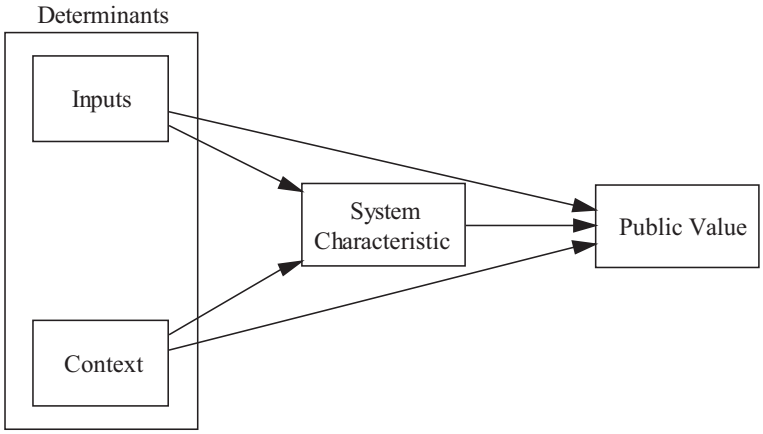

Fig. 1. A model to evaluate electronic government impacts (Source: Adapted from [36]).

provide two different types of outcomes or results. Some results related to system characteristics, and another set of results that are better described as public value (see Fig. 1). Empirical research in digital government suggests that it may be both direct and indirect relationships between determinants of e-Government and impacts.

As we discussed early in the paper, the relationships between determinants and characteristics of digital government are explored more frequently in the literature than the relationship between characteristics and impacts or public value [40]. Some of the better examples looking to understand this relationship between characteristics and impacts that we have found are based on surveys capturing the perception of system characteristics and user satisfaction or perception of value [29,56]. In this paper, we are contributing to this line of inquiry, by using secondary data on digital government portals functionality and impacts of this level of development on use, efficiency and government effectiveness. As we will discuss in the following section, the model presented in this paper considers some contextual factors as control variables.

3. Research model and hypotheses

For this research we selected a set of eleven variables in order to understand the impacts of digital governance in the creation of public value. We are considering variables describing levels of functionality of digital government portals as the main independent variable, three different measures of public value and a couple of contextual variables as control variables (Fig. 2). In the following sections we provide a definition for each of these variables.

3.1. Dependent variables

We included three dependent variables in the study, the state competitiveness index, the government efficiency index, and the number of transactions in e-government portals. We use these variables as a proxy to measure public value creation. Our selection of proxies for Public Value Creation in this paper is aligned to the literature on public value and digital government. The selected measures are associated with values in the realm of public administration activity and its relationships with the environment and

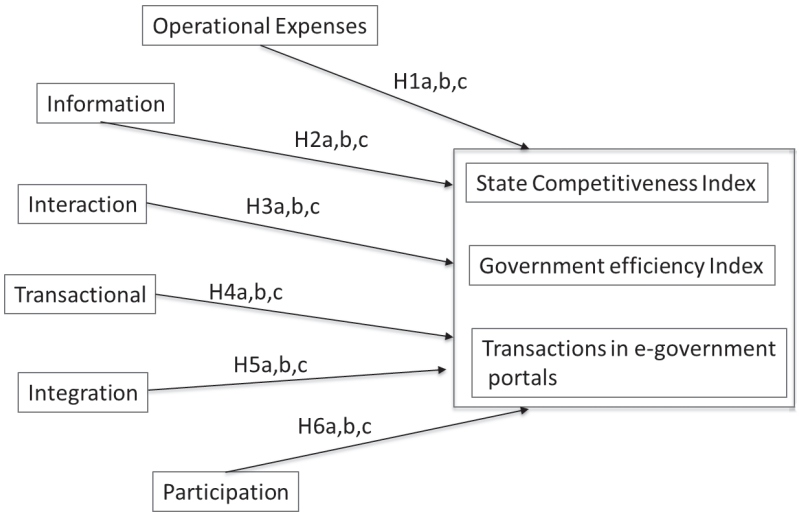

Fig. 2. Public value creation model.

the citizens. We chose the *Number of Transactions in e-Government portals* to measure the relationship between public administration and the citizens. We are using the *Government Efficiency Index* to observe public value creation in the realms of organizational value and public administration activity. Efficiency is also one of the basic value promises of digital governance. Finally, we selected the *State Competitiveness Index* as a proxy of wider impacts of public administration in its relationships to the environment [3].

3.1.1. Transactions in e-government portal

This variable represents a basic impact of digital governance projects, the actual use of government portals by citizens. The variable is measured through the number of transactions made by citizens in the portal of the entity. A transaction includes not only access to government services, but also information seeking activities. The variable is also related to the public service values of serving and social inclusion [2,51,57].

3.1.2. Government efficiency index

One of the main promises of digital governance is increasing government efficiency [2,15,20]. This index evaluates key performance indicators based on financial state resources, security, and the implemented legislation on the execution of law. It is compounded by five elements: Public Finances, Fiscal Politics, Institutional Environment, Legislation, and Social Framework [11,12].

3.1.3. State competitiveness index

As suggested in the literature, the impacts of digital governance should go beyond efficiency and effectiveness in government, having a broader impact [2,5,48]. It has been argued that digital governance will have an impact in the economy and competitiveness of regions [61]. This variable is an average of four competitiveness factors in each state: government efficiency, infrastructure, private business efficiency and general economic performance [11,12].

3.2. Independent variables

We are using six independent variables in this study. The first variable is considered an important input into digital governance projects. The other five are widely accepted measures of digital governance frequently used in evaluation studies, associated with digital governance development [34,55,62].

3.2.1. Operational expenses

Organizational resources have been identified as a key input in digital governance applications [14, 39]. In this study we use operational expenses, measured in terms of the amount of money each state government is using to develop and maintain its portal, as a proxy for such organizational resources. Because of accounting practices in the Mexican states, we could not get the basic day-to-day operational expenses, but all expenses made over the basic operational ones. Consistently with previous research, we expect that operational expenses will be positively related to public value creation, proposing the three following hypotheses.

H1a. Operational Expenses will have a positive impact on the competitiveness of the entity.
H1b. Operational Expenses will have a positive impact on the efficiency of the government.
H1c. Operational Expenses will have a positive impact on the number of transactions in the portal.

3.2.2. Information

This variable represents the quality of information in government websites [37,38]. It measures one-way horizontal communication from Government to Citizen (advertising, news, statistics, government on-line videos, and information about government offices). Quality of information has been recognized in the literature as a key component of website use [57], and access to information is one of the main antecedent for citizen participation, government transparency and accountability [2,51]. Moreover, it has been identified as one of the key factors in creating public value from the citizen perspective [29]. In this way, we put forward the following hypothesis that relate positively the quality of information to public value creation.

H2a. Information will have a positive impact on the competitiveness of the entity.
H2b. Information will have a positive impact on the efficiency of the government.
H2c. Information will have a positive impact on the number of transactions in the portal.

3.2.3. Interaction and transactional

Government portals have been widely adopted as one-stop service delivery alternative [14,48]. These two variables measure the level of development of interactive services in state government portals [38]. The first of them, interaction, measures the availability of both-way communication options between Government and Citizens. The second one, transactional, measures the number of transactional government services offered through the web portal, as well as the proportion of the service that can be done on-line. Interactive and transactional services have also been identified as sources of value creation from the citizen point of view [2,29]. In this way, we hypothesize that both variables are positively related to public value creation as suggested in the following statements.

H3a. Interaction will have a positive impact on the competitiveness of the entity.
H3b. Interaction will have a positive impact on the efficiency of the government.
H3c. Interaction will have a positive impact on the number of transactions in the portal.
H4a. Transactional will have a positive impact on the competitiveness of the entity.
H4b. Transactional will have a positive impact on the efficiency of the government.
H4c. Transactional will have a positive impact on the number of transactions in the portal.

3.2.4. Integration

This component measures the level of visual and transactional integration on the government state portals [38], quantifying the visual and design consistency of different agency web pages in the state government pages, and also the integration of services in a single page vertically (offering local and federal services in the state portal) and horizontally (having services of different state agencies in a single place). Web portal design has been identified as a key component for website adoption [57], government transparency and citizen participation [29,30]. In this way, we believe that the level of integration of government website is positively related to public value creation as specified in the following hypotheses.

H5a. Integration will have a positive impact on the competitiveness of the entity.
H5b. Integration will have a positive impact on the efficiency of the government.
H5c. Integration will have a positive impact on the number of transactions in the portal.

3.2.5. Participation

This last variable measures the level of development of state portals in terms of tools to promote citizen participation through electronic forums, blogs or similar tools [38]. Citizen participation has also been related to public value creation [2,15,51].

H6a. Participation will have a positive impact on the competitiveness of the entity.
H6b. Participation will have a positive impact on the efficiency of the government.
H6c. Participation will have a positive impact on the number of transactions in the portal.

3.3. Control variables

Finally, the literature recognizes the importance of contextual factors in digital governance success and impacts [34,39,57]. In this way, we included as control variables in this study two variables related with the level of adoption of the information society: number of Internet users, and number of mobile phone users in the state.

4. Methods

For this study we applied panel data analysis, using data from the 32 states in Mexico for years 2010 and 2012. As we mentioned in the literature review, digital governance portals are used in this study because they are considered key applications of government information technology initiatives [46,60]. We used secondary data on digital governance portals functionality, as well as for the measures of public value in Mexican states.

As described in the previous section, we selected the state competitiveness index, the government efficiency index and the number of transactions made in the e-government portals as dependent variables. The state competitiveness index measures the portal impact at state level. The government efficiency index is measuring the impacts only in government and finally, the number of portal transactions measures the impact directly on the citizenry.

Data was gathered from four different sources. Table 1 shows the source of data for each variable in this study. The state competitiveness index and the government efficiency index are computed every two years by the Graduate School of Public Administration (EGAP) [11,12]. The state competitiveness index is computed using 172 different variables. These variables are grouped in four categories: economic performance, governmental efficiency, business efficiency and infrastructure. Economic performance evaluates the state economy based on macroeconomic criteria such as the GDP (Gross Domestic Product) and

Table 1
Data sources

Variable	Source
Global Competitiveness Index	EGAP [11,12]
Government Efficiency Index	
Information	IGEE (State e-government index, from its acronym in Spanish)
Interaction	http://www.biiacs.cide.edu/
Transactional	
Integration	
Participation	
Transactions in e-government portal	INFOMEX
Operational Expenses	
Number of User with Internet Access	INEGI (National Institute of Statistics and Geography)
Number of Mobile Phone	http://www.inegi.org.mx/est/contenidos/Proyectos/encuestas/hogares/modulos/endutih/Default.aspx

unemployment rate. It considers four elements: domestic economy, international commerce, investment and employment. Business efficiency uses elements such as productivity and number of new companies to measures how attractive is a state to develop economic activities. The measurement of infrastructure includes criteria for considering aspects of both physical infrastructure and human capital necessary for competitiveness. Using measures on state financial resources, legislation and security, the government efficiency index measures the government efforts in relation to its functions as a public entity. This index consists of five sub-factors: public finance, fiscal policy, institutional environment, legislation and social framework. Details on the data sources and processes for index creation are described in detail in the Mexican State Competitiveness Reports [11,12].

The second group of variables (information, interaction, transactional, integration and participation) describe the characteristics and functionalities of government portals, and they are obtained every year through a panel of experts who develop a benchmark of government state websites [38]. The evaluation is based on an observation instrument that uses concepts from the evolutionary models of digital governance [33,55]. The first component, information, measures one-way communications such as advertising, news, transactions instructions, events, statistics, and executive video transmissions. The interaction component measures two-way communications, such as forums, email, etc. The transactional component measures the number of government transactional services offered through the portal, as well as the degree in which they can be completed on-line. The fourth component, integration, measures the ability of a portal to be the single point at which citizens can get either information or a service, regardless of which agency is in charge of the information or providing the required service. Finally, the last component, participation, measures the ability of a portal to allow citizens to interact among them and with government.

The collection of data for the number of transactions made through the government portals and the operational expenses of these portals was made through individual requests to each State. All requests were processed through INFOMEX system, which is an online system that allows citizens to request government information according to Freedom of Information Act regulations. This information was particularly difficult to obtain, and implied several rounds of information requests, with individual follow-ups with each State.

Finally, number of Internet users and number of mobile phones were obtained from INEGI (National Institute of Statistics and Geography). Both variables represent percentages.

Table 2
Descriptive statistics for independent and dependent variables

Variable	Mean	Standard deviation	Min	Max
Operational expenses	983,848.70	3'126,334	0.00	2.47e+07
Information	62.93	12.64	31.29	96.23
Interaction	40.62	12.67	13.45	76.94
Transactional	37.47	19.65	5.19	76.25
Integration	55.26	11.73	28.77	81.94
Participation	12.82	9.18	0.00	46.43
Internet users	37.33	9.58	19.80	61.70
Mobile phone users	56.82	13.35	28.80	82.10
Number of internet transactions	548521.40	1359497.00	4429	1.07e+07
State competitiveness index	0.49	0.07	0.35	0.66
Government efficiency index	0.51	0.08	0.34	0.67

5. Results

Descriptive statistics for all variables are shown in Table 2. As the table shows, the standard deviation for some of the variables is rather large. In particular, the standard deviation for operational expenses is three times its mean and the standard deviation of the number of internet transactions is more than two times its mean.

As it was mention before, both variables were difficult to obtain. As we mentioned before, operational expenses only include those expenses in web portals beyond day-to-day operations such as consulting or design services. High variation in the number of Internet transactions may respond to variations in the definition of a transaction in each state. While some of them may consider every visit to a site as a transaction, others may only consider a transaction when a payment is carried out. It is also important to notice that most transactions in state portals consist of tax payments from individuals and businesses.

Table 3 shows correlation coefficients for all pairs of variables. From this table we notice several important elements for our analysis. First, the correlation coefficients are significant at 0.05 level of confidence for the variable Operational expenses and the five elements of portal functionality (Information, Interaction, Transactional, Integration and Participation). This suggests a relationship between the money spent to operate a portal and its level of functionality. Second, the correlation coefficients for these five measures of portal functionality are also significant at 0.05 level of confidence. These relationships suggest that the different elements of the portals functionality are developed somehow in parallel. That is to say, the most advanced state portals perform better throughout all dimensions. However, as it is shown in Table 2, descriptive statistics suggest that portals perform better in offering transactional services when compared to opportunities for participation, and even better in providing informational services. Third, the correlations of our two control variables with the three dependent variables is also significant at 0.05 level of confidence. Additionally, the correlations of the number of Internet users and the variables Interaction, Transactional, Integration, Participation and Operational expenses are also significant at 0.05 level of confidence. Finally, the correlation of the number of mobile phone users and the variables Transactional, and Integration are also significant at 0.05 level of confidence. These correlations suggest that contextual variables associated with the information society are related to the development of government services over the Internet.

Results from panel data analysis are presented in Tables 4 to 6. We used the Hausman test to decide between using fixed or random effects. Given that the test was inconclusive, we tried both models, and there was not an important difference between them. In this way, we decided to use the random effects model for all dependent variables. Table 4 displays the results for the dependent variable state competitiveness index. The second column shows the results for the model without using the control variables,

Table 3
Correlation coefficients

	Operational expenses	Information	Interaction	Transactional	Integration	Participation	Internet users	Mobile phone users
Information	0.416*							
Interaction	0.480*	0.823*						
Transactional	0.275*	0.400*	0.542*					
Integration	0.392*	0.694*	0.724*	0.551*				
Participation	0.613*	0.713*	0.702*	0.362*	0.680*			
Internet users	0.264*	0.153	0.226†	0.427*	0.380*	0.319*		
Mobile phone users	0.069†	−0.036	0.076	0.353*	0.254*	0.117	0.783*	
Number of internet transactions	−0.047	0.192	0.218†	0.277*	0.380*	0.319*	−0.269*	−0.230†
State competitiveness index	0.188	0.083	0.088	0.113	0.286*	0.227†	0.729*	0.643*
Government efficiency index	−0.096	−0.088	−0.097	−0.037	0.071	−0.018	0.383*	0.431*

†$p < 0.1$, *$p < 0.05$.

Table 4
Panel data analysis for state competitiveness index

	Coefficient	Coefficient
Operational expenses	−1.87e-9	−3.84e-10
Information	0.0001394	0.0007285
Interaction	−0.0009597	−0.0013394†
Transactional	−.0000202	−0.0007159*
Integration	0.0007652	0.0006209
Participation	0.0012876	0.0010135
Internet users		0.0019323†
Mobile phone users		0.0015641*
Intercept	0.4603627	0.3129348
R^2	0.0667	0.5747
F	25.33	26.11
DF	6,57	8,55

†$p < 0.1$, *$p < 0.05$.

Table 5
Panel data analysis for government efficiency index

	Coefficient	Coefficient
Operational expenses	−6.24e-09*	−4.68e-09†
Information	−0.0004701	0.0002976
Interaction	−0.0001395	−0.0005515
Transactional	0.0001596	−0.0004406
Integration	−0.0008828	−0.0009427
Participation	0.0026298†	0.0020497
Internet users		0.0003794
Mobile phone users		0.0021961*
Intercept	0.5577478	0.4176838
R^2	0.0049	0.1990
F	23.44	31.09
DF	6,57	8,55

†$p < 0.1$, *$p < 0.05$.

and the third column shows the results for the model using the control variables. As it can be observed, the addition of control variables modifies the results of the panel data analysis, making statistically significant predictors that were not significant without the control variables. Although these results seem contradictory – control variables usually reduce predictive validity of independent variables – they are a consequence of a confounding effect that results from the correlations among the dependent variable, the control variables, and the predictors. In these cases, results from the model including the control variables are the ones that should be used [42]. In this way, for state competitiveness index variable, Transactional and Number of mobile phone users are statistically significant at 0.05 level of confidence, Interaction and Number of internet users are statistically significant at 0.1 level of confidence. As it can be seen, there is a positive impact of the number of internet users and the number of mobile users, and a negative impact for the interaction and the transactional variables.

Table 5 shows the results for the dependent variable Government efficiency index. Again, the second column shows the results for the model without using the control variables, while the third column shows the results for the model using the control variables. The second column shows the Operational expenses and Participation variables as statistically significant, once the control variables are added, only

Table 6
Panel data analysis for number of internet transactions

	Coefficient	Coefficient
Operational expenses	−0.0209808	−0.0102667
Information	18112.32	12363.42
Interaction	4127.175	6283.214
Transactional	17264.36*	28884.45**
Integration	−32811.87*	−25550.18†
Participation	−2057.667	839.36
Internet users		−80636.93**
Mobile phone users		2475.17
Intercept	413345.5	2672869
R^2	0.0643	0.2193
F	22.8	37.9
DF	6,57	8,55

†$p < 0.1$, *$p < 0.05$, **$p < 0.01$.

the Operational expenses variable remains significant. Operational expenses variable is significant at 0.1 confidence level and the number of mobile phone users' variable is significant at 0.05 confidence level. As it can be seen, there is a negative impact of the operational expenses and a positive impact of the Mobile phone users' variable on Government efficiency index.

Finally, Table 6 shows the results for the number of Internet transactions for the models without using and using the control variables. The variables Transactional and Integration are statistically significant in both analysis. As Table 6 illustrates, the number of Internet users is also statistically significant. The variables transactional and number of Internet users are significant at the point 0.01 confidence level and the variable integration is significant at 0.1 confidence level. As it is shown, the variable transactional has a positive impact, and the variables number of Internet users and Integration have a negative impact on internet transactions.

6. Discussion and conclusions

In this last section of the paper we discuss the main findings presented in the previous sections of the paper, and we also discuss the implications of these findings. We start the section by summarizing the main conclusions in terms of hypotheses testing, and we then continue with a discussion of main implications from the results.

As it is shown in the Table 7, most hypotheses were not supported by the data that we used in this paper. In fact, only one of the hypotheses presented in the methods section was supported by the data. Four more relationships were statistically significant, but in the opposite direction than we expected. The influence of the control variables is also included in the table given that at least one of them was significant for each model.

In general, our results are consistent with previous research, showing that governments are better in taking advantage of digital governance for the provision of informational and transactional services, and less effective in promoting participation [17,48,60]. Moreover, adoption and public value creation are highly related to contextual information-society variables [34,57]. The number of hypotheses supported by the data and the direction of the relationships found in our results have two potential implications for digital governance research. On one hand, it might be true that government portals are not the best proxy to understand the impacts of digital governance, but back-office applications. In fact, Kuk and

Table 7
Summary of hypotheses tests

	State competitiveness index	Government efficiency index	Transactions
Operational expenses		(-)	
Information			
Interaction	(-)		
Transactional	(-)		(+)
Integration			(-)
Participation			
Mobile phone users	(+)	(+)	
Internet users	(+)		(-)

Janssen [31] found that there is a trade-off when governments take a front-end versus a back-end approach in developing service infrastructures for e-Governance. Front-end applications provide faster results, but back-end approaches relate to better quality services in the long run. On the other hand, the results presented in the paper are similar to results found in more general ways in countries and regions described in the literature as the productivity paradox [9]. In this way, either we need to observe the phenomenon for a longer time or we need better theories of digital governance impacts on value creation including other causal mechanisms.

More specifically, in the case of the first model (see Table 7), two of the independent variables (Interaction and Transactional) had an impact on the State Competitive Index. However, the impact of these e-Government characteristic on the competitiveness of the state is negative, and we were expecting a positive impact. Both control variables had a significant and positive impact on the competitiveness index, which suggests a positive relationship between the adoption of technology and the competitiveness of the state. Results in this model also suggest that the digital governance development and the competitiveness of a region are not closely related. It is also possible that the negative impact of the development of electronic government transactions is only a spurious relation due to data limitations. However, it is also possible that, as we suggested in the previous paragraph, the impact from developments in digital government shows only after a delay of several years of investment [9]. The main explanation of this delay is related to the time needed by organizational structures and other institutions to adjust to the introduction of technology innovations [9,35]. In other words, although most Mexican State Government Portals were created around 2000, they have developed most of their transactional functionality during the years covered by our data. More specifically, the measures that we are using in this paper to observe transactional capabilities show values more or less stables in transactional capabilities from 2007 to 2010. These values went from 19.65/100 in 2010 to 55.47/100 in 2012. Most of such development responded to the belief (promoted by international agencies such ECLAC) that facilitating government transaction may translate in benefits for the state (in terms of attraction of investment, for example). It is possible, however, that all these investments have not had enough time to translate into a tangible benefit because of changes required in these other mediating variables.

In the case of the second model, only one of our independent variables had an impact on the Government Efficiency Index, operational expenses. However, the sign of the relation between operational expenses and efficiency is negative, suggesting that providing digital government services may have a negative impact on government efficiency. The result, although appears to contradict the literature on digital government benefits, is not necessarily counterintuitive. That is to say, if a State Government is investing in having two channels to provide a service, it may be expected that the additional channel had an impact on costs and efficiency. Again, it might be possible that the second channel creates some synergies increasing tax collection or other benefits that over time translate into a more efficient govern-

ment. However, our data suggests that there is for sure a negative effect in the short term. In this second model, the level of adoption of information technologies had also an impact on government efficiency.

Finally, our third model shows a positive relationship between the availability of government transactions and the actual number of transactions. Given that no other portal functionality has a positive impact on the number of transactions, the result suggests that the main use of digital government portals consists of making electronic transactions with government such as paying taxes. Given that this is the main use of the government portal, it is possible that having higher levels of integration of other functions gets in the way of citizens trying to pay their taxes or completing other transaction. In this way, data suggests that more integrated state portals have a negative impact on the number of transactions.

Although results presented in the paper are not conclusive, and there are data limitations in the preparation of the study, we believe that our findings constitute a first exploration of the relationship between digital governance characteristics and value creation. Results suggest that citizens use digital government mainly to complete electronic transactions with government, and also that they need simple portals to accomplish this tasks. Additionally, our results suggest that, at least at the initial stages, having two delivery channels has a negative impact on government efficiency. Furthermore, it appears that digital governance is not directly related to more general impacts in the competitiveness of a region, at least on the short term. Finally, our results show that most of the value is explained by the contextual variables used for control purposes, suggesting that the level of technology adoption and not the digital government initiatives has a greater impact in efficiency and effectiveness in the creation of value. More research advancing our understanding between digital governance development and final outcomes to the society is still needed.

Finally, relationships between digital governance and value creation appear to involve trade-offs between competing public values, such as access and efficiency. Moreover, our initial exploration also suggest the need of better frameworks to explain mechanisms of value creation in the short and long terms. For future research we recommend to replicate our study in other countries, and we also recommend more studies in the Mexican context but using data from other sources.

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