

Drivers, Enablers, and Conditions for Public Sector Innovation in European Countries

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Abstract: This study identifies the factors that influence innovation in the public sector in different countries. To do this, we identified innovation patterns in European countries and established the factors associated with such patterns. A cluster analysis was performed to group countries in terms of public sector innovation, while mean differences tests were used to identify the aspects that characterize these differences. The data are derived from the European Public Sector Innovation Scoreboard database, Hofstede's cultural dimensions, the European Innovation Scoreboard (EIS) 2017 Database, and the Global Competitiveness Report (2017-2018) by the World Economic Forum. The results indicate the existence of three groups of countries, where the factors identified are related to (i) the governance of public services, namely government effectiveness and regulatory quality, share of service innovators that innovate in-house, share of process innovators that innovate in-house, and importance of external knowledge; (ii) national culture, in particular uncertainty avoidance and indulgence; and (iii) national innovation capacity. This study provides empirical insights into the need to develop innovation capabilities as an element of successful innovation in public services.

Keywords: competitiveness, innovation, innovation in services, national culture, public sector,

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Introduction

The “public sector plays a key economic role as a regulator, service provider, and employer, and accounts for a significant share of economic activity at the European” (UNECE, 2017, p. 18), national, regional, and local levels. The public sector has many roles and functions, such as building and maintaining trust in the government, drafting rules and laws, ensuring social security, creating favorable institutional frameworks, providing quality services, and responding “to the needs of citizens and businesses” (European Commission, 2013, p. 6).

Innovation assumes an important role in development, is fundamental to achieving competitive advantages, and is a significant differentiator for firms, countries, and regions. Therefore, public services innovation is important because it can foster more government effectiveness and a better environment for business innovation. Public service innovation can also have a leadership role for innovation in a country and contribute to develop innovation policies that can support business innovation. It can also increase innovation by public procurement requirements.

However, innovation has traditionally been discussed in relation to the industrial sector. Hence, innovation in services and, specifically, public services has received less attention (Gonzalez *et al.*, 2013; Vergori, 2014).

The modern concept of innovation was developed by Schumpeter (1934) and expanded by the Organisation for Economic Co-operation and Development (OECD) with the Oslo Manual (OECD/Eurostat, 2005), which defines innovation as “the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations” (p. 46). The manual distinguishes between four types of innovation: product, process, marketing, and organizational innovation.

The 2018 edition of the Oslo Manual (OECD/Eurostat, 2018) replaces the definition that distinguishes between only two types of innovation (product innovation and business process innovation) and “reduces the ambiguity of the requirement for a ‘significant’ change by comparing both new and improved innovations to the firm’s existing products or business processes” (p. 34). The revised definition considers innovation as “a new or improved product or process (or combination thereof) that differs significantly from the unit’s previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)” (p. 20).

Still, service innovation has been neglected for a long time, although recently several researchers have developed the concept. Gallouj and Weinstein (1997) distinguish between characteristics of goods and services and extend the application of this formalization to the analysis

of innovation in the service sector by taking due account of the intangible nature of “products” and the interaction between agents that often characterize activities in the service sector. Gallouj and Savona (2009) provide a review of innovation in services and published the *Handbook of Innovation and Services* in 2010, which identifies service innovation characteristics, such as its non-technological nature. Furthermore, these authors reclassify the literature according to whether studies have been assimilated or differentiated regarding the traditional conceptualization of innovation in the manufacturing sector. Similarly, they review the different concepts of innovation in services and suggest a taxonomy for the modes of innovation.

More recently, Gallouj and Djellal (2019) compiled a list of what they consider the 15 major advances in the service innovation field since its advent. These advances can be divided into two types. The first reflects changes in the recognition of service innovation studies, in the general theoretical perspectives favored, and in understanding the fundamental nature of service innovation. The second encompasses advances in innovation modes and institutional and regulatory arrangements. Their conclusion identifies research challenges to be addressed in the future.

Additionally, Djellal *et al.* (2013) deepen and enrich the innovation literature, and their analysis of contemporary economies provides a systematization and framework of innovation in services, identifies shortfalls in this literature, and determines new avenues of research and action, paving the way for studies on innovation in public services.

In sum, innovation in the public sector has been largely neglected by mainstream innovation studies, becoming a research focus only in recent years. Gonzalez *et al.* (2013), an example of this development, offer a thorough review of the literature on innovation management issues in the public sector. De-Vries *et al.* (2015) conduct a systematic review on innovation in the public sector and consolidate the empirical state-of-the-art on the subject. Their study focuses on the concept, processes, types, objectives, and outcomes of public sector innovation. Finally, Cinar *et al.* (2019) present a systematic review of barriers in public sector innovation.

Considering the above, this study identifies the factors that influence innovation in the public sector in different countries, taking into account the importance of this issue, as stated by the European Commission (2013):

The public sector plays a key economic role as a regulator, service provider, and employer. It accounts for more than 25% of total employment and a significant share of economic activity in the European Union’s (EU) EU27 Member States.¹ Additionally,

¹ There are currently 28 member States. At the time of EPSS, Croatia was not yet a member State.

an efficient and productive public sector can be a strong driver of economic growth by providing support and governance to the private sector. (p. 4)

Based on the European Public Sector Innovation Scoreboard, this study identifies patterns of innovation in the public sector in different European countries and distinguishes the factors associated with such patterns. By comparing European countries, our objective is to verify the existence of subjacent clusters and identify the characteristics that distinguish the different groups of countries. A cluster analysis was performed to group countries in terms of public sector innovation and mean differences tests were used to identify the aspects that characterize these differences.

The remaining of this paper is organized as follows. First, we review the literature on public service innovation and follow this review with our hypothesis. Next, we explain the methodology and outline the results. Finally, we present a discussion and conclusions section.

Literature review

Research on public service innovation initially included studies on service innovation and the four different theoretical perspectives used therein –assimilation, demarcation, inversion, and integration/synthesis–, which address public service innovation and its special features, as acknowledged by Djellal *et al.* (2013). These authors highlight the specificities of services and their impact on innovation and examine the nature of public services that are perceived as non-market and non-competitive, which influence the inherent innovation processes. Finally, they highlight the principles of public service (equality, fairness, and continuity) that impact innovation.

For their part, Bloch and Bugge (2013) discuss how public sector innovation can be captured and to what extent such measurement can be based on frameworks originally developed for the private sector. They present a theoretical framework and indicators for measuring innovation in the public sector.

Arundel *et al.* (2019) provide a framework for measuring public sector innovation to assist policy needs. They apply the Oslo Manual guidelines (OECD/Eurostat, 2018) to the public sector and refer that:

Oslo Manual provides detailed lists of relevant items for measurement, such as the use of different knowledge sources or the importance of different innovation objectives. All of these thematic areas are relevant for innovation in the public sector. As an example, research on e-government, public policy and public management has evaluated the role of factors such as collaboration, knowledge sources, innovation activities such as training, and innovation objectives. (p. 792)

To measure public innovation capacity, Meijer (2019) builds a model based on innovation systems theory and the literature on public innovation. In this new perspective, the author identifies five functions (mobilizing, improvising, vitalizing, balancing, and coordinating between different actors) that promote innovation within the public sector. This model can be used as the basis for a reflection on government organizations' public innovation capacity and for interventions to improve this capacity.

Kallio *et al.* (2013) studied innovation in public services as an outcome and focus on two interlinked dimensions: the target and radicalness of the innovation. These authors developed co-innovation models from a user-driven perspective in the public sector and applied two types of user-driven co-innovation processes to public services: a planning-oriented and a rapid experimenting process that empowers users. They conclude that:

[...] the planning-oriented co-innovation process seems to create a situation of learning with the users; thus, mutual dialog and respect for each other's competence and experience must be learned. In the rapid experimenting process empowering the users, the task for the city then becomes learning from the users –their novel ways of innovating and producing the service. (p. 12)

More recently, the OECD (2017) published the report *Fostering Innovation in the Public Sector*, which examines “how the different aspects of public sector governance can support innovation at all stages of its lifecycle, from identifying problems to generating ideas, developing proposals, implementing and evaluating projects, and diffusing them more widely throughout the organization” (p. 11).

One of the key differences between the public and private sectors is their objectives. For firms, innovation brings a competitive advantage in the market and supports profit generation. In contrast, the public sector has multiple and competing objectives and often requires a balance to be struck between competing values. Altruistic motivations (e.g., to support a community or the values of an organization) are also an important driver of public sector innovation efforts (Daglio *et al.*, 2014).

Public sector innovation, according to the OECD (2017), has to do with “finding new and better means to achieve public ends. Innovation, especially breakthrough innovation, is complex and challenging for governments.” Thus, “the scale and nature of the challenges that governments face today require responses that go beyond incremental improvements” (p. 11).

Public sector innovation is about new ideas that can create public value (Bloch & Bugge, 2013; Daglio *et al.*, 2014; Mulgan, 2007). Consequently, ideas have to be new (rather than improvements), at least in part, they have to be adopted (rather than simply being good unusable ideas), and they have to be useful (Bloch & Bugge, 2013; Mulgan, 2007). Each public innovation aims to address a

public policy challenge and, in turn, a successful public innovation is one that achieves the desired public outcome (e.g., a political judgment reflected in government decisions) (Daglio *et al.*, 2014).

The aforementioned OECD (2017) report highlights that “generating public value through innovation is complex and challenging for governments. In fact, innovation runs contrary to the perceived role of bureaucratic organizations” (p. 14).

Studies confirm that innovation barriers affect innovation processes (Smith & Sandberg, 2018). As for public sector innovation processes, the most significant barrier identified is organization-related, namely, the administration of processes, as stated by Cinar *et al.* (2019). According to these authors, interaction barriers are the second most influential, because collaborative processes face many difficulties. The third barrier identified is the content of innovation itself. Finally, the last is related to innovation characteristics: the types and stages of innovation processes.

Within this context, as mentioned by the OECD (2017):

Innovation is new, unknown, and risky; by contrast, governments have a statutory duty, democratic responsibility, and political mandate to deliver public services consistently and equally. Thus, innovation does not fit well with the control function of hierarchies, which, while ensuring stewardship and accountability regarding the use of resources, tends to discourage risk-taking. (p. 14)

For its part, the definition of innovation by the European Commission (2013) is the following:

[...] an innovation is a new or significantly improved service, communication method, process, or organizational method. New or significantly improved methods of communicating activities to the public include new or improved methods of promoting an organization or its services; new or improved methods of influencing the behaviour of users, citizens or others; or first time commercialisation (for sale) of services or goods. New or significantly improved processes or organizational methods include new or improved methods of providing services, interacting with users, and organizing work responsibilities or decision making; furthermore, these include new or improved delivery or logistics systems for an organization’s inputs; supporting activities such as maintenance systems, purchasing, accounting or computing systems; and management systems. (p. 9)

De-Vries *et al.* (2015) identify the following types of innovation in the public sector: (i) process innovation (focused on either the technological or administrative core of the organization), (ii) product or service innovation, (iii) governance innovation, and (iv) conceptual innovation. This perspective differs from that by the European Commission (2013), which considers service, process, organizational, and communication innovations. Communication innovation replaces conceptual

innovation and, as already mentioned, refers to “the implementation of a new method of promoting the organization or its services and goods, or new methods to influence the behavior of individuals or others. These must differ significantly from existing communication methods in (the) organization” (European Commission, 2013, p. 9).

In summary, four thematic elements influence public sector innovation, according to Daglio *et al.* (2014, p. 6):

- (i) Generating and sharing ideas: The realm of knowledge and learning which allows us to consider issues related to the collection, analysis, and sharing of information, knowledge development, and learning, which are essential to innovation, and the way they are managed can support or hinder innovation. The challenge is to build the capacity to pool available knowledge to improve public decisions about innovative solutions and to share knowledge to encourage social innovation.
- (ii) Empowering the workforce: The cultural dimension, how people are motivated within an organizational setting to explore new ideas and experiment with new approaches. Here, it is also suggested that leadership and the way people are selected, rewarded, socialized, and managed have an impact on an organization’s innovative capacity.
- (iii) Navigating rules and processes: The legal/regulatory framework, budgeting processes and regulations, approval processes, and the opportunities they offer (or block) to innovate.
- (iv) Reviewing organizational design: Finally, organizational design elements, and in particular, the way work is structured within and across organizations may have an impact on innovation in the public sector. This includes the development of spaces and innovative methods to structure teams, break down silos, and work in partnerships across organizations and even sectors.

The OECD (2017) considers the following factors as motivators for innovation in the public sector:

- 1) capability to innovate –whether the relevant hierarchical level can innovate, 2) motivation to innovate –whether the unit wants to innovate, and 3) opportunity to innovate –whether enabling conditions exist to innovate. Capability to innovate is shaped by resources, skills, knowledge, and space to innovate. Motivation is shaped by incentives, values, leadership, and behavior. Opportunity is shaped by creativity, autonomy, and collaboration. (p. 21)

Therefore, innovation capacity is related to innovation drivers and barriers (structures, processes, and contextual factors), external networking, and leadership qualities (Lewis *et al.*,

2018). Faced with this, institutional design, public leadership, and systemic change may stimulate or hamper innovation processes (Torfing *et al.*, 2019). As a popular method to improve innovation capacity in the public sector, higher-level governments create innovation labs within city governments' organizational structure (Timeus & Gascó, 2018).

Hypotheses

Innovation is determined by the conditions that enable the innovation process. The first of these conditions, or enablers, are the human resources available in the public sector and their ability to develop new and better approaches to the services provided. The level of education is fundamental to this process, as are the attitude and organizational culture. Furthermore, without knowledge, it is difficult to bring about significant innovation processes in the public sector.

Another element directly linked to the innovation process in the public sector is the governance of public services. It is challenging to evolve and innovate without commitment to governance improvement and clear focus on service users. The determination to improve and continue improving is the basis of innovation. Therefore, the more a public service is committed to improving and achieving better governance, the more its willingness to invest in and develop innovation and relevant innovation. Thus, we hypothesize that:

H1: Innovation in the public sector depends on enablers –human resources, governance, and ICT development.

Apart from knowledge, values, attitudes, and commitment to improving, which are essential for innovation in the public sector, other aspects are also necessary. One element that determines the level of innovation is the type of activities performed. In fact, it can be argued that innovation is possible in all aspects of public services, but some activities are already better developed than others, and thus, improvement is less necessary. Similarly, some activities are simpler and easier to enhance than complex ones, and some are provided on a smaller scale while others are large-scale and involve more changes and investments. Furthermore, some innovations are aimed at improving internal processes and increasing efficiency, while some others at introducing new services and increasing the number of services available.

Another essential aspect for innovation processes in the public sector are the drivers of innovation. If managers in charge of a public service are actively involved in improving quality and finding innovative ways to manage the process and develop better and new services, then the conditions are right for moving towards innovation. Moreover, if public service employees are willing to provide insights to improve the organization and better serve the public, another relevant condition for innovation is met; however, if resistance to change and low motivation and participation are present, results become difficult to achieve.

Nonetheless, even when all these conditions are met, there are significant barriers to innovation in the public sector, which frequently arise in the decision-making process, where discussions may lack consensus not only regarding objectives, purposes, and the best ways to achieve them, but also on budget restrictions, lack of resources, bureaucracy, and excessive regulations that limit change and innovation. If political discussions become a limitation to faster and determinate action to innovate, their regulation can be a time-consuming process that further limits innovation. Besides, increasing budget limitations can affect innovation.

The level of complexity of the public services provided in many cases demands increasing financial investment, as revenue is low in times of small economic growth, aging populations, and increased costs in areas such as health care. Therefore, we establish the following hypothesis:

H2: Innovation in the public sector depends on relevant activities –capabilities, drivers, and barriers.

Innovation in the public sector can also be linked with national cultural aspects, qualities that are relevant because they influence the fundamental elements of the innovation process. These include access to resources, which can be highly concentrated or easily available to a large number of entities; the degree to which managers are isolated or collective and participative; whether the management approach is competitive or collaborative; the level of risk propensity; the long-term strategic development perspective; and the level of motivation and effort. Thus, we propose a third hypothesis:

H3: Innovation in the public sector depends on national cultural dimensions.

A fourth element influences innovation in the public sector –the current level of innovation in the country. The level to which a country's enterprises engage in significant innovation activities is associated with government policies for innovation, education, and research organizations' collaboration. Therefore, an environment that encourages enterprises to innovate can also facilitate public sector innovation by added focus in the innovation process and the provision of more resources in order to support innovation.

Similarly, the level of competition within the country and competitiveness of national firms internationally can influence public sector innovation. If the environment forces companies to develop capabilities for domestic competition but they are successful in competing internationally too, this indicates the presence of knowledge and innovation capacity, since innovation is the basis for competing successfully in many industries. Therefore, such competitiveness can also be a source of innovation in the public sector. Accordingly, we set forth the following hypothesis:

H4: Innovation in the public sector depends on countries' innovation and competitiveness capacity.

Methodology

This study uses the European Public Sector Innovation Scoreboard database, Hofstede’s cultural dimensions, the European Innovation Scoreboard (EIS) database, and the World Economic Forum’s Competitiveness database (2017-2018).

The European Public Sector Innovation Scoreboard database “is a pilot exercise to construct an EU-wide metrics system” that measures and compares “the performance and impact of public sector innovation in Europe” (European Commission, 2013, p. 6). This resource considers 27 EU countries, as well as Switzerland and Norway, and includes 22 variables of public sector innovation that capture different aspects of public sector innovation and reflect “inputs to innovation, innovation processes, outputs of innovation, outcomes of innovation, and environmental conditions that affect innovation in the public sector” (p. 19), as observed in table 1.

Table 1.

Variables of public sector innovation.

Variables
Employment share of “creative occupations.”
Share of employees in public administration with a university degree.
Government effectiveness.
Regulatory quality.
Increased efficiency of government services due to the use of ICT.
Online availability of public services.
E-government development index (EGDI).
Share of service innovators that innovate in-house.
Share of process innovators that innovate in-house.
Importance of internal barriers to innovation.
Importance of external barriers to innovation.
Active management involvement in innovation.
Importance of external knowledge.
Share of employees involved in groups that meet regularly to develop innovations.
Share of organizations in public administration with services, communication, process or organizational innovations.
Share of “new” services out of all service innovations.
Public sector productivity.
Public services for businesses have improved in general.

Introduction of innovative public services for businesses have had a significant impact on their performance.
Government procurement as a driver of business innovation.
Government procurement of advanced technology products.
Importance of innovation in procurement.

Source: **European Commission (2013, p. 20).**

Hofstede's cultural dimensions (Hofstede, 2011; Hofstede *et al.*, 2010) comprise power distance, individualism, masculinity, uncertainty avoidance, long-term orientation, and indulgence. The 2010 edition of "Cultures and Organizations: Software of the Mind" lists the scores for 76 countries on the dimensions, partly based on replications and extensions of the original IBM study on different international populations and by different scholars.²

According to Hofstede *et al.* (2010), the power distance index refers to the degree of acceptance of uneven power distribution in a society. Individualism can be defined as a preference in a society for individuals to take care of only themselves. Masculinity refers to the achievement, heroism, assertiveness, and material rewards for success. Uncertainty avoidance indicates the degree of comfort with uncertainty and ambiguity. Long-term orientation considers the past while dealing with present and future. Finally, indulgence refers to the gratification with enjoying life and having fun.

The Global Competitiveness Report (2017-2018) examines 140 economies using 114 productivity indicators. The Global Competitiveness Index (GCI) tracks the performance of countries in terms of 12 pillars of competitiveness (Schwab & Sala-i-Martin, 2017). Moreover, the EIS provides a comparative assessment of the research and business innovation performance of EU member States and the relative strengths and weaknesses of their research and innovation systems. It helps member States assess areas in which they need to concentrate efforts to boost innovation performance.

The performance of EU national innovation systems is measured by the Summary Innovation Index, a composite indicator obtained by taking an unweighted average of 27 indicators. The Innovation Index for each EU member State is based on their results in four performance groups: innovation leaders, strong innovators, moderate innovators, and modest innovators (EIS, 2017).

² Although much of the information related to these variables was collected more than 30 years ago, it is still used to characterize national cultures in several research studies, but should be seen as an approach that needs to be further tested in the future.

The methodology used in this study was based on cluster analysis. We considered innovation in the public sector as the dependent variable in order to identify the level of innovation and test its dependency on enablers and also determine whether it translates into output factors.

To verify the hypotheses proposed, cluster analysis was performed to group countries in terms of public sector innovation, while mean differences tests were used to identify the factors associated with the different patterns. In addition, the application of Scheffe's test allowed us to assess the principal determinants of innovation in the public sector.

This methodology groups countries according to their innovation capacity, considering the aforementioned variables related to public services and government procurement. The share of public organizations with services, communication, process, and organizational innovations and the share of new services measure the levels of public sector innovation; public services for business improvement and innovative services measure the impact on business through supply; government procurement and innovation in procurement measure the impact through demand.

Scheffe's test of mean differences was used to verify whether independent groups differed with respect to enablers, activities, Hofstede's cultural dimensions, the Summary Innovation Index, and GCI. This was aimed at verifying whether innovation in the public sector depends on the competitiveness level, which is a cultural phenomenon.

Results

Cluster analysis proved adequate, and the variables used to categorize the countries were all significant, as seen by the results of the ANOVA analysis carried out. Statistical significance can be observed through the F-statistics. The level of significance is associated with a low probability of analysis rejection (table 2).

Table 2.

ANOVA for groups of economies.

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
Share of organizations in public administration with services, communication, process or organisational innovations	251	2	45,714	26	5,486	0,010
Share of 'New' services out of all services innovations	972	2	71,611	26	13,571	0,000
Public services for business have improved in general	528	2	54,852	26	9,625	0,001

Introduction of innovative public services for business have had a significant impact on their performance	190	2	32,835	26	5,791	0,008
Government procurement as a driver of business innovation	393	2	84,147	26	4,671	0,018
Importance of innovation in procurement	416	2	60,612	26	6,855	0,004

Source: authors.

Based on the results in table 3, a total of three groups were identified. The first group shows a high level of public innovation through a higher share of services, communication, process, and organizational innovation; share of new services in all services; and procurement innovation. The second group displays a high level of public services for business and new business services and, therefore, a high level of innovation from public services. However, the third group shows a low level of innovation in four of the six dimensions considered, except public services for business improvement and the introduction of new public services for business.

Table 3.

Cluster averages for groups of economies.

	Cluster 1	Cluster 2	Cluster 3
	N=14	N=7	N=8
Share of organizations in public administration with services, communication, process or organisational innovations	93,71	92,66	84,10
Share of 'New' services out of all services innovations	33,82	26,28	14,29
Public services for business have improved in general	22,06	36,80	29,69
Introduction of innovative public services for business have had a significant impact on their performance	12,67	21,64	14,76
Government procurement as a driver of business innovation	30,31	22,57	18,38
Importance of innovation in procurement	12,70	23,69	9,56

Source: authors.

In terms of innovation by country (table 4), the first group includes Austria, Cyprus, Czech Republic, Denmark, Finland, Ireland, Italy, Netherlands, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom. The second group gathers Belgium, Bulgaria, Greece, Latvia, Luxembourg, Malta, and Portugal. The third group contains Estonia, France, Germany, Hungary, Lithuania, Norway, Poland, and Romania.

Table 4.
Countries by Cluster.

Cluster 1	Cluster 2	Cluster 3
(n= 14)	(n=7)	(n=8)
Austria	Belgium	Estonia
Cyprus	Bulgaria	France
Czech Republic	Greece	Germany
Denmark	Latvia	Hungary
Finland	Luxembourg	Lithuania
Ireland	Malta	Norway
Italy	Portugal	Poland
Netherlands		Romania
Slovakia		
Slovenia		
Spain		
Sweden		
Switzerland		
United Kingdom		

Source: authors.

Scheffe's test was used to identify whether the three groups differed on the variables of human resources, governance and ICT investments, capacities, drivers and barriers, Hofstede's cultural dimensions, global competitiveness, and innovation performance.

Regarding the importance of enablers in innovation capacity in the public sector, we can state that cluster one –organizational innovators– shows evidence of higher institutional efficiency in terms of government effectiveness and regulatory quality. The remaining enablers (human resources and the development of e-Government) are not significantly different (table 5).

Table 5.

Group differences: Enablers—Human Resources, Governance, and ICT development.

	Sum of Squares	df	Mean Square	F	Sig.	Obs
Employment share of 'creative occupations'	179,761	2	89,880	0,713	0,500	
Share of employees in public administration with a university degree	635,091	2	317,545	1,016	0,376	
Government effectiveness	1,810	2	0,905	2,710	0,085	1>3>2
Regulatory quality	0,780	2	0,390	2,825	0,078	1>3>2

Increased efficiency of government services due to the use of ICT	0,523	2	0,262	0,471	0,630	
Online availability of public services	163,371	2	81,686	0,309	0,737	
E-government development index (EGDI	0,025	2	0,012	1,546	0,232	

Source: authors.

Regarding capacities, drivers, and barriers for innovation in the public sector, the test of mean differences verifies that groups one and two have a greater share of innovators that innovate in-house and a share of process innovators that innovate in-house, thereby emphasizing the importance of external knowledge.

As for whether the focus is more on internal or external barriers to innovation, on active management involvement in innovation, and on the share of employees involved in groups that meet regularly to develop innovations, the ANOVA did not provide significant results, indicating no significant differences between groups. In addition, cluster one is more focused on process innovation in-house, while cluster two is more centered on service innovation in-house and the importance of external knowledge (table 6).

Table 6.

Group differences: Activities, capacities, drivers, and barriers.

	Sum of Squares	df	Mean Square	F	Sig.	Obs
Share of service innovators that innovate in-house	2449,524	2	1224,762	8,343	0,002	2>1>3
Share of process innovators that innovate in-house	1427,238	2	713,619	5,044	0,014	1>2>3
Importance of internal barriers to innovation	254,832	2	127,416	0,787	0,466	
Importance of external barriers to innovation	57,287	2	28,644	0,164	0,850	
Active management involvement in innovation	457,126	2	228,563	1,431	0,257	
Importance of external knowledge	685,071	2	342,536	7,529	0,003	2>1>3
Share of employees involved in groups that meet regularly to develop innovations	110,677	2	55,339	0,770	0,473	

Source: authors.

When using Hofstede's national cultural dimensions on innovation in the public sector, we observe that countries in cluster two reveal a national culture characterized by higher uncertainty

avoidance. In addition, clusters one and two, the most innovative, reveal a national culture characterized by indulgence (table 7).

Table 7.

Group differences: Cultural dimensions.

	Sum of Squares	df	Mean Square	F	Sig.	Obs
Power Distance	948,481	2	474,240	1,133	0,338	
Individualism	843,826	2	421,913	1,530	0,236	
Masculinity	259,780	2	129,890	0,186	0,831	
Uncertainty Avoidance	4819,334	2	2409,667	6,649	0,005	2>3>1
Long Term Orientation	261,334	2	130,667	0,423	0,660	
Indulgence	2953,369	2	1476,684	4,920	0,015	1>2>3

Source: authors.

With regard to the Summary Innovation Index 2013 and Summary Innovation Index 2017 and the Global Competitiveness Index 2017, countries in group one showed superior innovation index performance. The Global Competitiveness Scores were not significantly different between groups (table 8).

Table 8.

Group differences: Summary Innovation Index and Global Competitiveness Index.

	Sum of Squares	df	Mean Square	F	Sig.	Obs
Summary innovation Index 2017	5667,990	2	2833,995	3,093	0,062	1>3>2
Summary innovation Index 2013	6317,486	2	3158,743	3,513	0,045	1>2>3
Global competitiveness index 2017	0,842	2	0,421	1,647	0,212	

Source: authors.

Discussion and conclusions

The results of this study suggest the existence of three groups of countries according to innovation characteristics in the public sector. The factors identified in these groups are related to government effectiveness and regulatory quality: activities, capacities, drivers, and barriers (share of service innovators that innovate in-house, share of process innovators that innovate in-house, and importance of external knowledge); national culture (uncertainty avoidance and indulgence); and national innovation capacity.

These findings reinforce the importance of government effectiveness and regulatory quality has an element associated with innovation in the public sector. The higher the level of these indicators, the more chances of occurrence of adequate conditions for innovation; although we could also argue that innovation itself is fundamental to government effectiveness.

The association with a high share of in-house services and process innovation indicates a need to develop innovation capabilities that can promote innovation with the public sector as an element of successful innovation in public services. Outsourcing innovation processes may be inefficient in promoting effective innovation in the public sector, since this practice could not be adapted constantly nor is a continuous process. It is also clear the need to maximize resources and external knowledge in order to foster higher innovation and acceleration in public sector innovation processes.

The association with national culture, in particular, with uncertainty avoidance, shows that the motivation to better plan and define future outcomes fosters innovation in public services. However, the link to indulgence is interesting; it may be related to the motivation to provide easier ways to access public services and serve the public more conveniently. Innovation can promote new ways for citizens to access information on public services and for the government to process their requests and obtain feedback. This also means that public services should simplify and reduce administrative tasks and make them more efficient.

These results go in line with information from the European Commission (2013), which refers that public sector innovation can occur at different levels: innovations in public administration and organization of public sector establishments, policy and regulations innovations (reforms), innovations in public campaigns and public information dissemination, innovations in revenue collection and generation (tax system, public enterprises), innovations in service and goods delivery (such as education, public knowledge/research and development by universities), public services or goods innovations (e.g., infrastructure), financial support innovations (introducing new programs such as innovation subsidies), innovations in behavioral incentives provided, systemic innovations, and conceptual innovations.

The differences observed between groups suggest that policies must focus on increasing government effectiveness and regulatory quality, promoting companies' product and process innovation support programs, encouraging collaboration and networks development, and establishing mechanisms that could help reduce uncertainty and risk in innovation, thus diminishing risk perception in some cultures. Policies should also foster education and competences development in order to promote a positive attitude and capacity to act and create more innovation initiatives in lower indulgence countries.

Regarding the limitations faced, this study used the Scoreboard database as the single source of information for each country and a quantitative method as the unique method for analysis.

This study could be extended through the use of analyses founded in qualitative methods such as interviews and case studies, specifically those included in the OECD Observatory of Public Sector Innovation, which collect the best case examples of public sector innovation.³ Furthermore, employing a wider range of methods (such as participant observation and experiments) in public administration research could enhance our understanding, since each method has its own strengths.

Disclosures

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