FGV EBAPE

RAP
BRAZILIAN JOURNAL OF PUBLIC ADMINISTRATION

Drivers of innovation in state-owned enterprises: evidence to public enterprises from Ecuador

Anderson Argothy[1]
Nuria González Álvarez[2]

[1] Universidad Técnica del Norte / Facultad de Ciencias Administrativas y Económicas, Ibarra, Ecuador
[2] Universidad de León / Departamento Dirección y Economía de la Empresa, León, Spain

The current studies on innovation do not consider or tend to ignore innovation in Public Enterprises (PE) and their effects on other organizations. Recent evidence shows that PE are not necessarily inferior to their private counterparts (Kowalski, Büge, Sztajerowska, & Egeland, 2013). This article investigates the determinants of innovation in PE of Ecuador, for the first time, through an empirical study. It identifies internal and external determinants of innovation and the effect on the probability of innovation in PE. In addition, the variable environmental care is included as an internal determinant; this variable has not been analyzed in previous work on innovation in PE. The data used come from the Survey of Activities of Science, Technology, and Innovation of Ecuador (ACTI) published in 2014. The proposed model is estimated by logit linear regression. The results show that there are determinants that have a positive effect on the probability of innovation and they are of two types: internal (workers training, technology acquisition and environmental care) and external (government, through the support program for quality management).

Keywords: public innovation; public administration; drivers of innovation; public enterprises; economy of innovation.

Determinantes de la innovación en empresas propiedad del Estado: evidencia para las empresas públicas de Ecuador

Los estudios de innovación en la actualidad no toman en cuenta o tienden a ignorar la innovación en las empresas públicas (EP) y sus efectos sobre otras organizaciones. Evidencia reciente muestra que las EP no son necesariamente inferiores a sus contrapartes privadas (Kowalski et al., 2013). Este trabajo investiga por primera vez mediante un estudio empírico los determinantes de la innovación en las EP de Ecuador. Identifica determinantes internos y externos de la innovación y su efecto en la probabilidad de innovación en EP. Además, se incluye la variable cuidado ambiental como determinante interno; esta variable no ha sido analizada en trabajos previos sobre innovación en EP. Los datos utilizados provienen de la encuesta de actividades de ciencia y tecnología e innovación de Ecuador (ACTI) publicada en el 2014. El modelo propuesto se estima mediante una regresión lineal de tipo logit. Los resultados muestran que existen determinantes que tienen efecto positivo sobre la probabilidad de innovación y que son de dos tipos: internos (trabajadores, capacitación, adquisición de tecnología y cuidado ambiental) y externos (gobierno, mediante el programa de apoyo a la gestión de calidad).

Palabras clave: innovación pública; administración pública; determinantes de la innovación; empresas públicas; economía de la innovación.

Determinantes da inovação nas empresas estatais: evidência para as empresas públicas no Equador

Os estudos de inovação atualmente não levam em conta e tendem a ignorar a inovação nas empresas públicas (EP) e seus efeitos sobre outras organizações. Evidências recentes mostram que as EP não são necessariamente inferiores às empresas privadas (Kowalski et al., 2013). Este artigo investiga pela primeira vez através de um estudo empírico os determinantes da inovação em EP no Equador. Identifica os determinantes internos e externos da inovação e seu efeito sobre a probabilidade de inovação no EP. Além disso, a variável cuidado ambiental é incluída como um determinante interno; esta variável não foi analisada em estudos anteriores sobre a inovação em EP. Os dados são da pesquisa de atividades de ciência, tecnologia e inovação do Equador (ACTI), publicado em 2014. O modelo proposto é avaliado por meio de uma regressão linear de tipo logit. Os resultados mostram que existem determinantes que têm efeito positivo sobre a probabilidade de inovação e são de dois tipos: internos (funcionários, treinamento, aquisição de tecnologia e cuidado ambiental) e externos (governo, mediante o apoio para gestão de qualidade).

Palavras-chave: inovação pública; administração pública; determinantes da inovação; empresas públicas; economia da inovação.

DOI: http://dx.doi.org/10.1590/0034-761220170055
Article submitted on March 24, 2017 and accepted for publication on May 23, 2018.
[Translated version] Note: All quotes in English translated by this article's translator.

1. INTRODUCTION

At present there is renewed interest in the study of Public Enterprises (PEs) that goes beyond privatization (Florio, 2014a). Governments around the world are owners of a large part of productive capital. In light of the neoliberal economic model, interest in privatization has been revived and poses interesting questions: What is the current importance of PEs in innovation? Why are governments still owners of PEs? After the international crisis of 2008, the response of various governments was the nationalization or other forms of statization of organizations that previously were private in different economic sectors (Florio, 2014a). Some countries have undertaken recovery processes of strategic sectors or of public interest that were privatized in the past (Warner & Clifton, 2014). In the case of Latin America, Keynesian policies have been applied, based on heavy investments of the State, structural change (UN and CEPAL, 2012) to correct the development gaps (Espino, 1999), market failures and inefficiency of access to public services (Chang, 2007).

Currently, PEs have been rediscovered as instruments of public and economic policy in strategic sectors, managing in this way to focus investments in R&D (Bernier, 2014; Florio, 2014a) and to contribute to economic development (Senplades, 2013). Articles such as that of Kowalski et al. (2013) demonstrate the importance that the PEs have in international trade, where the total sales of State-owned Enterprises represent more than 10% of the total sales of the 2,000 largest enterprises of the world. At present the PEs are concerned with assuming risks, being proactive and, above all, developing innovation by means of R&D initiatives (Entebang, Harrison, & Run, 2010). In this respect there are internal and external elements in the organizations that facilitate innovation, these elements are known as determinants or drivers of innovation (Agolla & Lill, 2013; Damanpour & Schneider, 2006; Kim, 2010).

Despite their importance, the articles on innovation do not consider or they ignore innovation in PEs (Tõnurist, 2015). Therefore, this article seeks: i) beginning with the review of existing literature, to identify the determinants that influence the development of innovation; ii) to measure, using an econometric model, the determinants of innovation in the PEs of Ecuador, including an environmental variable in the analysis; and iii) to recommend alternatives for enterprises and decision-makers in order to promote development of innovation in the PEs. This article contributes to the existing literature because, for the first time, a study is made on innovation in PEs of Ecuador. In addition, none of the previous articles includes an environmental variable as an innovation driver in the PEs.

The article is structured as follows: section 2 is a review of the related literature necessary to explain the role of the PEs and the determinants of public innovation, proposing a model that includes those determinants. Section 3 presents a brief description of the data and methodology used. Section 4 shows the results and their analysis. To finish, section 5 includes some conclusions and recommendations.

2. THEORETICAL FRAMEWORK

2.1 PUBLIC ENTERPRISES AND INNOVATION

Public enterprises are defined as economic organizations: a) owned or co-owned by national or local government; b) that internalize a public mission among their objectives; c) that possess partial or total budgetary autonomy; d) that show discretion in the management; e) that are committed to business

activities; and f) where privatization could at first be possible or de facto, but for various reasons it is not an option (Florio, 2014b; Short, 1984). In current articles, State-Owned Enterprises (SOEs) are referred to, with these being one hundred percent of public capital (Florio, 2014a; Goldeng, Grünfeld, & Benito, 2008; Penfold, Oneto, & Rodríguez Guzmán, 2015), differentiating them from the mixed enterprises, which consist of agreements shared between the public sector and private operators or financial investors (Cruz, Marques, Marra, & Pozzi, 2014; Vining, Boardman, & Moore, 2014). The mixed enterprises can be seen as a prior stage of a fully public enterprise on the road towards a completely private enterprise (Asquer, 2014). According to Short (1984), the factors that contribute to the development of PEs are: i) socialist politics; ii) political and historical factors; iii) the search for socio-economic objectives; and iv) structural factors. In this context, it may be a way of correcting market failures, particularly in countries with regulatory weaknesses or where the private sector is insufficient (Chang, 2007; Kowalski et al., 2013).

At present, many Public Enterprises (PEs) are considered instruments of industrial policy in strategic sectors, sustaining high levels of investment in R&D (Bernier, 2014; Florio, 2014a), and promoting new industries where the private sector would not assume the risk (Chang, 2002; Kowalski et al., 2013). In the case of Ecuador, this power of the PEs is recognized in Art. 315 of the Constitution of the Republic of Ecuador (Constituent Assembly, 2008).

In emerging countries, the presence of the State in the economy is significant, in some cases it has increased in recent years (Kowalski et al., 2013; Senplades, 2013). In their articles, Kowalski et al. (2013) and Florio (2014a) show the importance of the PEs in the world market, comparing indicators of private and public enterprises, with the PEs obtaining a better performance in several.

The public sector is generally seen as scarcely inclined towards innovation, full of rules, adverse to risk and functioning as a monopoly (Bernier, 2014; Borins, 2002). Nonetheless, the PEs can be islands within the State, due their autonomy and capacity (Skocpol & Finegold, 1982). The literature highlights the importance of innovation (Kearney et al., 2008; Kim, 2010), although with certain differences in comparison to the private sector. Innovation in the public sector is motivated by benefits that are not always monetary (Benz, 2009).

Some articles have focussed on researching public innovation, such as, in the U.S.A. (Lee, Hwang, & Choi, 2012), Italy (Arduini, Belotti, Denni, Giungato, & Zanfeia, 2010), United Kingdom (Walker, 2006), Australia (Torugsa & Arundel, 2015), and Brazil (Brandão & Bruno-Faria, 2013), among others. However, there are few articles that analyse innovation in PEs. Some of them analyse the structure and concentration of the PEs (Choi, Park, & Hong, 2012), the contribution to industry of R&D generated in the PEs (Hu & Jefferson, 2004), role of the Direct Foreign Investment with respect to R&D in the PEs (Girma, Gong, & Görg, 2009), and the role of the PEs in the policies of R&D and innovation (Tõnurist, 2015), among others.

It is necessary to make a distinction between concepts. Public innovation can be defined: i) in a broad sense as any process of generation and application of new ideas capable of improving the operability of the organizations and elevating the living standards of the people (Pulido, 2006); ii) as conceived under the logic of organizational learning, structural (macro) change, inter-organizational dynamics and adaptive vision as a political process that goes much beyond the mechanical application of management tools (Ramírez-Alujas, 2011); and iii) as rooted in making something different and deliberately having the aim of achieving certain objectives or else deliberate changes in behaviour with a specific objective in mind (Koch & Hauknes, 2005).

Innovation in PEs includes the study of the micro-element within the macro-process of innovation (Metcalfe, 1999). It studies a focalized set of public organizations that in many cases are in charge of producing goods or services for the public or private sector, developing new processes in order to produce existing goods more efficiently, or new products, which permit improving their position in the market but also complying with social objectives (Girma et al., 2009).

The PEs could be propitious spaces for innovation and entrepreneurship, using State resources and protection (Bernier, 2014). There is nothing in the DNA of the public sector that makes it less innovative than the private (Mazzucato, 2014). However, in order for innovation to have a place, it is necessary to develop certain conditions both internally and externally of the PEs (Kim, 2010).

The study of PEs is traditionally based on the *New Public Management* (NPM) and the actions carried out in the last three decades for the inclusion of business practices and creation of quasi-markets, removing the differences between what is public and what is private (Hood, 1995; Pollitt, 2003). The results have been the privatization of public services, exclusion of basic services to citizens, deregulation and delivery of strategic resources to foreign countries (Acosta & Falconí, 2005). There are alternatives to privatization that generate equal or greater gain (Bartel & Harrison, 2005; Florio & Fecher, 2011; Omran, 2004).

Studying the public enterprises now can be more important than in the past, due to their evolution (Bernier, 2014). The governments now need policy instruments for the development of innovation and to ensure the return on the investment (Mazzucato, 2014). If one of the main reasons for the crisis of 2008 was the inadequate regulation of the private sector, the public enterprises can be a solution (Tõnurist, 2015; Warner & Clifton, 2014).

What we pose here is that innovation is an important variable in the study of public enterprises. Innovation in PEs is desired since it benefits the organization and the economy by means of an increase in productivity, including better practices, creating new industries, supporting competitiveness (Kearney et al., 2008) and the achievement of social objectives. However, innovation and performance in the PEs are not spontaneous phenomena; they are conditioned on internal and external determinants (Agolla & Lill, 2013; Arundel, Casali, & Hollanders, 2015; Farah, 2008; Kim, 2010). Below, the most relevant determinants are discussed.

2.2 DETERMINANTS OF THE PUBLIC INNOVATION

The review of previous literature identifies two types of determinants of innovation: internal and external (Agolla & Lill, 2013; Arundel et al., 2015; Damanpour & Schneider, 2006; Dunleavy & Margetts, 2006; Farah, 2008; Kim, 2010; Luke, Verreynne, & Kearing, 2010; Walker, 2008), their own and that of others (Bloch & Bugge, 2013; Vigoda-Gadot, Shoham, Schwabsky, & Ruvio, 2008).

2.2.1 INTERNAL DETERMINANTS

They are fundamental for innovation to occur (Kearney et al., 2008). They represent internal attributes of the public organizations, support activities of innovation and entrepreneurship (Luke et al., 2010). They affect the capacity of the organization to absorb external knowledge (Love, Roper, & Vahter, 2014).

There are several dimensions for this; however, in this article, the size of the organization, the workers, and acquisition of technology will be analysed. These factors were chosen mainly for their

wide presence in the literature on innovation in PEs. They can be seen in the articles of Arduini et al. (2010); Arundel et al. (2015); Borins (2002, 2001); Fernández and Wise (2010); Saari, Lehtonen, & Toivonen (2015), while the Environmental Care determinant was included due to the current importance in society as well as its scarce presence in previous articles on PEs.

2.2.1.1 Size of the Organization

Size has deserved special attention, it is a subject of debate among academicians and researchers (Fernández & Wise, 2010; Palmer & Dunford, 2001). It can be related to other factors, making the organization be more open or resistant to change (Fernández & Wise, 2010). A large size allows mobilizing greater resources (Damanpour, Walker, & Avellaneda, 2009; Damanpour & Schneider, 2006), and increases the probability of developing innovations (European Commission, 2010). Nonetheless, a larger size can also have negative effects on innovation (Lonti & Verma, 2003). In this article it is assumed that a larger size is beneficial for innovation, due to the growth in size the Ecuadorian public enterprises have experienced in recent years (Senplades, 2013). For this reason, the following hypothesis is proposed:

H1: The size of the organization is positively related to innovation in PEs.

2.2.1.2 Workers' training and skills

The workers are the ones that allow achieving objectives, many innovations are achieved through them (Borins, 2002). The motivation of the workers affects the results of innovation (Palmer & Dunford, 2001), type of contract, organizational climate and innovation (Montes, Moreno, & Fernández, 2004). The workers' education, training and capacity for learning is positively related to innovation (Lonti & Verma, 2003; Marr, 2009; Sánchez & Castrillo, 2006).

H2: The workers' training is positively related to innovation in PEs.

2.2.1.3 Environmental care

The importance of the environment and the environmental policies has reshaped the innovation strategy in the organizations (Craig & Dibrell, 2006). Due to the increase in restrictions imposed in favour of the environment, the sustainable economic development has become a source of competitive advantage for the enterprises (Berns et al., 2009; Hart, 1995).

Previous articles on private companies analyse: innovation and environmental strategy in a family of enterprises compared to individual enterprises (Craig & Dibrell, 2006); capacity for marketing and innovation based on sustainable environmental strategies (Mariadoss et al., 2011); and innovation based on *green products* (Dangelico & Pujari, 2010), among others. Previous articles highlight the benefit of integrating issues of environmental sustainability in the development of products and in the operations of the enterprise (Dangelico & Pujari, 2010). In this regard, the innovations focussed on reducing the environmental impact have a positive effect on the organizations (Berns et al., 2009; Craig & Dibrell, 2006; Hart, 1995).

In the literature reviewed, there was no empirical work on which this variable was included in articles related to PEs; however, there were articles that theoretically highlight the importance of innovation

in order to reduce the environmental impact (Agolla & Lill, 2013; Dunleavy & Margetts, 2006). In this regard, the following hypothesis is proposed:

H3: The reduction of the environmental impact is positively related to innovation in Public Enterprises.

2.2.1.4 Technology

It is defined as the acquisition, implementation, management of technology for creation of products or services for users and citizens (Arduini et al., 2010; Pärna & Von Tunzelmann, 2007), access to technological assets including equipment and the process of innovation (Cruz & Paulino, 2013).

In the majority of countries of the world, the differences in productivity have been explained by the role that technology plays (Keller, 2004). The PEs consider that the technological changes are significant in explaining innovation (Lonti & Verma, 2003). The technological advances have an important impact on the development of innovation in the organizations, bringing about as a result new or improved goods and services and other complementary innovations (Marr, 2009).

H4: The acquisition of technology is positively related to innovation in PEs.

2.2.2 EXTERNAL DETERMINANTS

These are external forces or elements that affect the planning and implementation of the process of innovation in the organization (Vigoda-Gadot, Shoham, Ruvio, & Schwabsky, 2005). The external factors play a principal role in the determination of opportunities, threats and restrictions (Pearce & Robinson, 2003).

There are several dimensions for these drivers; due to their broad presence in literature the following were selected: Government: political and legal environment, this driver is considered as the most important element for public innovation and has been studied by Agolla and Lill (2013); Fernández and Wise (2010); Vigoda-Gadot et al. (2008); Walker (2008), among others. Economic setting and budget changes: this determinant has been studied by Agolla and Lill (2013); Marr (2009); Mulgan and Albury (2003); Potts and Kastelle (2010), among others.

2.2.2.1 Government: political and legal environment

This concerns the capacity that the central government has to generate or influence in the regulatory and legal framework the incentives and investments for the development of innovation at the public and private level (Agolla & Lill, 2013; Fernández & Wise, 2010; Vigoda-Gadot et al., 2008; Walker, 2008). It permits protecting public interests, when market failures exist (Saari et al., 2015), affecting the social relationships and those of power in benefit of priority sectors, making investments in traditional and technological mega-projects (Agolla & Lill, 2013; Mazzucato, 2014), structural reforms in education, training policies, entrepreneurship, fiscal policies, standardization of products/services, support to public research institutes, policies for the creation of networks and knowledge spaces, infrastructure and offer of technology (Agolla & Lill, 2013; OECD, 2010).

The Ecuadorian government through the Ministry of Production has created several incentive policies, focussed on improving the production and innovation in public and private enterprises,

with the one most well known and used by the enterprises being the "Quality Management System" program. In this sense, the following hypothesis is proposed:

H5: Access to the support instrument "Quality Management System" is positively related to innovation in PEs.

2.2.2.2 Economic setting and budgetary changes

The macro-economic situation has a direct effect on the organizations, and affects the supply and demand of services (Agolla & Lill, 2013; Marr, 2009). The public sector is directed by economic principles of efficiency (Potts & Kastelle, 2010). There is a direct relationship between the economic situation and the adoption of innovations (Damanpour & Schneider, 2006). Some organizations manage the crisis in a positive manner, incrementing the capacity for innovation, innovating to confront the pressures by reducing costs and increasing efficiency (Borins, 2001; Mulgan & Albury, 2003; Saari et al., 2015), while other organizations are affected negatively (Vigoda-Gadot et al., 2008). In the case of the PEs, a restrictive economic setting means a reduction of the budgetary assignment by the central government.

H6: The restrictive economic setting, measured by the lack of funds in the PEs, is negatively related to innovation in PEs.

3. METHODOLOGY

The data for this article were taken from the database of the National Survey of Activities of Science, Technology and Innovation of Ecuador (Acti),[1] prepared by the National Statistics and Census Institute (Inec) and the National Secretariat of Higher Education, Science, Technology and Innovation (Senescyt), published in the year 2014, with updated information to the year 2011. It has a sample of 2,815 organizations, divided in 2,749 (97.66%) private enterprises and 66 (2.34%) public enterprises. The sample of public enterprises corresponds to 26% of the total public enterprises in Ecuador, according to the National Secretariat of State Planning there are 250 PEs (Senplades, 2013).

For this research, we have worked with the sample of public enterprises (66 organizations). As innovation in PEs is a relatively new subject of study, several of the previous articles were done with small samples, for example: 31 organizations of the United States (Borins, 2012), 51 projects from 16 enterprises (Vanagunas & Webb, 1994), 81 questionnaires of the United Kingdom, Denmark, Finland and Estonia (Pärna & Von Tunzelmann, 2007), 97 Australian public agencies (APSC, 2011), 120 directors of public organizations in the United Kingdom (Walker, 2006), 125 organization of the United Kingdom (Dunleavy & Margetts, 2006).

Below, the variables used are described:

Dependent variable:

Innovation: a dichotomous variable composed by enterprises that carried out at least one type of innovation (product, process, service).

Independent variables:

[1] The database can be downloaded from: www.ecuadorencifras.gob.ec/ciencia-tecnologia-e-innovacion/.

Size of the enterprise: it is measured by the number of workers, using a scale (0 = medium, 1 = large).

Training and skills: a dichotomous variable in which those enterprises that have carried out training programs for their workers are identified (1 = Yes, 0 = No).

Environmental care: this is an indicator of the importance that environmental care, as a strategic objective of innovation, has in public enterprises (1 = important, 0 = not important).

Technology: a dichotomous variable, for the enterprises that acquired some type of technology during the analysed period.

Government: a dichotomous variable that shows the enterprises that accessed the governmental support program for innovation "Quality Management System" (1 = accessed, 0 = did not access).

Economic Setting: it measures the lack of budgetary assignment to the PEs and its effect on innovation. (1 = important, 0 = not important).

Given that the choice of the econometric model depends on the distribution of the dependent variable, a *logit* model was selected. This explains the propensity to innovate of the PEs based on the determinants. Thus, the equation that represents the model is the following:

$$Ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon \qquad (1)$$

This model provides as a result the probabilities that the variable *Innovation* takes value 1, conditioned by a set of variables posed as determinants. The multi-variate model proposed will identify its own effect, different for each variable, simultaneously controlling the effects of all the variables included in the model. In addition, it guarantees greater internal validity. For this reason, two basic suppositions must be fulfilled, correct specification and absence of multi-collinearity. However, by itself that equation is complex and not directly interpretable, for which reason it has to be transformed. The logistic equation can be simplified as follows:

$$\frac{p}{1-p} = e^{\beta 0 + \beta 1 X1 + \beta 2 X2 + \ldots + \beta k Xk} \qquad (2)$$

The logistic regression is not linear in the parameters, for which reason its interpretation, although improved, continues being more complex than the linear regression. The coefficients of the logit model as such do not serve for its interpretation. In the above equation the coefficients indicate how the odds ratio of the event varies, measured by the dependent variable according to a change of 1 magnitude in the value of the independent variables. This interpretation expresses the change of the independent variable in terms of the odds ratio.

The results presented below will be expressed in coefficients and in the odds ratio.

In this research three models were prepared along with a series of indicators that identify the relevance, fit and variation of the model:

N = number of cases.

ll_0 = logarithm of the likelihood of the base model.

ll = logarithm of the likelihood of the evaluated model.

chi2 = likelihood test.

r2_p = pseudo r^2 or McFaddern R^2.
p = significance test of the model
aic[2] and bic[3] = Akaike information and Bayesian information criteria

4. DISCUSSION AND RESULTS

This section shows the results obtained. In the first place, information is presented on the variables used and the existing correlations (table 1).

TABLE 1 INFORMATION ON VARIABLES AND CORRELATION OF VARIABLES

Variable	Obs	Mean	Std. Dev.	Min	Max
Innovation	66	0.2727	0.4487	0	1
Size of the enterprise	66	0.5303	0.5029	0	1
Training and skills	66	0.4090	0.4954	0	1
Environmental care	66	0.4848	0.5036	0	1
Technology	66	0.6060	0.4924	0	1
Quality management program	66	0.6212	0.4888	0	1
Economic setting	66	0.3939	0.4923	0	1

Source: Elaborated by the authors based on Acti (2014).

Variables	1	2	3	4	5	6	7
Innovation	1						
Size of the enterprise	0.0992	1					
Personnel training	0.5284*	0.5361*	1				
Environmental care	0.0186	0.1841	0.3644*	1			
Technology	0.3545*	0.2975*	0.5447*	0.6581*	1		
Government program	0.2625*	0.4884*	0.4572*	0.2179	0.3292*	1	
Economic setting	0.0633	-0.049	0.1491	0.2726*	0.4596*	-0.0593	1

Source: Elaborated by the authors based on Acti (2014).
Legend: * Significance $p < 0.05$

[2] AIC = Akaike Information Criterion. It is calculated using the likelihood of the model and the number of parameters. It is interpretable especially in comparison rather than on its own: the model with lower AIC is the best adjusted.
[3] BIC = Bayesian Information Criterion. It is a more useful measurement for comparing logit models, it is better developed theoretically: the model with lower BIC can be interpreted as the best.

Table 1 shows the number of analysed observations (N), mean, standard deviation and the possible values for each of the proposed variables, in addition to the correlations between different variables. There exists a significant correlation between Innovation and Personnel training; Innovation and Technology; Innovation and the Quality program. With respect to innovation and the rest of the variables, the correlation values are low.

The results of the three models prepared as well as their respective indicators of fit, variation and relevance (table 2) are presented below. Model 1 is a regression that uses only the proposed internal determinants. Model 2, in turn, uses only the proposed external determinants, while in the third model a joint regression is made using the proposed internal and external determinants.

TABLE 2 MODELS EXPRESSED AS COEFFICIENTS

Variable	Model 1	Model 2	Model 3
Internal Determinants			
Size of the enterprise	-17.7487***		-20.2588***
Personnel training	19.6141***		21.9201***
Environmental care	-2.7587*		-4.1032**
Technology	3.1743*		4.8608**
External Determinants			
Quality Management Program		0.5848	2.3998*
Economic setting		0.1896	-1.6698
_cons	-2.9526***	-1.4415**	-4.4374***
Statistics			
N	66	66	66
ll_0	-38.6729	-38.6729	-38.6729
ll	-20.0273	-38.0658	-16.8339
r2_p	0.4821	0.0157	0.5647
chi2	1.00E+03	1.3834	464.0614
p	0.0000***	0.5007	0.0000***
aic	50.0546	82.1315	47.6679
bic	61.0028	88.7005	62.9955

Source: Elaborated by the authors based on Acti (2014).
Legend: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

By selecting the same cases for the three models, the first two rows of statistics (N and ll_0) are exactly the same. By comparing the logarithm of the likelihood of the evaluated model (ll) with the logarithm of the likelihood of the base model (ll_0), it verifies whether or not the independent variable has an effect on the dependent variable.

Model 1 and model 3 are significant ($p<0.05$); this is shown by the corresponding test of χ^2 and the value *P* for each model. As for the fit of the model, the logit regression shows the pseudo r^2. Although this statistic is not as precise as the r^2 of a linear regression, it allows comparing the explanatory capacity of different models. One can see that there is a difference in the fit of each model; hence, Model 1 (0.48), Model 2 is not analysed due to the lack of significance and Model 3 (0.56).

In accordance with AIC and BIC, Model 3 is the one that possesses lower values in these two indicators (47.67) and (62.99), respectively, compared to the other two models, for which reason it is assumed to be model that best explains the probability of innovating in the PEs.

Taking into account the indicators r^2, aic, and χ^2 corresponding to Model 3, this is the one that presents best results. Before analysing the coefficients of the model, two additional indicators were generated (table 3).

TABLE 3 FIT OF MODEL 3 (INTERNAL AND EXTERNAL)

Indicator	Result
Hosmer-Lemeshow chi2 (8) =	5.09
Prob > chi2 =	0.7482
area under ROC curve =	0.9497
Correctly classified	84.85%

Source: Elaborated by the authors based on Acti (2014).

The Hosmer-Lemeshow test is a test of the goodness of fit of the data to the model, the null hypothesis is that the model corresponds to the reality (Cameron & Trivedi, 2009). In this regard, the value P does not reject the null hypothesis, for which reason it can be stated that Model 3 has a good fit. The area under the curve near 1 confirms that the model has a good fit with respect to sensitivity (capacity to identify positives) and specificity. In addition, the statistics of classification show that there is a correct classification for 84.85% of the cases.

The coefficients obtained in the regression show that the *size* is significant ($p < 0.001$) and negatively affects innovation in PEs; therefore, H1 is rejected.

The determinant *Training and skills* has a significant result ($p < 0.001$), also showing a positive relationship with innovation, which confirms H2.

For *Environmental care,* the results show that this determinant is significant ($p < 0.01$) with a negative relationship as regards the probability of innovation; thus, the posed hypothesis H3 is not confirmed. That is, the enterprises that consider the environmental objectives as important for innovation reduce their probability of innovating. This result must be taken with caution since it deals with a relatively new subject for the PEs, and the application of recent measures in favour of the environment. Therefore, perhaps it is not the moment for evaluating the effects on innovation.

Technology is possibly one of the fundamental factors for the development of innovation, the results show that the determinant is significant ($p < 0.01$), positively related to the probability of innovation in the PEs, which confirms the posed hypothesis H4.

Government has traditionally been seen only as being in charge of creating the regulatory framework for innovation. In this regard, the governmental support instrument for innovation, *"Quality Management System",* has been evaluated. The results show that it has a significant effect ($p < 0.05$) on the probability of innovation in the PEs, thus confirming H5.

As for the *Economic Setting,* the lack of resources (budgetary assignments for the PEs) and its effect as a driver of innovation, the results show that this factor does not have a significant effect ($p < 0.05$) on the probability of innovation. Therefore, the posed hypothesis H10 cannot be verified, which sought to confirm the existence of a negative relationship between the lack of funds and innovation.

In the methodology section, it was stated that the analysis through the odds ratio is quite complex. The values corresponding to each model express how much the ratio of occurrence of the event would vary according to the change in the independent variables; that is, when the independent variable changes, how much the ratio[4] of innovation would vary in the PEs. If the odds ratio associated with a variable is higher than 1, the ratio increases the value of the variable; therefore, the variable has a positive effect on the probability of the event occurring. If the coefficient shown is less than 1, the ratio of occurrence of the event decreases as the associated independent variable increases by one unit of measure (Escobar, Fernández-Macias, & Bernandi, 2010). The negative variations go from 0 to 1, while the positive variations are from 1 to infinitive. To try to normalize and make the magnitudes comparable, a good alternative is to work with standard deviations, that is, using its standard deviation as a unit of variation of the independent variable and obtaining the inverse of the coefficients that present variations inferior to 1. Table 4 includes this information in such a way that the determinants are identified that have a greater effect on the probability of developing innovation.

Table 4 shows, in the first column, the determinants evaluated in the model, in the second column are the coefficients, next the value *P*, followed by the odds ratio. The fifth column is important, since it shows the change in the innovation ratio in view of the increase of one standard deviation in the independent variable. By using this measurement, all the coefficients can be compared with each other, identifying those that have a greater effect.

[4] Ratio: the frequency that represents the occurrence of an event over the frequency of its not occurring.

TABLE 4 EFFECTS OF THE COMPARED DETERMINANTS

Variables	Coefficients	P Value	Odds Ratio	Variation of one Standard Deviation*
Internal Determinants				
Size of the Enterprise	-20.25882	0.000	0.0000	0.0000
Personnel Training	21.92008	0.000	3.31E+09	5.20E+04
Environmental Care	-4.10322	0.001	0.0165	0.1266
Technology	4.86084	0.004	129.1326	10.9497
External Determinants				
Quality Management Program	2.39976	0.046	11.0205	3.2317
Economic Setting	-1.66983	0.108	0.1883	

Source: Elaborated by the authors based on Acti (2014).
Legend:* Only the significant coefficients where $p < 0.05$ are taken into account.

Thus, the determinant that has the most important effect is *Training and skills,* training the workers increases the probability of innovating in the PEs. Next, *Acquisition of Technology,* the enterprises that acquire technology, whether in an incorporated way or not, have a greater probability of innovating. The *Government* through the evaluation of the quality management program likewise exercises a strong influence on the probability of developing innovation, again highlighting the importance of a Government that is proactive and not reactive in view of innovation. The determinants *Environmental care* and *Size of the enterprise,* as mentioned earlier, have a negative effect, decreasing the probability of developing innovation.

5. CONCLUSIONS

This research studies the drivers of innovation in the public enterprises of Ecuador. For this study, we have worked with the National Survey of Activities of Science, Technology and Innovation of Ecuador (Acti) 2014 and within this, 66 cases were selected that correspond to PEs. In this research, through the theoretical review, two general types of determinants of public innovation were distinguished, referred to as: i) Internal Determinants, composed of: Size of the Enterprise, Training and Skills, Environmental Care, Acquisition of Technology; and ii) External Determinants, composed of Government Quality Management Program, and Economic Setting.

The results show that the internal determinants by themselves have a better fit than the external determinants, according to the posed models. However, the interaction of both (internal and external), increases the fit of the model. They show that *workers, technology* and *government programs* are the main determinants for innovation in public enterprises. There are determinants that negatively affect the probability of innovation, which are: *Size of the Enterprise* and *Environmental Care.* These last results must be taken with caution since they could be influenced by the size of the sample or the static nature of the data.

The results of the research also reinforce some previous articles, so it can be concluded that: a larger size does not increase the probability of innovating in the PEs, and bureaucracy is considered an obstacle for the innovation (Borins, 2001; Lonti & Verma, 2003). As for Training and skills, this result supports the articles of Bingham (1978); Lonti and Verma (2003); Marr (2009); Pärna and von Tunzelman (2007), who highlight the importance of the investment in training within the public organizations as one of the main determinants for innovation. In this regard the concern of the PEs in improving the workers' conditions has a positive effect on innovation; these results confirm the articles of Mohr (1969); Montes and collaborators (2004); Palmer and Dunford (2001), who find positive relationships between the satisfaction of the workers and innovation.

On Environmental Care, the results obtained in this article contradict the theoretical articles of Agolla and Lill (2013); Dunleavy and Margetts (2006), who express the importance of the actions in favour of the environment as an object of innovation, obliging the enterprises to undertake innovative solutions in order to reduce the environmental impact.

As for technology, the result for the Ecuadorian case confirms the articles of Koch and Hauknes (2005); Lonti and Verma (2003); Marr (2009); Mulgan and Albury (2003), who highlight in their research the importance of the technology for innovation in public organizations, allowing the development of new products, processes, services, improving the quality and reducing costs. In addition it supports the results of the empirical works of Hughes, Moore, and Kataria (2011); Pärna and Von Tunzelmann (2007); Vanagunas and Webb (1994).

The results obtained for the *Government* innovation determinant confirm the importance of this element for the development of innovation in the PEs. Furthermore, they support the articles of Agolla and Lill (2013); Fernández and Wise (2010); Walker (2008), which highlight the importance of government in generating and influencing in the regulatory and legal framework the incentives and investments in the development of innovation at the public and private level.

As regards the Economic Setting, the results of this article do not clarify for the Ecuadorian case the ambiguity existing on the subject, since some articles see the lack of resources as a positive factor for innovation (Borins, 2001; Mulgan & Albury, 2003), while other articles show the negative effect on innovation (Vigoda-Gadot et al., 2008).

Some recommendations of public policy can be extracted from this article:

a) The need to strengthen those determinants that present a greater boost for innovation, therefore, increasing the investment in training of the workers should be the policy of each PE. b) The State, for its part, should focus its efforts towards providing technology, alternative funds and programs or other instruments for development of innovation in public enterprises. c) The public enterprises should increase the investments destined to the acquisition of technology, incorporated or not. d) It is important for the PEs to take into account the environmental impact, although the data show a negative effect on the probability of innovation; in the medium and long term, it is an obligation, especially for megadiverse[5] countries such as Ecuador.

While the results do not show a significant effect on the economic setting –restrictive on innovation– it is necessary to create programs for development of creativity in the workers in such

[5] Ecuador is considered within the 17 megadiverse countries of the planet (UNEP, 2016).

a way that the crises and lack of funds are not an obstacle for innovation, but rather an opportunity for finding creative solutions to the problems in such a way that innovation is the lever that mitigates the crises.

With respect to the limitations, it must be mentioned that this is a cross-sectional article, due to the irregularity of the innovation survey of Ecuador, for which the information that it provides is static and does not allow viewing the evolution of the innovation determinants of the PEs. The sample is small for which reason the lack of information can cause noise affecting the results. As this is a first article on the subject in Ecuador, it is not comparable to previous articles.

As future lines of research, it is possible to prepare articles that allow identifying the economic and social impact of the innovation carried out by the PEs, cooperative relationships between public enterprises, and technology transfer, among others, adding in the future the results obtained for the public enterprises with the private enterprises. In this sense, we have tried to estimate the three models proposed, using the private enterprises in the sample. However, upon analysing the subsample of private enterprises, it resulted that, despite the abundant number of companies included in the sample, only a low percentage of private enterprises made investments in R&D. Thus, 78.3% (2,152) of the private enterprises included in the sample provide 0.00 USD of investment in R&D. This fact may be due to the economic structure of a country such as Ecuador, in which 90% of the private enterprises are commercial. For this reason, it was decided not to fit the models using the sample of private enterprises since the main objective of the article is to analyse the determining factors of innovation and it cannot be analysed in a sample of companies that scarcely invest in R&D. At this time, the highest percentage of investment in R&D in Ecuador is made by the public enterprises and, therefore, this article has focussed on their study. In the future, if Ecuador becomes a more developed country with private enterprises less focussed on marketing and which opt for making greater investments in R&D, it will be appropriate to carry out the analysis on private enterprises that the reviewer suggests.

Lastly, it would also be interesting to carry out this same study on a sample of public enterprises of another country or even on a sample of public enterprises belonging to different countries since this comparison would verify if they are corroborated on the international level or, on the contrary, if they are specific to Ecuador.

REFERENCES

Acosta, A., & Falconí, F. (2005). *Asedios a lo imposible*: *propuestas económicas en construcción*. Quito: Flacso-Ildis.

Agolla, J. E., & Lill, J. B. V. (2013). Public sector innovation drivers: a process model. *Journal of Social Sciences*, *34*(2), 165-176.

Australian Public Service Commission – APSC. (2011). *State of the service report: state of the service series 2010-2011*. Canberra: Commonwealth of Australia.

Arduini, D., Belotti, F., Denni, M., Giungato, G., & Zanfeia, A. (2010). Technology adoption and innovation in public services the case of e-government in Italy. *Information Economics and Policy*, *22*(3), 257-75.

Arundel, A., Casali, L., & Hollanders, H. (2015). How European public sector agencies innovate: the use of bottom-up, policy-dependent and knowledge-scanning innovation methods. *Research Policy*, *44*(7), 1271-1282.

Asamblea Constituyente. (2008). *Constitución de la República del Ecuador*.

Asquer, A. (2014). Explaining partial privatization of public service provision: the emergence of mixed ownership water firms in Italy (1994-2009). *Annals of Public and Cooperative Economics*, *85*(1), 11-30.

Bartel, A. P., & Harrison, A. E. (2005). Ownership versus environment: disentangling the sources of public-sector inefficiency. *The Review of Economics and Statistics*, *87*(1), 135-147.

Benz, M. (2009). Entrepreneurship as a non-profit-seeking activity. *International Entrepreneurship and Management Journal*, *5*, 23-44.

Bernier, L. (2014). Public enterprises as policy instruments: the importance of public entrepreneurship. *Journal of Economic Policy Reform*, *17*(3), 253-266.

Berns, M., Townend, A., Khayat, Z., Balagopal, B., Reeves, M., Hopkins, M. S., & Kruschwitz, N. (2009). Sustainability and competitive advantage. *MIT Sloan Management Review*, *51*(1), 18-27.

Bingham, R. D. (1978). Innovation, bureaucracy, and public policy: a study of innovation adoption by local government. *The Western Political Quarterly*, *31*(2), 178-205.

Bloch C., & Bugge, M. M. (2013). Public sector innovation—from theory to measurement. *Structural Change and Economic Dynamics*, *27*, 133-145.

Borins, S. (2001). Encouraging innovation in the public sector. *Journal of Intellectual Capital*, *2*(3), 10-19.

Borins, S. (2002). Leadership and innovation in the public sector. *Leadership & Organization Development Journal*, *23*(8), 467-476.

Borins, S. (2012). Making narrative count: a narratological approach to public management innovation. *Journal of Public Administration Research and Theory*, *22*(1), 165-189.

Brandão, S. M., & Bruno-Faria, M. F. (2013). Inovação no setor público: análise da produção científica em periódicos nacionais e internacionais da área de administração. *Rev. Adm. Pública*, Rio de Janeiro, *47*(1), 227-248.

Cameron, A. C., & Trivedi, P. K. (2009). *Microeconometrics using Stata*. Texas: Stata Press.

Chang, H. J. (2002). *Kicking away the ladder?* Economic development in historical perspective. Londres: Anthem Press.

Chang, H. J. (2007). *State-owned enterprise reform*. Nueva York: United Nations.

Choi, S. B., Park, B. I., & Hong, P. (2012). Does ownership structure matter for firm technological innovation performance? The case of Korean firms. *Corporate Governance: An International Review*, *20*(3), 267-288.

Craig, J. B., & Dibrell, C. (2006). The natural environment, innovation, and firm performance: a comparative study. *Family Business Review*, *19*(4), 275-288.

Cruz, N., Marques, R. C., Marra, A., & Pozzi, C. (2014). Local mixed companies: the theory and practice in an international perspective. *Annals of Public and Cooperative Economics*, *85*(1), 1-9.

Cruz, S., & Paulino, S. (2013). Public service innovation and evaluation indicators. *Journal of Technology Management & Innovation*, *8*, 285-297.

Damanpour, F., & Schneider, M. (2006). Phases of the adoption of innovation in organizations: effects of environment, organization and top managers. *British Journal of Management*, *17*(3), 215-236.

Damanpour, F., Walker, R. M., & Avellaneda, C. N. (2009). Combinative effects of innovation types and organizational performance: a longitudinal study of service organizations. *Journal of Management Studies*, *46*(4), 650-75.

Dangelico, R. M., & Pujari, D. (2010). Mainstreaming green product innovation: why and how companies integrate environmental sustainability. *Journal of Business Ethics*, *95*(3), 471-486.

Dunleavy, P., & Margetts, H. (2006). *Achieving innovation in central government organisation*s. Londres: The Stationery Office-National Audit Office.

Entebang, H., Harrison, R. T., & Run, E. C. (2010). Entrepreneurial orientation of public enterprises in Malaysia. *Business Strategy Series*, *11*(2), 75-77.

Escobar, M., Fernández-Macias, E., & Bernandi, F. (2010). *Análisis de datos con Stata*. Madrid: Centro de Investigaciones Sociológicas.

Espino J. A. (1999). *Instituciones y economía*. Una introducción al neoinstitucionalismo económico. México: Fondo de Cultura Económica.

European Commission. (2010). *Innobarometer 2010*: analytical report innovation in public administration. Brussels: Belgium.

Farah, M. F. S. (2008). Disseminação de inovações e políticas públicas e espaço local. *Organ. Soc.*, Salvador, *15*(45), 107-126.

Fernández, S., & Wise, L. (2010). An exploration of why public organizations "ingest" innovations. *Public Administration*, *88*(4), 979-998.

Florio, M. (2014a). Contemporary public enterprises: innovation, accountability, governance. *Journal of Economic Policy Reform*, *14*(3), 201-208.

Florio, M. (2014b). *The return of public enterprise*. (Working Paper, n. 01/2014). Milan: Centre for Industrial Studies.

Florio, M., & Fecher, F. (2011). The future of public enterprises: contributions to a new discourse. *Annals of Public and Cooperative Economics*, *82*(4), 361-73.

Girma, S., Gong, Y., & Görg, H. (2009). What determines innovation activity in Chinese state-owned enterprises? The role of foreign direct investment. *World Development*, *37*(4), 866-873.

Goldeng, E., Grünfeld, L. A., & Benito, G. R. G. (2008). The performance differential between private and state owned enterprises: the roles of ownership, management and market structure. *Journal of Management Studies*, *45*(7), 1244-1273.

Hart, S. L. (1995). A natural resource based view of the firm. *The Academy of Management Review*, *20*(4), 986-1014.

Hood, C. (1995). The "new public management" in the 1980s: variations on a theme. *Accounting, Organizations and Society*, *20*(1-2), 93-109.

Hu, A. G., & Jefferson, G. H. (2004). Returns to research and development in Chinese industry: evidence from state-owned enterprises in Beijing. *China Economic Review*, *15*(1), 86-107.

Hughes, A., Moore, K., & Kataria, N. (2011). *Innovation in public sector organisations*: a pilot survey for measuring innovation across the public sector. Londres: NESTA.

Kearney C., Hisrich, R., & Roche, F. (2008). A conceptual model of public sector corporate entrepreneurship. *International Entrepreneurship and Management Journal*, *4*(3), 295-313.

Keller, W. (2004). International technology diffusion. *Journal of Economic Literature*, *42*, 752-82.

Kim, Y. (2010). Stimulating entrepreneurial practices in the public sector: the roles of organizational characteristics. *Administration & Society*, *42*(7), 780-814.

Koch, P., & Hauknes, J. (2005). *On innovation in the public sector*: today and beyond. (Publin report, D20), Oslo: Nifu Step.

Kowalski, P., Büge, M., Sztajerowska, M., & Egeland, M. (2013). State-owned enterprises: trade effects and policy implications. *OECD Trade Policy Papers*, *147*, 1-33.

Lee, S. M., Hwang, T., & Choi, D. (2012). Open innovation in the public sector of leading countries. *Management Decision*, *50*(1), 147-162.

Lonti, Z., & Verma, A. (2003). The determinants of flexibility and innovation in the government

workplace: recent evidence from Canada. *Journal of Public Administration Research and Theory*, *13*(3), 283-309.

Love, J. H., Roper, S., & Vahter, P. (2014). Dynamic complementarities in innovation strategies. *Research Policy*, *43*(10), 1774-1784.

Luke, B., Verreynne, M.-L., & Kearing, K. (2010). Innovative and entrepreneurial activity in the public sector : the changing face of public sector institutions. *Innovation: Management, Policy & Practice*, *12*(2), 138-153.

Mariadoss, B. J., Tansuhaj, P. S., & Mouri, N. (2011). Marketing capabilities and innovation-based strategies for environmental sustainability: an exploratory investigation of B2B firms. *Industrial Marketing Management, 40*(8), 1305-1318.

Marr, B. (2009). *Managing and delivering performance*: *how government, public sector and not-for-profit organisations can measure and manage what realy matters.* Oxford: Elsevier.

Mazzucato, M. (2014). *El Estado emprendedor: mitos del sector público frente al privado*. Barcelona: RBA Libros.

Metcalfe, L. (1999). La gestión pública: de la imitación a la innovación. In Losada, C. (Ed.) *¿De burócratas a gerentes?: las ciencias de la gestión aplicadas a la administración del Estado.* Washington: Banco Interamericano de Desarrollo, 47-68.

Mohr, L. B. (1969). Determinants of innovation in organizations. *The American Political Science Review*, *63*(1), 111-126.

Montes, F. J. L., Moreno, A. R., & Fernández, L. M. M. (2004). Assessing the organizational climate and contractual relationship for perceptions of support for innovation. *International Journal of Manpower*, *25*(2), 167-180.

Mulgan, G., & Albury, D. (2003). *Innovation in the public sector*. Londres: Strategy Unit, Cabinet Office.

Organisation for Economic Co-operation and Development – OECD. (2010). *Innovation to strengthen growth and address global and social challenges*. Paris: Ministerial Report on the OECD Innovation Strategy.

Organização das Nações Unidas – ONU / CEPAL. (2012). *Cambio estructural para la igualdad*. Una visión integrada del desarrollo. San Salvador: Eclac.

Omran, M. (2004). The performance of state-owned enterprises and newly privatized firms: does privatization really matter? *World Development*, *32*(6), 1019-1041.

Palmer, I., & Dunford, R. (2001). The diffusion of managerial innovations: a comparison of Australian public and private sector take-up rates of new organizational practices. *International Public Management Journal*, *4*(1), 49-64.

Pärna, O., & Von Tunzelmann, N. (2007). Innovation in the public sector: key features influencing the development and implementation of technologically innovative public sector services in the UK, Denmark, Finland and Estonia. *Journal Information Polity*, *12*(3), 109-125.

Pearce, J. A., & Robinson, R. B. (2003). *Strategic management*: *formulation, implementation, and control.* Nueva York: McGraw Hill.

Penfold, M., Oneto, A., & Rodríguez Guzmán, G. (2015). La transparencia del gobierno corporativo en las empresas de propiedad del Estado en América Latina. *Política Públicas y Transformación Productiva*, *20*, 1-68.

Pnuma. (2016). *Biodiversidad*. Programa Nac. Unidas para el medio ambiente 2016: biodiversidad. Retrieved from www.pnuma.org/biodiversidad/

Pollitt, C. (2003). Public management reform: reliable knowledge and international experience. *OECD Journal on Budgeting*, *3*(3), 121-138.

Potts, J., & Kastelle, T. (2010). Public sector innovation research: what's next? *Innovation: Organization & Management*, *12*(2), 122-37.

Pulido, A. (2006). *La innovación en el siglo XXI*. Madrid: La Universidad del Futuro.

Ramírez-Alujas, Á. V. (2011). Sobre la aplicación y desarrollo del concepto de innovación en el sector público: estado del arte, alcances y perspectivas. *Circunstancia*, *26*, 1-37.

Saari, E., Lehtonen, M., & Toivonen, M. (2015). Making bottom-up and top-down processes meet in public innovation. *The Service Industries Journal*, *35*(6), 325-344.

Sánchez, M. P., & Castrillo, R. (2006). La tercera edición del Manual de Oslo: cambios e implicaciones. Una perspectiva de capital intelectual. *Revista Madri+d*, *35*, 1-16.

Senplades. (2013). *Empresas públicas y planificación — su rol en la transformación social y productiva*. Quito: Secretaria Nacional de Planificación y Desarrollo del Ecuador.

Short, R. (1984). The role of public enterprises: an international statistical comparison. In Floyd, R. H., Gray, C. S., & Short, R. *Public enterprise in mixed economies: some macroeconomic aspects*. Washington: International Monetary Fund, 116-122.

Skocpol, T., & Finegold, K. (1982). State capacity and economic intervention in the early New Deal. *Political Science Quarterly*, *97*(2), 255-278.

Tõnurist, P. (2015). Framework for analysing the role of state owned enterprises in innovation policy management: the case of energy technologies and Eesti Energia. *Technovation*, *38*, 1-14.

Torugsa, N. A., & Arundel, A. (2016). The nature and incidence of workgroup innovation in the Australian public sector: evidence from the Australian 2011 State of the service survey. *Australian Journal of Public Administration*, *75*(2), 202-221.

Vanagunas, S., & Webb, J. (1994). Administrative innovation and the training of public managers. *Public Personnel Management*, *23*(3), 437-45.

Vigoda-Gadot, E., Shoham, A., Schwabsky, N., & Ruvio, A. (2008). Public sector innovation for Europe: a multinational eight-country exploration of citizens' perspectives. *Public Administration*, *86*(2), 307-329.

Vigoda-Gadot, E., Shoham, A., Ruvio, A., & Schwabsky, N. (2005). *Report on the publin surveys*. (Publin Report, D17). Haifa: University of Haifa.

Vining, A. R., Boardman, A. E., & Moore, M. A. (2014). The theory and evidence pertaining to local government mixed enterprises. *Annals of Public and Cooperative Economics*, *85*(1), 53-86.

Walker, R. M. (2008). An empirical evaluation of innovation types and organizational and environmental characteristics: towards a configuration framework. *Journal of Public Administration Research and Theory*, *18*(4), 591-615.

Walker, R. M. (2006). Innovation type and diffusion: an empirical analysis of local government: public administration. *Public Administration*, *84*(2), 311-335.

Warner, M. E., & Clifton, J. (2014). Marketisation, public services and the city: the potential for Polanyian counter movements. *Cambridge Journal of Regions, Economy and Society*, *7*(1), 45-61.

Anderson Argothy Almeida

https://orcid.org/0000-0003-4887-1625
Holds a PhD in Business Economics (Universidad de León); Professor-researcher, School of Administrative and Economic Sciences, Department of Economics, Technical University of the North, Ibarra, Ecuador.
E-mail: laargothy@utn.edu.ec

Nuria González Álvarez:

https://orcid.org/0000-0002-2224-567X
Holds a PhD in Business Administration (Universidad de León); Associate professor of Management, Department of Business Economics, Universidad de León, León, Spain. E-mail: nuria.gonzalez@unileon.es