



Public procurement as a driver of innovation and entrepreneurship¹

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Abstract

This paper analyses the effectiveness of public procurement (PP) to spur the development and expansion of innovative ventures. In particular, we focus on whether there is a differentiated effect for start-up companies. We analyse two mechanisms through which PP has a positive impact on companies: (i) making it possible to reach a sufficient scale to expand in the domestic market or abroad and, (ii) complementing innovation promotion programs that operate as drivers of the innovation offer of a country. For the whole sample of firms analysed and our set of three main variables (employment growth, sales growth and export growth), we do not find any evidence indicating that being a supplier of the state affects the development and expansion of companies. We however, reject the null hypothesis that there is no effect of PP on the growth of the exports / turnover ratio of start-ups. Indeed, both in the case of those that have not made innovation and in that of the innovators, being a public supplier is linked to a greater orientation to the external market. We also reject the null hypothesis that there is no impact on the interaction of demand- and supply-side policies.

JEL classification: D22, D78, L26, L38, L52, O25, O31, O38, O54

Keywords: firm behavior, positive analysis of policy formulation, entrepreneurship, public policy, industrial policy, Latin America

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1 Introduction

An integrated innovation system implies designing and implementing supply- and demand-side policies in such a way that they complement and strengthen each other. Supply-side policies can lift firm's specific constraints. Most usual, supply-side policies provide finance under special conditions (lower rates, or with implicit subsidies) that can help firms build human capital, acquire physical capital, or enhance social capital. In complement, demand-side policies can stimulate the demand for innovative products and services, create incentives for business innovation and accelerate the diffusion of new technologies. In particular, public procurement (PP) has one such potential. Several countries have designed and implemented guidelines with the aim of creating the conditions for PP to become a catalyst for innovation (see for example, Vinnova 2007, Tekes 2009, Georghiou et al 2014, Uyarra et al 2014, and Lember and Kattel 2014). In complement, s

However, firms face obstacles when it comes to transforming themselves into public suppliers. These obstacles have been identified and analysed by the economic literature, classifying them into:

- complexity / incompatibility of the legal framework
- risk management difficulties
- lack of capacity and resources to satisfy bidding and contracting requirements of the public body

For start-up companies, it is not clear which -if any- of these obstacles is binding.

Our contribution in this paper is twofold. First, we analyze empirically how effective PP is to spur the development and expansion of innovative ventures in an emerging economy (Uruguay) using a unique qualitative and quantitative dataset. Second, we verify the validity of the conceptual framework and identify an additional set of barriers and obstacles to innovative PP, addressing specifically the case of start-ups.

We conduct 29 in-depth stakeholders interviews, including to 16 start-ups, 1 con-

solidated firm, 7 policy makers and 5 start-up incubators. We also use the most recent representative survey at the national level with the objective of characterizing innovation in Uruguay (ANII and INE 2013-2015 survey) through econometric analysis in order to contrast our findings.

Therefore, we provide unique empirical evidence on the challenges to PP that exist in Uruguay. We make a cadaster of innovators that have tried (successfully or not) to become public providers (in several of the State levels: national government, public firms, decentralized agencies and municipal governments).

Second, we verify through in-depth interviews with innovators, incubators, and policy makers, the validity of the conceptual framework adapted for Uruguay. In the third place, we identify a new set of barriers and obstacles to innovative PP with those qualified informants. We conduct an econometric analysis using a representative national survey to analyze the relationship between PP and other traditional innovation policies (supply side) for the whole set of Uruguayan firms. In particular, we analyze the effect of PP on the growth rates of sales, employment and exports. We also evaluate how PP (demand-side policy), public support programs for innovation (supply-side policies) and their interaction affect innovation. We focus on whether there is a differentiated effect for start-up firms.

We analyze two mechanisms through which PP may have a positive impact on start-ups firms: (i) making it possible to reach a sufficient scale to expand, either in the domestic market or abroad and, (ii) complementing supply-side innovation promotion programs that operate as drivers of innovation in a country.

The rest of the article is organized as follows: in section two we describe the theoretical framework, the Uruguayan innovation ecosystem and our main hypotheses; in section three we expose the methodology and data used to conduct both qualitative and quantitative analyses; in section four we explain our main findings and in section five we discuss policy implications and conclude, exploring avenues for further research.

2 Framework and hypothesis

This section presents the theoretical framework under which PP spurs innovation and boosts economic growth. The second part describes the case of Uruguay, as analyzed by Gheorgiou et al. (2014) and Moñux and Ospina (2017). In the third place, this section streamlines the main hypothesis to be contrasted empirically in next section.

2.1 Theoretical framework

An important precedent for this study is Crespi, Fernández-Arias and Stein's book on productive development policies in Latin America (2014), where they provide a taxonomy on policies of innovation, highlighting how the focus of these policies has varied over time. At first, policies were oriented towards the promotion of the supply side (1950-80s). Later, the focus shifted to the demand side (1980-2000) and, eventually, since the 2000s, a systemic approach is being promoted and applied in many countries. The rationale is that the promotion of innovation as a public policy is justified by its link with the improvement in productivity and economic growth. The underlying idea is that government intervention can be beneficial if -from a social welfare perspective- firms are sub-investing in innovation, due to the presence of externalities, information asymmetries, or coordination failures.

The empirical evidence for Latin America shows that the business sector effectively sub-invests with respect to what could be expected given its level of financial development and human capital accumulation. In part, the authors explain this difference by the scarcity of public sector investments in the generation of generic knowledge, as well as by the lack of sophistication of the productive structure (Crespi, Fernández-Arias and Stein, 2014).

Although within the countries that are on the frontier of technological innovation there are different approaches to and definitions of what a successful innovation policy is, the cited authors point out certain common lessons: (i) there is a long-term public-

private consensus on the importance of public support and the constant updating of innovation policies; (ii) there is initial support for the adoption of foreign technology (concept of "new to the country"), promotion of human capital, and generation of innovation infrastructure is available; (iii) a stable macroeconomic environment is guaranteed; (iv) a systemic approach of simultaneous support to supply-side and demand-side policies, as well as the use of public procurement for innovation benchmarked by mission-oriented research and development (R & D) policies.

An essential characteristic of mission-oriented R & D is that the projects financed are of an applied nature. Results are maximized when lessons from this research can be applied to different sectors, when it focuses on the first phases of a new technology, when it finances a multipurpose technological infrastructure, when designing public procurement rules encourages competition and collaboration between research teams, universities, public laboratories and firms. Obviously, mission-oriented R & D also entails risks, especially whether the institutional management capacities are weak (Crespi, Fernández-Arias and Stein, 2014). The current panorama of innovation policies in advanced economies distinguishes between horizontal and vertical types, while discriminating according to their scope (public good or market intervention). The use of the innovative PP as an innovation policy is part of the case of vertical market interventions (in specific sectors).

On the other hand, Moñux and Uyarra (2016) present a conceptual framework by which innovative PP stimulates innovation and economic growth. Based on Georghiou et al (2014), they hypothesize that PP could be an effective tool to promote innovation and therefore economic development, since it is an important component of countries' demand for goods and services. The idea is to stimulate the demand for innovative goods and services, create incentives for innovation in firms and accelerate the diffusion and adoption of new technologies. They present nine case studies (United States, China, Holland, Estonia, United Kingdom, Spain, Brazil, Chile and Colombia) in order to identify similarities and to highlight successful policies. According to the authors,

public purchases in LAC reach an average of 20% of GDP, which suggests a potential benefit in using it in order to strength innovation.

Finally, there is evidence that PP policies have a significant impact on innovation (IDB 2016, 2017, OECD 2015, European Commission, 2018), since supply-side policies (such as tax incentives for innovation, the creation of incubators), seed capital delivery programs for innovation) would have positive but insufficient effects.

2.2 The Uruguayan framework

Moñux and Ospina (2017) construct a SWOT analysis and propose a series of specific recommendations for Uruguay also based on the theoretical framework proposed in Georghiou et al. (2014) and described in Moñux and Uyarra (2016).¹ They analyze whether innovative PP can improve the efficiency of public spending as well as promoting innovation from the demand side. To do this, they analyze the current regulatory framework on innovation, public purchases and digital agenda, as well as its updates. They also consider stylized facts verified in OECD and LAC countries. The authors review the studies and statistics available to the macroeconomic context, innovation, public procurement and its importance in relation to GDP, among others.² They elaborate a diagnosis and a proposal to generate the institutional structure and implement improvements in public policies in order to increase the innovative PP in Uruguay.

Moñux and Ospina (2017) identify Uruguay's specific advantages, such as the low corruption rates and the relatively high technical skills in buyers (public agents). In turn, they consider that innovative PP can cover deficiencies in the R & D system (low levels of technology absorption and insufficient investment). The Uruguayan government, in particular, has created start-up incubators and has strengthened networks within business and the academia, placing one of its public universities in the unique

¹SWOT analysis is a strategic planning technique used to identify strengths, weaknesses, opportunities, and threats related to business competition or project planning.

²We presume that the researchers also interview certain agents in relation to some issues (such as the eventual resistance of the innovation agency to participate in a public policy to promote innovative PP).

technology park (LATU), next to the public innovation agency (ANII). Furthermore, it offers seed capital for dynamic ventures. Uruguay presents advantages to stimulate innovative PP, given its homogeneity and small size, the fact that state-owned firms handles many of the key sectors of the economy, and public officials are considered as highly capable in relation to other regional countries. In addition, Uruguay is part of the D7 group of the world's most advanced digital countries.

2.3 Hypotheses

From the theoretical framework highlighted above, along with its adaptation to the Uruguayan case, we have streamlined the following hypothesis to be contrasted empirically.

Hypothesis 1: Public procurement does not affect the development and expansion of firms.

Hypothesis 2: The interaction of demand- and supply-side innovation policies has no impact on the development and expansion of firms.

In the following sections we present our results, emphasizing the cases where we reject those null hypotheses.

3 Methodology and data

In this paper we integrate both qualitative analysis and quantitative analysis with the objective of expanding the breadth of approaches and enriching the evidence in order to strength this field's knowledge and the set of public policies available to Uruguay.

For the purposes of this study, we define innovative PP in a wide-ranging way, including initiatives that emerge to satisfy public or private needs, motivating innovative entrepreneurs to develop a project and, frequently, to look for support from business incubators. Our definition is consistent with the IDB's theoretical framework (Moñux

and Ospina, 2016, Navarro, Benavente and Crespi, 2016, European Commission Innovative Public Procurement Group, 2018).

We consider that Edquist and Hommen (1998) definition *”a public policy tool through which a public purchaser acquires a solution that is not yet available in the market, but that could be developed in a reasonable period of time”* - used by Moñux and Ospina (2017), is too restrictive for our purposes. Indeed, their definition excludes all but one of the innovators that had tried to sell (successfully or not) their goods and services to the government.

The innovators in our cadaster have made their process or product innovation independently of who was going to buy it.³ In some exceptional cases, ex-engineers of the public sector have developed customized solutions, but none of these cases came to a successful end. The only evidence that this study could collect of a public pre-purchase of a solution tailored for the public sector (Municipality of Montevideo) was carried on by a firm with more than 30 years of presence in the market.

3.1 Qualitative methodology and data

Six incubators were contacted (see annex). From the interviews with the incubators a list of twenty potential “interviewable” start-ups emerged. Based on this information, 16 innovative start-ups and a consolidated firm with more than 30 years of presence in the market were interviewed.

We conducted in-depth interviews with those Uruguayan innovative entrepreneurs between May and July 2018. We present our questionnaire (in Spanish) in Annex 1 at the end of this paper, as well as we show a complete list of key agents interviewed in Annex 2 (policy makers information is also presented in detail).

We deepen on the analysis of innovative entrepreneurs’ answers in the section that synthesizes results.

³A “process” innovation is concerned with reducing the cost of production of existing goods (Acemoglu, 2009).

3.2 Quantitative methodology and data

In order to improve the understanding of innovation processes and its determinants, we describe and econometrically analyze a nationally representative dataset. The Survey on Innovation Activities carried out jointly by the National Institute of Statistics (INE) and ANII, was applied during 2016 to 2,494 firms, covering the period from 2013 to 2015. The sample has statistical representation at the national level.

The main characteristics of the firms analyzed are detailed below and a series of tables summarizing the evidence are presented in the corresponding annex.

The survey reflects information on firms that are mostly private (99%), nationally owned (95%), located in Montevideo (65%) and constituted formally as a limited firm or limited liability firms (70%) The analysis also shows that 92% does not belong to any economic group or conglomerate, while 87% have only one location or establishment. For the purposes of this analysis, new or young firms ("start-ups") are considered to be those firms that during the base year of the study (2013) had less than 5 years of existence. 6.3% of firms were created between 2008 and 2012. 12% of Uruguayan firms won a public tender between 2013 and 2015 .

[Insert: Table 1.1]

Firms employed 37 (2013), 38 (2014) and 38 (2015) workers and generated income for 102 (2013), 109 (2014) and 113 (2015) million Uruguayan pesos. During the three years studied, approximately 90% of the firms directed all their production to the domestic market and less than 2% directed all their production abroad, determining that the average of exports in total sales of the set was located slightly above 5%.

[Insert: Table 2]

Investment in innovation among those that did innovate between 2013 and 2015 was 5 (2013), 4.5 (2014) and 3.9 (2015) million Uruguayan pesos. About the origin of this investment, the consultation shows that about 80% of the amount invested responds to own resources.

[Insert: Table 1.2]

The firms that did innovate during one of the analyzed years answered fourteen questions about the obstacles faced in the context of the development of innovation activities. For illustrative purposes, this section exposes only obstacles identified as "high importance" by at least 25% of the firms (a full table with details is presented in the annex). Thus, the obstacles that stand out in the development of innovation activities are: "Period of return on investment" (30%), "Reduced market size" (38%) and "Difficulties in access to financing" (25%).

[Insert: Table 3]

Firms were consulted about the type of innovation carried out. In more than half (54%) of the cases the respondent said that they introduced a product innovation, while in 43% it was a process innovation, in 27% an organization innovation and in 5% of the cases a marketing innovation.

[Insert: Table 4]

3.3 Methodology

We evaluate how PP (demand policy) affects the growth of exports, employment, sales and innovation, as well as the ratio of investment in innovation on sales. We also assess how public innovation support programs (supply-side policy) influence those dependent variables. In addition, we review the effect of the interaction between both types of policies (PP as demand-side type and innovation support programs as supply-side type) on firms.

3.3.1 Model 1:

We seek to answer the question of whether it is worth for a government to pursue public procurement as a policy to promote innovation for start-ups. The channel of events would be that being a public supplier enables to overcome the small-scale constraint.

This effect would be larger on start-up companies, who have significantly smaller levels of sales and employment. However, if the internal market is small, being a public supplier could crowd out the possibility of expansion for the firm, a problem that would be enhanced if there was a strong weight of the state in that market.

For each firm i , we estimate equations of the following form:

$$Y_i = \alpha + \beta S_i + \theta \cdot K_i + \gamma \cdot D_i + \delta \cdot S_i * D_i + \tau K_i * D_i + \mathbf{X}_i \phi + \varepsilon_i \quad (3.1)$$

Where, the following binary variables equal one if: D_i =having won public at least one tender

S_i =being a start-up

K_i =Subject of financial support for innovation from a promotion program

and X_i is a set of controls (indicative of size, geographical location, economic sector, legal form, foreign participation in the capital).

The dependent variable Y_i represents: (i) exports growth (Table 5), (ii) employment growth (Table 5), (iii) sales revenue growth (Table 5), (iv) innovation growth (Table 6), and (v) innovation/sales ratio (Table 6).⁴

First hypothesis

Public Procurement has no effect on the development and expansion of firms.

Null hypothesis 1: $\gamma = 0$

Null hypothesis 1 Start-ups: $\delta = 0$ Indeed, in the case of a small country with a size-relevant public sector (government, state-owned enterprises, state-owned banks, municipalities, etc.) like Uruguay, being a public provider may make a difference. Such effect would indeed be more important for start-ups.

The second mechanism under which being a public supplier has a positive impact on the development and expansion of innovative entrepreneurship is through complementing and strengthening supply-side innovation support policies.

⁴Growth is measured à la Davis, Haltiwanger and Schuh (1996): $g_Y = \frac{Y_{2015} - Y_{2013}}{0.5(Y_{2015} + Y_{2013})}$.

Second hypothesis

Public procurement has no effect on the development and expansion of firms.

Null hypothesis 2: $\tau = 0$ PP complements other policies to promote innovation available in the country (generally supply side policies, like seed capital and subsidies). Therefore, PP may be strengthening the country's innovation ecosystem.

4 Results

This section presents the qualitative and quantitative results from the analysis.

4.1 Qualitative results

A first reflection is that the innovative start-ups that are government providers in Uruguay are distributed in a great variety of sectors of economic activity. Of the 17 firms interviewed, three are from the telecommunications branch, two from Fintech, two from health, and the rest is dedicated to providing innovations in road infrastructure, urban furniture, transportation, or recycling of construction waste, energy and education.

The experiences of innovators in their relationship with the public sector are diverse, but almost all unfavorable. There are experiences in progress, experiences that have already ended, and attempts to sell to the public sector that failed before they started (two of the 17 innovators even ended up yielding their prototype before the impossibility of fulfilling the necessary requirements to be able to charge it). The counterpart in the public sector is diverse: IMM and several municipalities of the interior (Canelones, Colonia, San José), ASSE, MGAP, ANTEL, Centro Ceibal, UdelaR, ANCAP, Armed Forces. Nine innovators highlighted as strength the support received from ANII. The problems identified by the innovative start-ups are related to: (i) Lack of physical and human capital to expand the scale of innovation, beyond the prototype phase; (ii) Lack

of human capital to intellectually protect innovation; (iii) Lack of capacity to manage the risk associated with innovation; (iv) Small size of the firm, which forces them to participate as sub-contractors of larger firms.

Several public sector agencies have tried to use or used innovative solutions for already identified challenges. Within the public sector, the central government, decentralized agencies, and the Municipality of Montevideo were interviewed, gathering information on the state of the promotion policies of the ICC, the government's agenda in this matter, as well as past experiences with CPI. The experiences are also diverse, and the reasons that explain it are due to weaknesses along the chain of implementation, which make it difficult to operate and the maneuver margin of the public sector. Many times those obstacles are justified, but in some cases the regulations are obsolete, or are too restrictive. Among the barriers found in the public sector are: (i) Lack of capacity to define the value of innovation and to understand the value of innovation ("exceeds the object of public purchase" said one of the interviewees); (ii) Incoordination in the implementation of the process / complicated procedures that discourage innovators; (iii) Lack of possibilities to do field tests with prototypes - risk aversion; (iv) Lack of intellectual property protection for innovators; (v) Bad stock management (lack of processes and systems); (vi) Lack of transparency in the public procurement process through tenders.

Although the number of start-ups interviewed (17) is consistent with the small scale of Uruguay, we decided that it was worthwhile to validate/contrast our results from those that may be obtained after conducting an econometric analysis using the nationally representative ANII survey.

4.2 Quantitative results

As explained above, the objective of this analysis is to study if PP favors the development and expansion of firms. We are particularly interested in exploring whether

there is a differentiated effect on start-ups. We analyze two mechanisms through which PP may have a positive impact on firms: (i) making it possible to reach a sufficient scale to expand in the domestic market or abroad; and (ii) complementing innovation promotion programs that operate as drivers of the innovation.

Regarding our first hypothesis: although we do not find evidence that being a public provider affects the development and expansion of firms (complete sample) in any of the four dimensions that we construct as indicators of development and expansion (exports, employment, sales and innovation), we reject the null hypothesis that there is no effect of PP on the growth of start-ups' exports (as a proportion of total sales). Indeed, both in the case of those that have not made innovation and in the case of innovators, selling to the government is linked to a greater orientation to the external market.

Regarding our second hypothesis: we reject the null hypothesis that there is no impact of the interaction of demand and supply policies. On the contrary, in the particular case of expansion of the growth of exports (as a proportion of total sales), a significant and positive effect is observed both for the entire set of firms and for the innovative ones. There is also a positive and significant effect on employment and billing, but in these two dimensions only in the sub-sample of firms that have made innovation.

We also detected other patterns: in the case of innovative firms, there are negative effects of both PP and innovation promotion programs on the expansion of employment. Finally, being a start-up has a positive effect on exports, on employment (only in the case of non-innovative) and on sales. Likely, this pattern is due to the fact that the probability of registering expansions is higher in the first years of life of an entrepreneurial venture .

5 Conclusions

The economic literature presents a conceptual framework in which innovative PP may be a policy instrument on the demand side that complements supply-side policies, improving productivity and favoring economic growth. Such is a systemic approach.

In this study, we analyze unique qualitative evidence that we collected and processed on innovation and PP, as well as evidence from the national representative survey available in Uruguay (the ANII 2013-2015 national survey). The results of our qualitative analysis are consistent with the results of our econometric analysis.

From the qualitative analysis, our contribution is to complement existing analyses carried out to date by providing on-site evidence on the PP and innovation. Indeed, we: (i) map innovative firms, (ii) document their experiences and those of the incubators that have worked with them, and (iii) consult key players of the public institutions that would constitute public demand (or would facilitate and promote it through public policy). The supply-, demand- and supply/demand-side problems encountered and exposed through this paper express vividly the multiple challenges that innovative PP faces in order to achieve its full potential as a key component of the innovative ecosystem.

Our quantitative analysis reflects that PP has currently a positive impact on exports growth, but limited to start-ups. Nevertheless, PP appears to strengthen other policies designed and implemented to support innovation (supply side).

We have showed the existing relationships between PP, firm creation and development in an emerging economy.

In this paper we have analysed the barriers and obstacles that public procurement has when used as a policy to spur innovation among firms and start-ups in particular.

We found the following supply-side problems : (i) the lack of financing (which makes impossible the escalation of innovative solutions beyond the prototype phase), (ii) the lack of human capital to expand the scale of innovation, (lack of knowledge

about property protection intellectual, lack of capacities to manage risk, ignorance of peculiarities / specificities in the relationship with public sector interlocutors) and (iii) the lack of access to networks that cover the mentioned problems of access to financing and qualified human capital, and others related to the small size of the innovative company.

We also found problems related to the demand-side: lack of vision in terms of the benefits that innovation would bring, which results in lack of intellectual property protection for innovators, risk aversion, which prevents the realisation of field tests, the implementation of innovative solutions, and that translates into a bad handling of stocks that ends up harming the innovator. A rigid regulatory framework hinders and slows down the relationship of start-ups with the public sector, making it unattractive and generating problems of adverse selection.

Table 1.1: Sample characterization

	Average	Standard Deviation
Montevideo	0,646	0,020
Privada	0,997	0,001
Propiedad Individual	0,173	0,017
Sociedad de Hecho	0,041	0,009
SRL	0,315	0,020
SA	0,397	0,018
Cooperativa	0,037	0,008
Asociaciones, Clubes y Fundaciones	0,012	0,003
Otros	0,024	0,006
Participación Extranjera	0,052	0,007
Pertenencia a Grupo	0,078	0,008
Startup	0,063	0,011
Establecimiento único	0,869	0,010
Ganó Licitación Pública entre 20013 y 2015	0,122	0,011

Table 1.2: Sample characterization

	Average	Standard Deviation
Empleados 2013	37,717	2,312
Empleados 2014	38,275	2,379
Empleados 2015	38,254	2,342
Ingresos 2013 (millones)	102,946	12,334
Ingresos 2014 (millones)	109,153	12,611
Ingresos 2015 (millones)	113,037	13,127
Exportaciones 2013 (en %)	5,312	0,645
Exportaciones 2014 (en %)	5,226	0,637
Exportaciones 2015 (en %)	5,383	0,682
Inversión Innovación 2013 (millones)	1,363	0,385
- Sub-muestra con inv. en inn. positiva	4,985	1,420
Inversión Innovación 2014 (millones)	1,233	0,341
- Sub-muestra con inv. en inn. positiva	4,513	1,262
Inversión Innovación 2015 (millones)	1,063	0,142
- Sub-muestra con inv. en inn. positiva	3,890	0,537
Recursos Propios Innovación 2013 a 2015	0,815	0,022

Table 2: Exports

Proportion	2013	2014	2015
% of firms that do not export	89,57	89,38	89,74
% of firms that exports all its production	1,95	1,95	1,89

Fuente: cálculos propios en base a Encuesta ANII e INE

Table 3: Obstacles and perception of obstacles among innovative firms

	Alto	Medio	Bajo	Irrelevante	Total
1 Escasez de personal capacitado	0.22	0.13	0.32	0.32	1
2 Rigidez organizacional	0.11	0.27	0.29	0.34	1
3 Riesgos que implica la innovación	0.22	0.27	0.25	0.26	1
4 Período de retorno de la inversión	0.30	0.29	0.20	0.21	1
5 Reducido tamaño del mercado	0.38	0.29	0.13	0.20	1
6 Escasas oportunidades tecnológicas del sector al que pertenece la empresa	0.22	0.13	0.32	0.32	1
7 Dificultades de acceso al financiamiento	0.25	0.24	0.21	0.30	1
8 Escasas posibilidades de cooperación con otras empresas/instituciones	0.21	0.23	0.19	0.37	1
9 Insuficiente información sobre mercados	0.12	0.26	0.27	0.35	1
10 Insuficiente información sobre tecnologías	0.08	0.27	0.29	0.35	1
11 Escaso desarrollo de instituciones relacionadas con Ciencia y Tecnología	0.16	0.23	0.22	0.39	1
12 Infraestructura física inadecuada	0.09	0.25	0.28	0.37	1
13 Sistema de Propiedad Intelectual deficiente	0.05	0.14	0.26	0.55	1
14 Inestabilidad macroeconómica	0.19	0.31	0.22	0.28	1

La tabla indica proporción de respuestas entre quienes sí innovaron. Cálculos propios en base a encuesta ANII e INE.

Table 4: Type of innovation among firms that did innovate between 2013 and 2015

Tipo innovación entre quienes sí innovaron	Promedio	Desviación Estándar
Innovación en producto	0,543	0,033
Innovación en proceso	0,436	0,033
Innovación en organización	0,267	0,028
Innovación en comercialización	0,054	0,054

Table 5: The effect of public procurement on growth rates

	Exports		Employment		Sales revenue	
	All firms	Innovative firms	All firms	Innovative firms	All firms	Innovative firms
Public procurement (PP)	-	-0,2967	0,0154	-0,0604	0,0080	-0,0442
	0,1926					
	0,1381	0,1796	0,0196	0,0237	0,0275	0,0358
				**		
Apoyado por ecosistema innovación	0,0540	0,0121	0,0072	-0,0490	0,0404	-0,0427
	0,1032	0,1236	0,0260	0,0268	0,0370	0,0400
				*		
Start-ups	0,3845	0,3919	0,2298	0,1058	0,4551	0,2984
	0,1497	0,2129	0,0693	0,0878	0,0796	0,1551
	**	*	***		***	*
PP*Start-ups	1,0191	0,8702	0,0035	0,3061	0,1229	0,3941
	0,3528	0,4124	0,1936	0,2331	0,2663	0,2777
	***	**				
PP*Apoyado por ecosistema innovador	0,5270	0,6891	0,0669	0,1448	0,0360	0,1179
	0,2287	0,2460	0,0497	0,0494	0,0595	0,0639
	**	***		***		*
N	560	323	2486	1028	2444	1018
R2	0,17	0,25	0,08	0,14	0,10	0,15

Todos los modelos son estimados por MCO, incluyen códigos CIIU a dos dígitos, así como también indicadores de otras características de las firmas (tamaño, orientación de mercado, forma jurídica, participación extranjera en la propiedad, ubicación en la capital del país).

Table 6: The effect of public procurement on innovation (growth rate and ratio)

Innovation growth rate	(Inn/Total Revenue) 2015	
Public procurement (PP)	-0,0949 0,1145	0,0873 0,0364 **
Apoyado por ecosistema innovación	-0,0842 0,1362	0,3367 0,1396 **
Start-ups	-0,1763 0,2904	-0,1157 0,0670 *
PP*Start-ups	0,3925 0,5063	0,2854 0,1179 **
PP*Apoyado por ecosistema innovación	-0,0403 0,2265	-0,1735 0,1085
N	991	2451
R2	0,09	
Pseudo R2		0,19
N Censuradas		1544

El primer modelo es estimado por MCO y el segundo MV, con variable dependiente censurada para todas aquellas firmas con innovación nula en 2015. Los modelos incluyen códigos CIU a dos dígitos, así como también indicadores de otras características de las firmas (tamaño, orientación de mercado, forma jurídica, participación extranjera en la propiedad, ubicación en la capital del país).

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