Public Procurement for Innovation: Economic and Strategic Terms on the Supply-Side of the Market

Carolina Azedo-Morais

ISCTE-Lisbon University Institute

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ABSTRACT

Public procurement for innovation can be seen as a tool that encourages public sector modernization, drives strategic policy objectives, promotes readiness for technology commercialization, and acts as a catalyst for the creation of new R&D-intensive markets (Research and Development). In addition to the emphasis on public user-supplier interaction and the recognition that the search for innovations greatly impacts the efficiency of the public sector, there are economic and strategic conditions that must be analyzed and framed from a holistic point of view. Through a contextual approach, this article considers the motivation and economic logic of the supply side - i.e., innovators - to participate in an innovation public procurement procedure, as well as the scope for an effective public procurement policy. Conclusions are presented that strategically contextualize the terms, benefits and risks associated with the participation of companies / innovators in public procurement, as well as some inefficiencies to be avoided and mitigated in the innovation system, through public innovation policies aimed at the medium-long term.

Keywords: public procurement; innovation policy; supply-side of the market; innovators.

INTRODUCTION

Public procurement presents itself, today, as a vigorous instrument to stimulate R&D, namely with the purpose of supplying leading markets with new technologies. Economic agents are incentivized to spend money on scientific and technological research, and competition is shifted from an exclusive focus on price towards solutions that offer the greatest advantage to users during the purchase lifecycle (Lenderink et al., 2022).

Public procurement for innovation, also called innovation public procurement (IPP), can be seen as a tool that encourages the modernization of the public sector, drives strategic policy objectives (e.g., environmental, competitiveness and economic) and to address societal challenges (Bamfo et al. 2023). As such, IPP can also be seen as a policy instrument to foster technology commercialization readiness, besides acting as a catalyst for the creation of new R&D-intensive markets in a cooperative environment that connects the public sector and private entities (Amann and Essig 2015).

An innovation procurement policy aims to provide a supportive framework, eminently macro-contextual, with the intent to encourage public entities to subscribe to modernization, as a priority strategy, in the public services modus operandi. Complementarily, it provides support guidelines to the creation of acquisition entities groups, as well as providing guidelines for the awareness of public entities regarding carrying out market research and cost-benefit analysis in their procurement activities (European Commission 2017).

Despite the emphasis on user-supplier interaction and the acknowledgement that the search for innovations impacts the public sector efficiency, the design of policies through systemic approaches tends to focus mainly on the supply side (Edler & Georghiou 2007). However, neither is innovation policy from the supply side nor the ones from the demand side totally efficient (public procurement policy) per se. To feed innovation, it is required a holistic alignment of the entire value chain, in which every part and institution confront and influence each other. IPP studies generally tends to focus on the supply or in the demand side, separately, with few studies analyze these two aspects simultaneously. Thus, the main contribution of this article is to bring to

the literature an integrated approach that analyses and contextualizes the main implications on the supply side, that is, from innovators to participation in IPP.

This article proposes a set of lessons that aim to answer the following starting questions: What are the main terms for the supply side of the market to participate in IPP? Taking into account the risks underlying the process of innovating, how systemic and integrated can be the connection between the two sides of the market (public users and innovators) in innovation procurement?

In order to guarantee duly substantiated answers we use, as research methods: literature review on the demand and supply-side theories on innovation public procurement, and empirical evidence, extracted from a longitudinal analysis of data from Innobarometer Reports, allowing to understand the involvement of European firms in innovative public procurement.

Thus, through a contextual approach, this article considers the motivation and economic logic of both sides of the market to contribute to the realization of an effectively robust IPP procedure (Section 2) and the scope for a successful innovation policy in theoretical terms (Section 3). Conclusions on public procurement policy and innovation implications are presented in Section 4.

Economic Terms for Innovation Public Procurement to the Supply-Side of the Market

In the perspective of economic policy, the demand-side innovation policy should be aligned with the supply-side innovation policy, which implies a multi-level governance and for each buyer-supplier scenario, different public procurement typologies (European Union 2020). For this purpose, it can be considered that there are market sectors more closely related to radical innovation and others more incrementally innovative regarding economic and social development (Uyarra et al., 2020). Innovation is conceived as a key factor to the economic growth, whereby, throughout the last decades, the governments have been implementing policy measures that seek to encourage innovation activities in the public and private sectors (i.e., on the demand side and the market's offer) (Acemoglu 2009). In fact, there are several available tools to encourage these activities in firms (e.g. financial grants, tax incentives, venture capital, credit subsidies, customs duties, intellectual property rights, etc.)[1], nevertheless, more and more, public procurement has been in the center of recent discussions about innovation policy, at a European level, due to its potential to enhance competitiveness in economy (Aschhoff & Sofka 2009).

According to the 2014 Directives regarding public contracting[2], the public acquisition of technologies is a competitive tool from the demand side, in which the product or service functional requirements to be obtained are predetermined by the public entity[3], with the intent to meet a necessity or challenge, trusting the creativity of private organizations, as technological suppliers, to get an efficient answer (Aghion 2002). That is, through technologies with a more sustainable value for money relationship[4].

[1] It is noted that innovation theories refer to the offer impulse theories which establish that innovation is the fundamental force for economic change and that growth and productivity are boosted by the production of knowledge per capita. This approach refers to public/state incentives for R&D and innovation, for example, tax credits for collection reduction in IRC for innovative firms, intellectual property rights or financial grants for the private sector and other scientific or technologic entities participation in innovative activities. Therefore, public policy has, as a main goal, the reinforcement of the production and demand of this knowledge, in order to speed up the spillovers and whatever can occur from them.

[2] Directive 2014/23/EU of European Parliament, of 26 February 2014, on the award of concession contracts; Directive 2014/24/EU of European Parliament, of 26 February 2014, on public procurement; Directive 2014/24/EU of European Parliament, of 26 February 2014, on public contracts concluded by entities operating in the water, energy, transport, and postal services sectors; Directive 2014/55/EU of European Parliament, of 16 April 2014, on electronic invoicing in public contracts.

[3] The two main reasons for use of this policy tool are to satisfy and better the offer of public services and to take into account certain political objectives by stimulating the demand, for example, in emerging areas as sustainability and energy efficiency.

[4] Promoting innovation through acquisitions is not a new concept; some countries have been following technologic acquisition policy for years. In France, public contracts have been used to develop high speed railroad technology and nuclear energy technology. In the United States, military demand has been contributing for technological innovation and dissemination for the last decades. However, the public procurement of innovation potential has recently got a renewed impulse, for the most part linked to the 2014 Directives. Governments have the power to mold the strategic use of innovation acquisitions, not to forget that national firms benefit from this tool, given the likelihood to recover from high-risk and reward investments associated with R&D activities. In practical terms,

Innovation policy specialists (Bound & Puttick 2010; Connell & Probert 2010; Malerba 2007) have been emphasizing, for several year, the importance of the use of acquisitions as an innovation or industrial policy tool, since that, by comparing the R&D aids with the R&D public acquisitions, it is concluded that innovation acquisitions are more effective to create innovations than the incentives. Edler & Georghiou (2007) review the main innovations that come from innovation procurement proceedings and realize that acquisitions are able to stimulate innovation under certain conditions, as the possibility of high standards, the definition of a precise set of needs for which the innovative efforts can be directed, the offer of a market for new products and services in the beginning stages of its life and the very incentive to competition (Chesbrough & Boger, 2014).

The progress in information and communication technologies (ICT) and the rise of the user participation in the innovation activity, in some sectors, have been speeding up the interaction between supply and demand in the innovation process. Edler & Gee (2013) argue that, despite the demand having had much attention in literature, a lot of questions regarding the influence of the demand in innovation still remain. Edler & Georghiou (2007) highlight the importance of the size of the market in triggering technological developments. Demand at scale attracts innovation as it ensures a significant level of production and an uncertainty decrease, which allow firms to benefit from scale economy and technological investments, and it guarantees that they would get greater profits. Demand-side network externalities also create advantages for certain industries, allowing more dynamic growing returns (Edquist et al. 2000).

Demand theories suggest that the ability to generate innovation is wide and flexible, however it requires, more frequently than not, market opportunity. These approaches have as a main focus not the beginning of the value chain but rather on its purpose, in other words, the market (Uyarra et al., 2020). That being considered, demand is the force that directs resources and competences for innovation as a mean to meet society and market's needs (Edler et al. 2009). Therefore, both technological driving forces and demand driving forces lean on to the reach of innovation commercialization and diffusion in the market, so a simultaneous occurrence is suggested. This implies that innovation policy from the demand-side and the one from supply-side should complement each other since innovation is made of the creative interaction between both (Foxon & Pearson 2008). Hereupon, an innovation policy from the demand-side plays a more crucial role in the public sector because it prompts investments in the capabilities of its resources, as well as cultural and organizational changes. For this purpose, public entities act as initial users or leaders in that market segment, even if it implies higher learning costs, given the possible technical refinements associated with the novelty of these products or services (Haimowitz & Warren 2007). Alongside with this, public contracting has, as a matter of fact, revealing positive effects in economy, as long as acquisitions are not restricted to the acquisition of standardized products that don't involve innovation (e.g., paper, pencils, folders). This way, public contracting represents a promoting tool for technological innovation creation and diffusion. Also, according to Edler & Georghiou (2007), public entities, through innovation procurement, can influence the private market and increase the awareness in these sectors and core fields of high technological intensity.

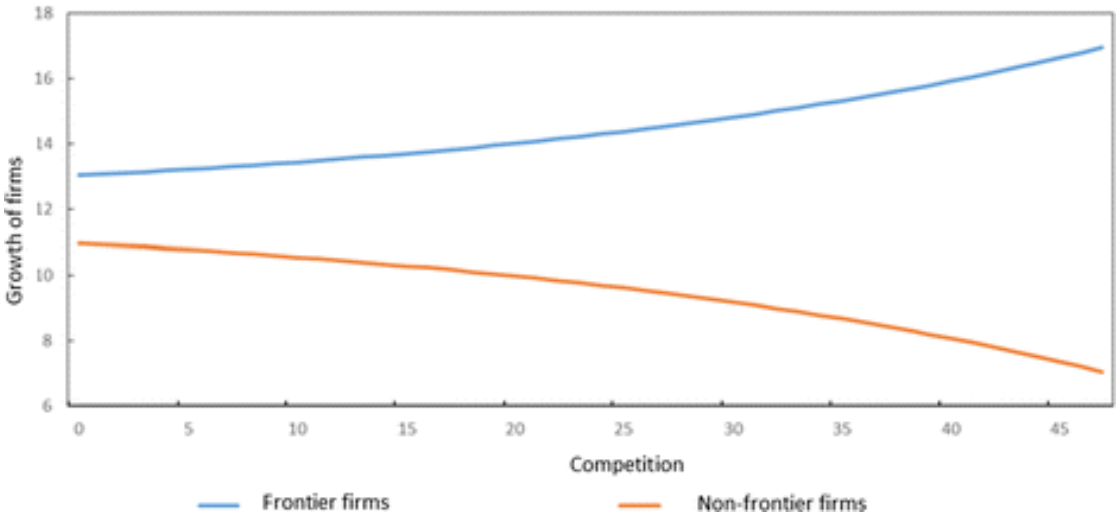
Demand is also analyzed in studies that address the dynamic relationship between innovation and the market structure (Lember et al. 2015) and models of the industry cycle of life (Lehto 2009). The Schumpeterian argument is the main principle of the studies about the relationship between demand, market structure and innovation and it asserts that there is a positive impact of the market power in the innovation activity. According to Schumpeter (1934), there is a creative destruction process, associated with the innovation phenomenon, in the way that innovation boosts the increase in profits for the entrepreneur (i.e., supplier in public contracting), but decreases the profits for non-entrepreneurs. Innovation and technological diffusion are at the heart of the growth process, for example, long term growth happens when there is cumulative innovation, so firms tend to invest less in innovation because they not only undervalue the importance of technological knowledge that their innovation can bring to society but also the fact that other innovators can lean on that fact, in the future.

innovation public procurement can be used to achieve public policy goals, particularly in digital and sustainability fields. It can, in fact, take up different forms and the consumers can influence the level at the demand is dedicated or generic and more or less standardized or specialized. With its focus on the standardization and on its association with the level of innovation to be developed, in response to the unsatisfied public necessity.

It is thought that all that contributes to profits reductions, specially increased competition in the market, automatically reduces the incentive to innovate and also that more competition implies necessarily less innovation and therefore less growth. Malerba (2005), in his empirical studies, shows a positive correlation between competition and innovation in a certain sector on between competition and productivity growth in that sector. That is, an added competition can be associated with innovation or a more revealing growth. In fact, in regard to innovation activities, new firms can enter a particular sector/market segment while others less efficient might leave, thus boosting a more dynamic competition. As a matter of fact, there are two types of active firms that do not react the same way to competition: firms that rely more on technology in a certain sector, whose productivity is closer to the maximum level of productivity in that sector/market segment; and firms that less technological and whose productivity is much lower than the maximum productivity in the same sector/market segment.

According to Lember et al. (2015), the first type of firms is called best practice, as the firms remain active and obtain significant profits, even before starting innovation activities. The other firms, further from technology or inactive, show weaker or even zero profits and they seek to innovate and become more technological. As it is shown in Figure 1, the firms closer to the technological border will innovate even more to escape competition. On the other hand, the other firms will be discouraged by the competition. Aghion et al. (2002) tested this prediction based on data from firms in the United Kingdom, using foreign firms' penetration rate to measure the competition level in a particular sector and the number of registered patents per firm in order to measure innovation activity.

Fig.1. Competition intensity curve and firms' growth, depending on the distance from the technological border



Note: The upper curve shows the average of firms closer to the technological border than the mean firm. The lower curve shows the average of firms further from the technological border than the mean firm.

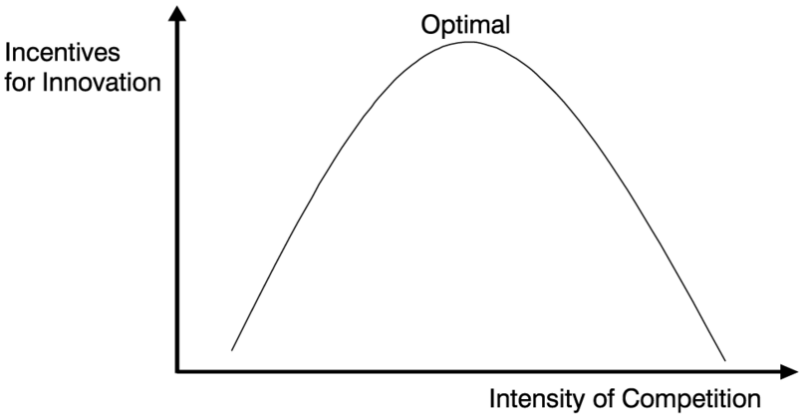
Source: Aghion 2002.

Nevertheless, there are still some differences in the R&D and innovation expenses related to the industries structures and the type of firms which make part of them. The Schumpeterian economic theory imposes that big firms, with more or less monopolists' positions, are the ones with greater incentives to innovate and to supply innovative products or services, and therefore, big firms tend to become the engine of the technological progress (Afonso & Vasconcelos 2007, 2015). According to Schumpeter (1934), big firms can easily get access to capital markets, a better financial availability to invest in innovation, a greater ability to absorb risks and they benefit more from scaling economy and learning in R&D activity.

The global effect from competition about innovation and growth has been the cause of several studies, theoretical and empirical, and the evidence shows a 'inverted U' relationship between the amount of innovation and the intensity of competition in an industry. There is a positive effect from competition regarding innovation on the firms that sit on the technological border. However, there is also a negative effect

on the ones that seek to get to it. In other words, when the competition intensity is weak, the scenario is similar to the left side on Figure 2, because the firms that are further from the border have a strong incentive to seek the technological level of the border, since the profits will considerably increase if they achieve that. So, the firms that were initially far from the border, will become frontier firms. When the competition level is initially weak, having an intensification of it will certainly result in a positive effect in innovation activity (Aghion et al. 2002).

Fig.2. Competition effect in innovation



Source: Aghion et al., 2002.

Aghion et al. (2002) claim that the relationship between innovation and the market structure depends on the type of innovation that is being discussed. When debating process innovation where expenses are reduced, it is found that firms with an inferior market power have a greater incentive to innovate since the importance of costs reduction increases as the competition intensity grows in the market (Aghion 2002).

Acquisitions can also influence innovation indirectly by changing the competition structure in the market, in the short and medium term. In the short term, acquisitions may affect the level of participation of firms in specific biddings, the homogeneity of the biddings and the level of involvement in tactical collusion. The growing amount of competition in the bidding process should result in lower prices and better quality. However, there are certain conditions in regard to biddings that may exclude the small and medium enterprises (SMEs), which reduces the possibility of innovation by excluding these types of economic agents. Although the increase of the number of bidders tends to increment a more intense competition, in some cases, the high cost of evaluation of the proposals, the high specificity of the assets and/or the long-term revenues can mean that it is sensible to restrict participation through the application of quality criteria, as for example the supplier's reputation (Alvarez-Pelaez & Groth 2005).

Being aware of the existence of positive externalities that the investment in R&D can generate (spillovers) might make firms want to cooperate in R&D investments and in joint acquisitions, in order to internalize those same externalities (Ang & Madsen 2015). More specifically, assuming that both firms have a marginal cost of c, before introducing innovation, there is a balanced environment (Cournot's model[5]) with the following demand curve: $\boldsymbol{P=A-B.Q}$, in which c1 and c2 are marginal costs from firms 1 and 2 respectively, after the investment in innovation. In fact, the initial costs can be reduced as a result of an investment in innovation, however that investment generates spillovers in the rival firm (j). Considering β as the level of spillover as it measures the impact of the investment in R&D that is taken over by the firm that does not make an investment, one gets: $c1=c-I1-\boldsymbol{\beta}\ \mathbf{x}\ I2$ *and* $c2=c-I2-\boldsymbol{\beta}\ \mathbf{x}\ I1$. The costs reduction is considered in β x Ii , where Ii represents the marginal costs reduction that is obtained by the rival firm as a result of their investment in R&Di , i = 1,2.

[5] In Cournot's model, firms produce homogeneous and indistinguishable goods, and the competition level of production is fixed. Due to this dynamic where firms produce based on their rival's production, the balance between price and quality is not obtained by the supply and demand of the market, but instead when firms correctly estimate the quantity that their rival will make. In this way, they can perfectly determine the other's level of production in order to maximize their profits (Barro, 1990).

It is obtained that:

$$q_1^c = \frac{A + c_2 - 2c_1}{3B} = \frac{A - c + I_2(2\,\boldsymbol{\beta} - \mathbf{1}) + I_1(2 - \boldsymbol{\beta})}{3B} \qquad 1$$

$$q_2^c = \frac{A + c_1 - 2c_2}{3B} = \frac{A - c + I_1(2\,\boldsymbol{\beta} - \mathbf{1}) + I_2(2 - \boldsymbol{\beta})}{3B} \qquad 2$$

This way, it is possible to conclude for which **β** values firms will want or not to cooperate. As an example, a necessary condition for firms to cooperate is:

$$\frac{\partial q_i^c}{I_j} > 0\,, \quad i = 1,2 \quad \text{when} \quad i \neq j \quad \rightarrow \quad \boldsymbol{\beta} > \frac{\mathbf{1}}{\mathbf{2}} \qquad 3$$

Through this condition, the quantity made by a certain firm **i** is growing with the level of innovation investment of the rival firm. Assuming that profit is positively correlated with the output level, it can be concluded that, in a scenario of strong enough externalities, the more innovation activity that is carried out by a firm, the greater the incentive is to cooperate on the part of the competition[6] in a joint innovation acquisition (Aghion et al. 2002).

Nevertheless, despite the benefits of innovation being acknowledged theoretically and empirically, the efforts and investments by firms, potential suppliers or technological sellers fall short, socially speaking, due to: (a) the risk and uncertainty as the expenses with R&D activities do not always result in commercial innovations and often, when created, these activities can become not profitable in the market; (b) the negative externalities, since the developed innovation has an impact on the activities of other competitors because the result of innovation (as it has, in part, some public good features) can easily be imitated or copied; and (c) the low appropriability since the social return generated by innovation is frequently superior than the private return for the economic agent that supports the costs of theses innovation activities (Backus et al. 1992).

The protection of the intellectual property rights plays a crucial role as it secures the innovator and their monetary profits from the imitation threat. However, there is a bit of controversy between the competition policy and the intellectual property rights policy (Cohen et al. 2003). The most radical scholars believe that the protection of patents is important since it retains the profits created by innovation and the innovator is immune to imitation by potential competitors (Aghion et al. 2001). This perspective is a result of an economic point of view where only the new participants innovate, as opposed to the existing firms. The incentive to innovation comes from the will to obtain future additional profits, as it results from the profit differential between innovating or not innovating (Bleaney et al. 2001). Specifically for firm 1, it can be concluded that its incentive is given by:

$$\text{Incentive (1)} = (\pi_1^{Innovates} - \pi_1^{Doesn't\ innovate}) \qquad 4$$

In which $\pi_1^{Innovates}$ represents the profit from firm 1 when it innovated,

and $\pi_1^{Doesn't\ innovate}$ represents the profit from firm 1 when it does not innovate.

On the other hand, Boldrin & Levine (2008) argue that competition is favorable to growth in innovation. Considering a frontier firm: increased competition will reduce the P0 incomes of that firm, in case it does not innovate; a better intellectual property rights protection will, instead, increase the P1 incomes of that firm, if it

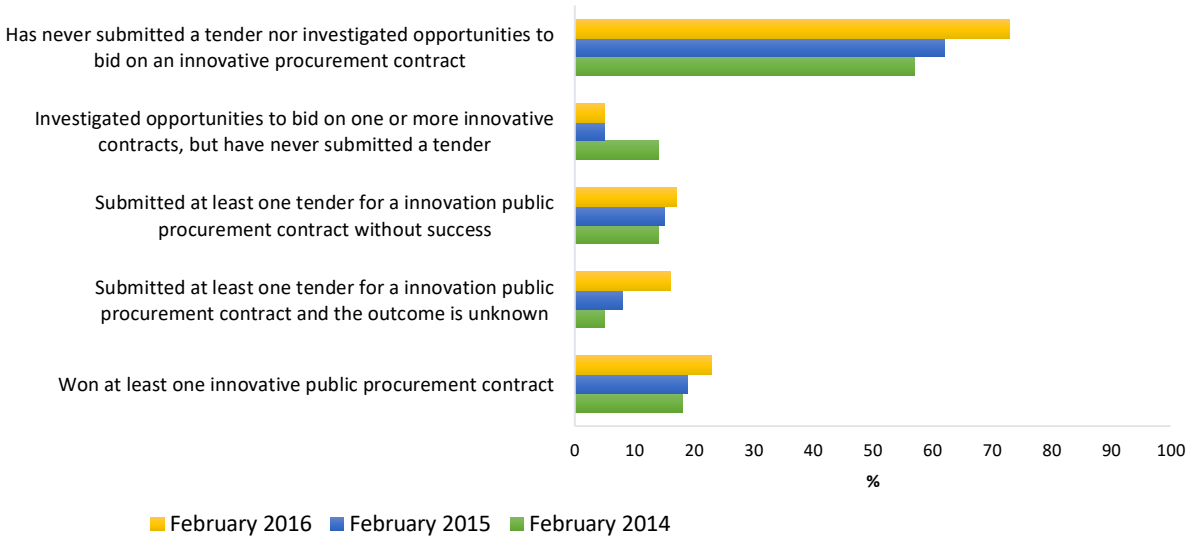
[6] Both product innovation and service/process innovation often lead to an increase in productivity and competition. The first ones elevate their market power, and the second ones can achieve a better performance by increasing their production with the same inputs (*i.e.*, technological change with expenses curve change). On the other hand, innovation potentiates the creation of competitive advantages for entrepreneurs/technological suppliers, through differentiation (when new products are developed or significantly modified) or through costs reduction.

innovates. A net gain from innovation occurs, as P1 – P0, which is the reason for the importance of conducting the two types of policy: the intellectual property rights protection and the preservation of competition. Capitalism should then provide incomes to innovation, as well as it should be regulated to avoid those incomes to lead to the disappearance of competition, compromising future innovations. This complementarity between competition and patents was tested and the conclusion is that the integration of the European single market, favorable to competition, is stimulating for more innovation activities in countries in which intellectual property rights protection is strong (Aghion et al. 2002). Besides competition policy and intellectual property policy, there have been studies on measures that influence the innovation markets. The main demand-side policy tool is precisely regulation: "the implementation of rules by public authorities and governmental agencies to influence private agents' behavior in economy"[7] (OECD 2009, p. 4). Regulation policy can also be considered as an indirect and non-selective method of innovation activities monitoring developed by technological firms.

The size of the market – one of the factors that most conditions the amount of demand – is hugely influenced by the level of taxation to incentive end user's demand for innovation. Taxation can be used as a booster tool for demand, in certain key-sectors. Effectively, it is a pre-requisite: the policy that promotes a demand for innovation should be followed by policies which guarantee that innovation is in force to meet that demand. According to Storper (1997, p.108), demand architecture "defines a collective action problem for innovators, associated with each particular type of product or service". The firm evaluates the viability of so innovation investment, based on the size and quality of demand, however this practice is quite rare.

This scenario is confirmed by Innobarometer results, from 2016, and it is verified that only one in every five European firms' claims having obtained, at least, one public contract with innovative features between 2012 and 2016, while one in every ten firms reveal having effectively made, at least, a proposal despite having obtained it or not (i.e., not having been chosen the technological supplier). Only some firms seek, in fact, bidding opportunities. However, the majority of firms (62%) do not have as a current practice of seeking innovation products or services suppliers in this sector (Figure 3).

Fig.3. Innovation firms' involvement in innovative public procurement (2014-2016)



Source: Author's elaboration, based on Innobarometer reports of 2014, 2015 and 2016.

When all three years under analysis are compared (2014, 2015 and 2016), it can be seen a considerable increase probability of firms presenting, at least, an IPP proposal (7 more percentage points between 2014 and 2016), although, year after year, it appears to be less likely to search for opportunities in the market (9 less percentage points between 2014 and 2015).

[7] *See* European Commission (2004). *Innobarometer* 2004. Flash Eurobarometer 164, Brussels.

Comparing the countries in the European Union, it appears that firms from UE28[8] are more likely that the USA ones (19% versus 14%), but less likely that the ones from Switzerland (23%) to obtain, at least, an innovative public contract. Firms from Greece (35%), Cyprus (31%) and Slovenia (29%) are more prone to be a part of an innovative procurement (2014-2016). Firms from Belgium (18%) and France (14%) are the ones more prone to present a proposal which the result is unsatisfactory, while firms from Romania (7%), Bulgaria, Spain, Slovenia, and Portugal (8% for all) are the most likely to have a defeatist result. In Latvia, there is an increase of 7 percentual points, between 2014 and 2016, regarding the proportion of firms that presented, at least, one innovative product or service proposal to the public sector. On the other end of the scale, there are Portugal (with 8 less percentage points) and Ireland (with 7 less percentage points). In general, in all of the countries in the analysis, it can be noted a considerable reduction, between 2014 and 2016, in regard to the proportion of firms that looked into bidding opportunities for innovation administrative contracts. Figure 4 shows the medium scenario of the enquired European firms in Innobarometer[9] in the time between 2014 and 2016, when it comes to their involvement in public procurement (Figure 4).

Fig. 4. Involvement of European firms in innovative public procurement between 2014 and 2016 (in comparison with China and USA)

Country	Won at least one innovative procurement contract		Submitted at least one tender for an innovative procurement contract and the outcome is unknown		Submitted at least one tender for an innovative procurement contract without success		Investigated opportunities to bid on one or more innovative procurement contracts, but have never submitted a tender		Has never submitted a tender nor investigated opportunities to bid on a public procurement contract	
BE	28%	+7	18%	+6	24%	+5	4%	-8	51%	-5
BG	14%	=	2%	-1	8%	-4	7%	-19	69%	+20
CZ	23%	+3	8%	+5	15%	-3	12%	-13	52%	+13
DK	15%	=	5%	-4	14%	-6	8%	-4	66%	+5
DE	18%	+1	9%	+3	19%	+6	4%	-8	59%	-2
EE	13%	-4	3%	-1	12%	+1	2%	-5	76%	+5
IE	22%	+1	10%	-1	16%	-7	8%	-4	50%	+3
EL	35%	+12	10%	+6	15%	+5	5%	-2	53%	-10
ES	17%	+1	3%	+2	8%	+1	3%	-10	74%	+11
FR	22%	-4	14%	+5	20%	-1	4%	-8	57%	+3
HR	28%	+5	6%	+4	14%	-1	4%	-19	51%	+13
IT	22%	+2	6%	+2	19%	+6	4%	-3	61%	-1
CY	31%	+15	8%	+7	14%	+6	1%	-6	60%	-4
LV	24%	+3	2%	=	18%	+7	8%	-23	60%	+21
LT	25%	+1	2%	+2	11%	+2	8%	-13	59%	+12
LU	19%	-8	10%	+7	10%	-2	4%	-12	68%	+19
HU	13%	+4	4%	+2	13%	-1	10%	-23	63%	+21
MT	16%	-10	5%	+1	12%	=	5%	=	73%	+17
NL	9%	-2	3%	-1	9%	-3	8%	-12	68%	+13
AT	16%	-1	7%	+1	15%	-5	4%	-2	70%	+6
PL	19%	+2	7%	+5	15%	+2	5%	-14	64%	+13
PT	16%	-9	5%	-2	8%	-8	5%	-5	67%	+12
RO	14%	-2	2%	-1	7%	-2	2%	-13	74%	+14
SI	29%	+13	4%	+1	8%	-6	3%	-4	56%	-7
SK	20%	+1	7%	=	16%	-5	5%	-20	52%	+23

[8] In this analysis, UK is considered as a member of the EU.

[9] This report was not continued after the mentioned dates, so the values presented are considered as the most recent and current references in regard to the involvement of European firms in innovation administrative contracts.

FI	21%	-4	9%	+1	18%	-5	14%	-8	53%	+14
SE	14%	-2	7%	+3	11%	=	6%	-6	71%	+9
UK	18%	+6	11%	+7	14%	+6	5%	-6	56%	-12
CH	23%	+8	9%	+3	12%	-4	3%	-4	56%	-7
USA	14%	+2	11%	+5	13%	+3	3%	-11	60%	-5

Source: Author's elaboration, based on Innobarometer reports of 2014, 2015 and 2016.

Considering what was referred before about the effects of the market structure and the likelihood of firms to innovate, Innobarometer also shows an analysis by type of firm interested in providing innovation through public procurement. As such, in Figure 5, it appears that bigger firms are more prone to obtain, at least, one contract (in about 35% of the cases) or have presented an innovative product or service unsuccessfully (36%); in general, it is claimed that the smallest the firm is, the greater the probability of never having presented a bidding is. Furthermore, about 65% of the European micro-firms (i.e., with 1-9 employees) strongly claim never having even looked into bidding opportunities. In terms of how senior a firm is, it is also noted that the more years the entity has in the market, the bigger the probability of obtaining a contract is, with one in every 5 established firms before 2009 (20%) having obtained, at least, an innovation administrative contract in comparison to the more junior ones (i.e., founded after 2016). Also, the firms that integrate a business group are more likely to obtain an innovative contract (25%) or to present innovative products or services (13%) than the ones who do not integrate any business group. Furthermore, the bestowed profits seem to influence the success of the involvement of firms in procurement, as the less revenue a firm makes, the smaller the probability of participating in a bidding is (70% of the firms with lower budgets say that they do not look into R&D development and innovation opportunities for the public sector).

From a sectoral perspective, there is a bigger possibility of the industrial sector to obtain a contract (31%), followed by the services sector (17%) in comparison to the rest of the sectors. It can also be noted that firms that introduce innovative products or services (in this case, from January 2012) are more prone to obtain, at least, one contract. Also, firms with innovative products or services refer less that they do not present proposals, as they show more interest in seeking new bidding opportunities (58%) (Figure 6).

Fig. 5. Involvement of European firms by type of firm, sector, maturity in the market and turnover (in 2016)

	Won at least one innovative procurement contract	Submitted at least one tender for an innovative procurement contract and the outcome is unknown	Submitted at least one tender for an innovative procurement contract without success	Investigated opportunities to bid on one or more innovative procurement contracts, but have never submitted a tender	Has never submitted a tender nor investigated opportunities to bid on a public procurement contract
Firm size					
1-9 employees	17%	6%	14%	5%	65%
10-49 employees	27%	12%	20%	5%	52%
50-249 employees	29%	15%	21%	3%	52%
250+ employees	35%	15%	36%	5%	29%
Sectors					
Manufacturing	16%	7%	13%	6%	64%
Retail	16%	5%	11%	4%	68%
Services	17%	7%	15%	6%	63%
Industry	31%	14%	25%	5%	47%
Firm age					
Before 2009	20%	7%	16%	5%	61%
2009 - 2016	14%	8%	12%	7%	68%
After 2016	12%	9%	9%	9%	75%

Part of a group					
Yes	25%	13%	18%	5%	56%
No	18%	7%	15%	5%	63%
Firm's turnover in 2016					
Up to €100 000	12%	4%	10%	6%	70%
€100 000 to €500 000	19%	8%	16%	6%	61%
€500 000 to €2 million	24%	8%	17%	5%	60%
€2+ million	24%	12%	20%	5%	57%

Source: Author's elaboration, based on Innobarometer reports of 2014, 2015 and 2016.

Fig. 6. Involvement of European firms by type of developed innovation (in 2016)

	Won at least one innovative procurement contract	Submitted at least one tender for an innovative procurement contract and the outcome is unknown	Submitted at least one tender for an innovative procurement contract without success	Investigated opportunities to bid on one or more innovative procurement contracts, but have never submitted a tender	Has never submitted a tender nor investigated opportunities to bid on a public procurement contract
Innovation					
At least one	21%	9%	17%	6%	60%
None	13%	5%	11%	4%	69%
Goods/services innovators	22%	9%	17%	6%	58%
Other innovators	16%	7%	14%	4%	68%
Non-innovators	13%	5%	11%	4%	69%

Source: Author's elaboration, based on Innobarometer reports of 2014, 2015 and 2016.

Adopting innovation procurement requires different strategies that impact the demand environment with which firms are confronted, particularly for those which the public sector is an important client. There are, in fact, several traps that should be avoided, for example, favoring big players (i.e., governmental contracts tend to favor established firms to the detriment of new innovative SMEs and start-ups), the prioritization of scientific sectors or fields which have a high learning potential, and the exclusion of foreign competition in specific markets (Bamfo et al. 2023). These conditions, despite being astute, influence the low influx of firms in biddings (Baldwin et al. 1998). Therefore, it is important to figure a well-structured and reinforced public procurement policy, in order to have participation encouragement in these procedures in the next upcoming years.

Strategic Conditions For A Harmonious Innovation Public Procurement Policy

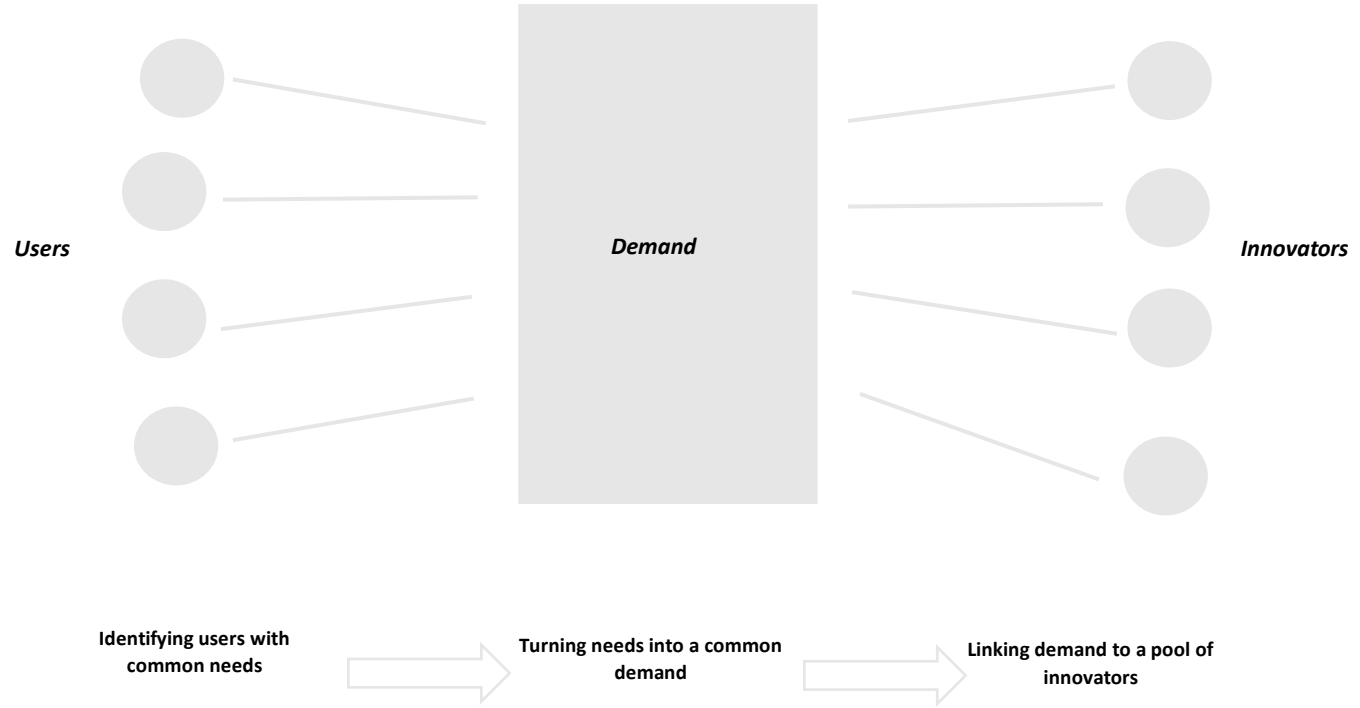
A series of empiric studies have been claiming that one of the most determining principals of a systemic innovation policy is the organization of information flows between users, consumers, suppliers, partners and other interested parties in the innovative activity, based on the articulation and communication of preferences and needs that aren't been met (Metcalfe & James 2001). However, the innovative process is not linear. The sectors differ a lot between one another in regard to the level of dynamics in innovation and their structure in the market. Some sectors, as for example, the pharmaceutical, biotechnological, energy and materials sector are ruled by the technology-push model. Other sectors are ruled by industries based on patterns, as the automotive, telecommunications and ICT sector. Therefore, especially in the industries that boost technology,

the supply of new or radical innovations, to meet the demand, appear to be particularly important. For others, to answer to changes through more incremental or residual innovations is also a possible response.

Rogers (2003) believes that the innovation policy oriented for the demand of the market can be more effective to stimulate incremental innovation than radical innovation. Taylor et al. (2005) claim that the majority of innovations induced by public contracting do not imply innovation in the beginning phase, focusing instead on in adaptations or improvements of already existing solutions, or even in non-technological innovations.Yaslan (2009), in the analysis of thirty innovative acquisition projects, also shows the rare existence of radical innovations.

It is important to mention that the sectorial and industrial dynamic can have implications for the public procurement policy. There are some barriers that affect the introduction of innovation activities in the market, mainly: (a) the lack of interaction between producers and users, and; (b) the high cost of changing for new technologies, due to the really high entry costs, and the imprisonment effects (Uyarra & Flanagan 2010). Furthermore, it is relevant to note the case of social challenges that care for public goods (e.g., the climate change or the new paradigm of digital transition), as there is a clear justification for the intervention of the State, which is not contradictory to the logic of the market and competition already addressed. The involvement of end users and the interaction between public buyers and private firms are essential for the innovation systems dynamic (Georghiou 2007). The systemic nature of the demand-side innovation policy implies an alignment between public entities, the industry, and other interested parties, as seen in Figure 7.

Fig. 7. Articulating demand to transform private and public markets



Source: Author’s elaboration. Adapted from Georghiou, 2007.

As explained in the previous Section, it is clear that public procurement policy complements the supply-side innovation policy, instead of being replaceable. According to Edler et al. (2009), the reasons for public procurement policy stand on four important pillars: (a) innovation policy, namely overcoming system failures; (b) societal goals and policy needs; (c) industrial/economic policy, namely modernization; and (d) industrial/economic policy, namely pushing local innovation production.

Uyarra & Flanagan (2010) propose a typology of public contracting, adapted by Aschhoff & Sofka (2009), that starts with acquisitions of standardized products that serve a generic market (efficient procurement), even acquisitions with adapted technological solutions (experimental procurement). See Figure 8.

Fig. 8. Main role, motivation, and innovation category in terms of procurement

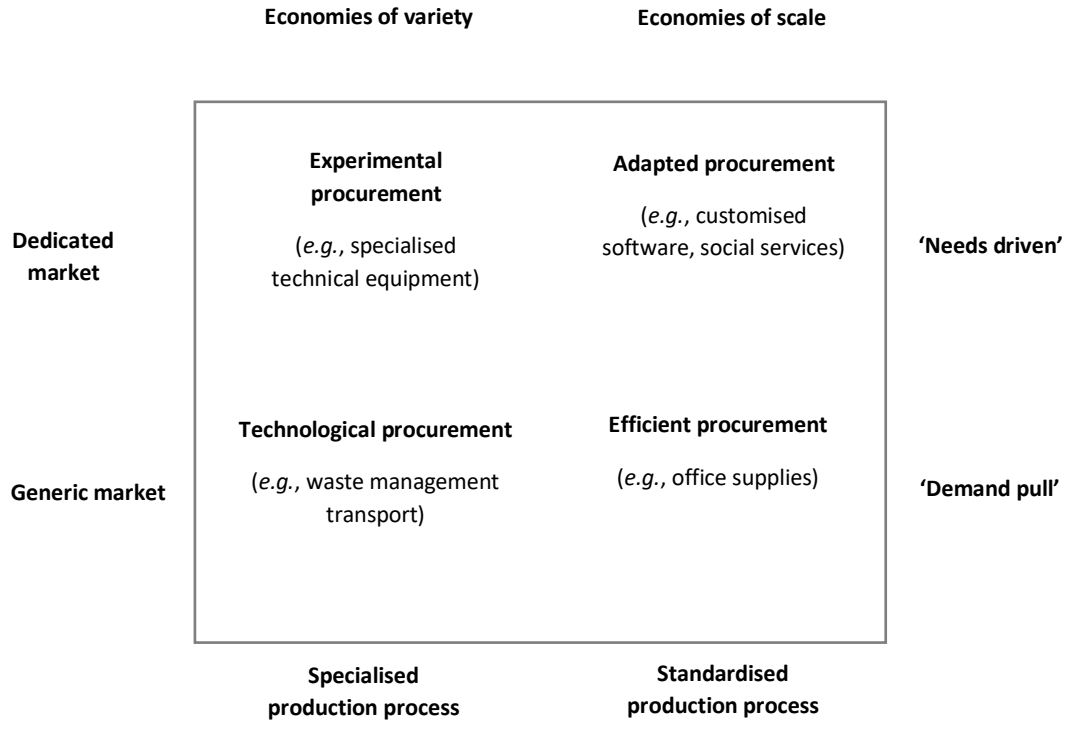
	Role of the public sector	Main motivation of procurement award	Innovation type	Innovation-related risks on the supply side
Efficient procurement	Large efficiency-driven user	Best value for money	Incremental	Overdependence on public markets, risk of obsolescence
Adapted procurement	Niche user	The best adapted solution	Market niche	Market uncertainty
Technological procurement	Sophisticated customer	The best available solution	Architectural	Insufficiently reliable demand to justify investment
Experimental procurement	Lead user	The most innovative solution	Disruptive	Market uncertainty, difficult user-producer communication, insufficient incentives (e.g., IP protection)

Source: Author's elaboration. Adapted from Aschhoff & Sofka (2009).

Public procurers can, equally, influence on what extent the products and services to be acquired are more generic or more specific. Certain institutions or agencies can, in fact, seek for differentiation and demand more customized solutions from innovators. Heterogeneity may also be due to specific local technical characteristics (e.g., in the case of maintenance/rehabilitation projects of public buildings) or due to the geographic variation in services provision based on proximity (e.g. waste collection).

According to Tsipouri et al. (2010), it is possible to identify four types of public acquisitions: (a) acquisition of standardized products that serve a generic market (efficient procurement); (b) specific demand niches, through already existing practices (adapted procurement); (c) acquisition of new technical solutions to serve a generic need (technological procurement); and (d) adapted technical solutions (experimental procurement). Entities can decide to switch market segments in order to reduce the risks, in both demand and supply sides, and therefore maximizing the purchasing power (Figure 9).

Fig. 9. Procurement typologies matrix



Source: Author's elaboration. Adapted from Tsipouri et al. (2010).

However, different procurement situations require different types of connections in the buyer/supplier relationship. Gancia & Zilibotti (2005) identify four types of relationships that depend on the duration of the contracts, product complexity and the uncertainty regarding the results. It is certain that both market sides switch information in an open way frequently, in order to reach the goals of the concluded contract. This cooperation is particularly important in the experimental procurement category. The recurring relationships are important in the projects where the low product complexity and the low certainty of the results are combined with long term contracts, characteristic of adapted procurement. In these cases, the government has a supervision role, and the suppliers have the freedom to choose the most appropriated techniques and models. In the case of the efficient procurement category, remote hiring, like e-procurement, appears as the most appropriate, since it is relevant to guarantee transparency regarding information about hiring opportunities to ensure competition and to obtain the best bidders.

Specifically, the idea of public procurement is multifaceted and involves the acquisition of a well-diversified product or service set, from common equipment to state-of-the-art technology (Kumar, 2003). In particular, innovation procurement raises important questions regarding governance and coherence between the main goal (to acquire quality products and services for the public sector) and the potential secondary goal that consists of supporting research and innovation in the public and private sectors (European Commission 2021).

It is important to mention still that public procurement can act as a positive force to improve the national competitive advantages, providing anticipated demand for advanced products and services, in which the government acts like a demanding and sophisticated buyer who reflects on the international needs in establishing specifications. However, despite the clear benefits, the use of IPP involves a series of varied risks[10], in an economical perspective and in public policy. Specially the risk of capture by large firms and other anti-competitive effects. Sousa et al. (2021) point out the following:

- Technological risk, which is the risk of not finishing an innovative product or service given the novelty of its technical, operational, and functional particularities. For this purpose, there are some mitigation actions that can be effective, such as: the specifications drawing of the product or service to be acquired in the administrative contract, the implementation of framework agreements, or the multi-step acquisition processes, and the involvement of other interested parties and external experts in the process, in advance.
- Organizational and corporate risk arising from the buying public entity, in order to fight potential risk of this type, prospective exercises should be carried out between all users. It is suggested an early user involvement in the acquisition process, as well as transparency in public contracting goals.
- Market risk (e.g., inability to respond from potential suppliers, novelty factor). For this purpose, the promotion of training schemes and joint awareness raising actions (i.e. between both sides of the market) should be protected.

Inside the innovative acquisitions category, other differentiations were made in terms of end users of the acquired products or services (Edler & Georghiou 2007; Hommen & Rolfstam 2009), the strategic nature of the acquisition policy (Edler & Georghiou 2007), the position of the public sector market in relation to the suppliers (Rothwell & Zegveld 1981; Edquist et al. 2000), the type of innovation and the stage of the innovative technology lifecycle (Edler et al. 2009; Hommen & Rolfstam 2009). Curiously, there is not any typology based on the nature of the acquired products or services.

Despite public procurement being the main innovation policy tool from the demand-side, the regulations and norms also play an important part in the structuring of goods and services market – which can be complementary with public procurement market (Greenberg et al. 1979; Haimowitz & Warren 2007). The regulations can affect the performance or the consequences in products and services and can also have a direct impact on public demand. More specifically, Georghiou (2007) note the importance of regulation in the

[10] The risk lifecycle, whether technological or market risk, implies the identification of risks – where it should be designated what risks can condition the project throughout its lifecycle -, risk analysis – through the analysis of risk interactions for the prioritization and assortment of the need for responses -, contingency planning – assignment of responsibilities for risky actions, mitigation development and/or contingency plans, metering development and action plans development to respond to risks, and finally, risk allocation – determining what party is better positioned to mitigate risk and assign agreement responsibility.

medical devices field, where public policy has been crucial to mold the innovation processes in Europe and in the United States. The systemic nature of this type of policy implies that it is necessary to have more coordination than the traditional innovation policy oriented to the offer. However, the narrow link between supply and demand requires the construction of recurring interfaces throughout the value chain, being, as such, the main strategic challenge in the innovation policy field (Nemet 2009).

Edler et al. (2009) note that the demand (or necessities) of the public sector can be different, complementary and more profound or previous in comparison to the private demand. Firms can decide to specialize in public markets to explore the acquired experience in public procurement when the learning costs are significant, or they can simply find more reliable clients in the public sector than in the private sector. The weak absorbing capacity throughout the value chain can appear to be a great barrier to innovation and its dissemination. Also, some studies suggest that the introduction to a specific totally new technology, product or service can be a better serviced process by firms that are not yet well integrated in the existing value chains. Furthermore, firms that are already established in the market can, effectively, look for defensive business strategies against unwanted radical innovations, with the intent to avoid new learning costs (Uyarra & Flanagan 2010).

Mobilization of authorities and sectorial agencies for an innovation policy agenda appears to be crucial for the incentive to innovation procurement practice. E.g., public-private partnerships are a way of linking the sectorial missions to the demand and opportunities of the market, as well as the clusters policy, interactive technological platforms, vouchers schemes for SMEs, among others. It can be concluded that for innovation public procurement policy to be successful, an alignment with non-public agents, external to the governmental agencies, are needed, particularly in the industry and more and more in the social sector (Bamfo et al. 2023). Despite the alignment between the government and other economic and social agents not being easy to reach, the governments can use other various administrative or political tools. For example, the joint advisory boards with business representatives to support and expedite the strategic alignment of the different sectors of economic activity.

CONCLUSIONS AND POLICY IMPLICATIONS

Innovation public procurement policy instruments can be defined as a set of public measures to increase the search for innovations, improve the conditions for the uptake of innovations in the public sector and/or improve the connection between demand and market supply of innovative solutions.

From a policy perspective, innovations achieved refers to the use of public policy to increase or strengthen the demand base which, in turn, should enable companies to obtain a better return on their innovative efforts. However, the issue is so new in policymaking that there is still no concrete universal definition on IPP. More innovation-friendly legal-procedural, instrumental, and regulatory framework conditions are indeed needed in Europe, ones which enable the acquisition of R&D and/or innovation in the public sector, as well as a broader medium-long term relationship between public entities and private companies. This link is seen as crucial to the success of innovation procurement, as, through a trusting relationship with the supply side, public entities are willing to pay an additional cost to meet certain policy objectives and current real societal needs.

The traditional focus on value for money as well as the problem of fragmentation of public demand tend to constrain the potential scale effects for IPP. A strategic procurement policy should bring together future needs and future supply at an early stage. On the supply side, many companies do not perceive public procurement as a relevant source of business, and this may also limit the level of governmental action. As noted earlier, procuring innovation entails several risks (e.g., technological, organizational, and social risks), and risk aversion makes it challenging to use procurement to stimulate innovation, particularly in the case of procurement of innovations from SMEs.

It should be noted that the public administration assumes the responsibility of launch customer/ test user of a new product or service, developed by technology providers. As a result, through public procurement, public entities can affect innovation indirectly by influencing the size and structure of the market, setting standards, and increasing or reducing competition. However, the scale of public procurement is only relevant if it can be put into effect through the exercise of purchasing power. System failures arise from fragmented markets,

where suppliers and customers are not aware of demand and what innovations the market can offer. Public procurement can help articulate that demand. Specifically, the scale of demand is of paramount importance in industries characterized by high R&D investment, as they are those with substantial economies of scale and associated high levels of risk. As such, well-established public demand can, at an early stage, reduce market risks and enable innovative companies to increase their productivity, including SMEs.

The results of this article suggests that innovation procurement policy should aim to put in place the necessary incentives, but also the necessary skills and capabilities to enable policy makers to launch cohesive strategies and action plans, and for public entities to allow themselves to modernize and make strategic decisions that stimulate innovation. Such strategic commitment, though it is the basis for successful implementation, is not homogeneous across Europe. The governance challenges of moving towards an approach that recognizes the potential importance of the impacts of innovation procurement are significant. Even more profound are the challenges associated with the need to monitor, evaluate, and attribute innovation impacts to public action. There are no organized, integrated, and potentially transferable systems in place in Member States.

From an empirical perspective, progress in this policy area may be linked to sectoriality. Approaches suggest that demand-side innovation policies have the greatest leverage when combined with sectoral government objectives. Public procurers in a specific sector (e.g., public transport) are more encouraged to undertake innovation procurement when innovation procurement is embedded as a strategic objective in the national policy frameworks and action plans that set the priorities for their specific sector (e.g., national strategy/action plan on transport/mobility). Consequently, public policies seem to find in innovation procurement a favorable framework for development and appropriation to the current circumstances of competitiveness and societal development.

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