

DISCUSSION PAPER

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**STRENGTHENING BRAZIL'S
INNOVATION POLICY THROUGH
PUBLIC PROCUREMENT**

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Economic Research

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PROCUREMENT¹**

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1. This paper is the outcome of research led by the author, which has been further developed into a book. The book, edited by the author and published by the Institute for Applied Economic Research (Ipea) in 2022, encompasses a comprehensive exploration of the topic. This paper represents an enhanced and translated version of the first chapter of the book, adapted from Portuguese to English.

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CONTENTS

ABSTRACT	
SINOPSE	
1 INTRODUCTION	6
2 METHODOLOGY	7
3 THE MODERN INNOVATION POLICY MIX: THE POWER OF DEMAND	9
4 LEGAL CHANGES AND NEW SOCIAL ACCOUNTABILITY FOR PPI IN BRAZIL	11
5 RESULTS FROM THE RECENT LEGAL CHANGES IN BRAZIL	13
5.1 New uses for traditional instruments	13
5.2 Specific instruments for PPI and the TRL	15
6 FINAL REMARKS.....	23
REFERENCES.....	24

ABSTRACT

Since the enactment of the Brazilian Innovation Law, the country has acquired valuable insights into the intricacies of the innovation process. This acquired knowledge is manifested in the updated New Law of Bidding and Contracts (NLBC), the revised Legal Framework for Startups, and the amended text of the original innovation law itself. These pioneering legislations have introduced a unique set of tools that foster innovation by leveraging the State's procurement power to stimulate private demand. This article aims to present the rationale behind these novel instruments from a neo-Schumpeterian perspective and the Technological Readiness Level methodology. By conducting an in-depth analysis of the legislation and incorporating recent theoretical contributions, we demonstrate for the first time that all stages of the innovative process are covered, including the "Death Valley" and the ambiguous transition between research and development (R&D) and innovation. As a result, ten public procurement instruments can be employed to promote private innovation. Among these, three are not innovation-specific, while one is entirely new. The remaining seven are specific to innovation, with four being completely original. Considering other traditional instruments that act on the supply side, we conclude that Brazil now possesses a powerful combination of innovative policy instruments, which necessitates advanced training for public employees.

Keywords: Public Procurement for Innovation – PPI; demand side innovation policies; Brazil.

SINOPSE

Desde a promulgação da Lei de Inovação brasileira, o país aprendeu muito sobre a natureza do processo inovativo. Esse aprendizado está expresso na nova Lei de Licitações e Contratos, no novo Marco Legal das Startups e na nova redação da própria lei de inovação original. Estas novas legislações criaram um conjunto de instrumentos de fomento à inovação que atua pelo lado da demanda e utiliza o poder de compra do Estado como mercado consumidor potencial. Este texto tem como objetivo apresentar a racionalidade desses novos instrumentos sob a perspectiva neoschumpeteriana e a metodologia do nível de prontidão tecnológica (TRL, em seu acrônimo em inglês). A partir de uma análise aprofundada da legislação e com o auxílio das mais recentes contribuições teóricas sobre o assunto que foram reunidas em livro recém-lançado pelo Instituto de Pesquisa Econômica Aplicada (Ipea) e intitulado *Compras Públicas para Inovação no Brasil: novas possibilidades legais*, o trabalho mostra, pela primeira vez, que todas as etapas do processo inovativo são contempladas, até mesmo o "Vale da Morte" e a sutil transição entre pesquisa e desenvolvimento (P&D) e inovação. Como resultado, dez instrumentos de compras públicas podem ser usados para fomentar a inovação privada no Brasil. Destes, três não são específicos à inovação, mas um é novo. Os sete restantes são específicos, dos quais quatro são inteiramente novos. Considerando outros instrumentos tradicionais que atuam do lado da oferta, concluímos que o Brasil passou a contar com um robusto mix de instrumentos de política de inovação, o que exigirá grande capacidade estatal para sua execução.

Palavras-chave: compras públicas para inovação – PPI; políticas de inovação pelo lado da demanda; Brasil.

1 INTRODUCTION

To fulfill its societal obligations, the contemporary State must engage in the procurement of goods and services from the market. These purchases frequently have a substantial capacity to impact market dynamics. The State's procurement power can be utilized to serve multiple objectives, including fostering innovation. Nevertheless, the procurement of innovations or their subsequent development necessitates the use of appropriate legal mechanisms and the technical expertise of public officials. This paper delves into how certain innovative legal instruments in Brazil facilitate innovation by engendering a public consumer market for privately-developed innovations.

While Brazil has only recently instituted formal public support for innovation, it has made substantial and swift advancements in related legislative areas. The efforts to implement the Innovation Law (Law No. 10.973/2004) initiated a profound institutional learning process, culminating in a series of legal modifications and the establishment of new legal and para-legal regulations pertaining to innovation (Rauen, 2020b; Rauen, 2016). This learning journey fostered the creation of new tools that operate from the demand perspective, capitalizing on the government's procurement power. Consequently, Brazil now boasts a robust array of policy instruments for innovation, on par with those in the United States or Europe.

Historically, Brazil's approach to innovation policy was solely through traditional supply-side tools such as credit provision, grants to firms, and tax breaks, in which the State simply served as a catalyst for the system. As a result, the innovation policies' impact in Brazil was constrained, and the anticipated crowding-in effect was rarely seen (Chiarini et al., 2020; de Negri, 2021; de Negri and Rauen, 2018; Rocha and Rauen, 2018; Suzigan, Garcia and Feitosa, 2020). Over the past decade, Brazilian legislators recognized the limitations of this "linear supply-side" approach¹ and instigated legal amendments with the intention of crafting novel and contemporary policy tools for innovation, characterized by a potent demand vector.

Despite the capacity of these newly introduced instruments to catalyze innovation in Brazil, particularly in addressing pressing societal issues, both policymakers and academic researchers acknowledge that this renewed policy blend alone is not sufficient to elevate the rate of innovation in the Brazilian economy. A conducive business environment and an effective tax system are essential prerequisites (Biljanovska and Sandri, 2018; OECD, 2021).

1. A public policy agenda very much based on the Big Science approach and Vannevar Bush's seminal report; Science: The Endless Frontier. Available at: <<https://bit.ly/3VnVIDP>>.

This paper asserts that Brazil possesses a comprehensive array of tools for stimulating innovation, encompassing both demand and supply-side mechanisms that integrate all phases of the innovation process, inclusive of research and development (R&D). However, we underscore the requirement for a substantial level of technical proficiency within the State and a consistent training schedule for the effective utilization of this policy toolkit.

For the first time, this paper collectively examines the recently introduced demand-side mechanisms and assesses them using the Technology Readiness Level (TRL) methodology. Originally developed by the National Aeronautics and Space Administration (NASA) for managing technology discovery, this methodology provides invaluable insights. The paper is structured into four distinct sections. The inaugural section elucidates the methodological approach, key definitions, and the research scope. The subsequent section describes the modern innovation policy mix in developed nations, accentuating the resurgence of the demand side and the advent of mission-oriented innovation strategies. The third section delineates the recent legal evolution in Brazil that precipitated the emergence of new demand-side instruments and an innovative approach to deploying older tools. The final section showcases the impact of the legal modifications and discusses the unique instruments for Public Procurement for Innovation (PPI) in Brazil. The paper concludes with a few summarizing comments.

2 METHODOLOGY

This paper employs the neo-Schumpeterian-evolutionary perspective on innovation as encapsulated in studies by Dosi et al. (1988), Kline and Rosenberg (2010), Nelson and Winter (1982), Rosenberg (1982), among others. This research is guided by three principal assumptions.

Firstly, this investigation focuses on innovation in the strictest sense, defined as the introduction of novelty into the market by firms or as a survival strategy in a constantly innovating environment. The aim is to probe the role of innovation as a driver of economic development (Schumpeter, 1982) rather than government innovation. However, it is crucial to recognize that successful promotion of private sector innovation via public interventions, such as public procurement, often requires innovation within the government.

Secondly, the innovation process is characterized by three chronological stages: i) research, development, prototyping, and scaling up; ii) commercial introduction; and iii) diffusion of innovations into the market. The TRL methodology, conceived by NASA, provides an uncomplicated yet refined means of identifying the readiness phase of technology integrated into a solution. This methodology, which consists of nine levels,

ranging from curiosity-driven basic research to market introduction of a solution, is widely adopted by the Brazilian Federal Audit Court (Tribunal de Contas da União – TCU).

Technologies are categorized into one of these nine levels based on responses to a standardized questionnaire.² For a technology to progress to a higher level, it must satisfy all relevant prerequisites; otherwise, it remains at its previous level. This methodology has been widely embraced as a resource employed by various global institutions, including defense and health organizations.

Thirdly, the innovation process is not linear, with R&D not necessarily being the first step. Furthermore, formal R&D does not serve as the sole information source for innovation; instead, it represents one of many stages in the process. The innovation process follows a “chain-linked” model where technology and market vectors concurrently interact (Kline and Rosenberg, 2010).

To categorize different public procurement tools in Brazil according to the TRL, this paper undertakes a comprehensive analysis of new federal legislation along with recent and relevant contributions. Each instrument is scrutinized in relation to its primary procurement object and underlying economic rationale. These are then contrasted with the TRL and the stage of the innovation process.

Potential procurement objects include: i) common goods or services; ii) complex goods or services necessitating system interaction; iii) new (to the government) goods or services; iv) R&D, prototyping, or scaling services; and v) embedded technology. The rationale for procurement could be: i) reducing information asymmetries for future commercial acquisitions; ii) purchasing at the lowest price on a large scale; iii) fostering endogenous technological development; iv) highlighting a socially relevant problem; and v) developing a solution not currently available in the market, among others.

This exploratory research intends to systematize and classify the economic and legal rationale behind all PPI instruments in Brazil for the first time. While the new legislation is the outcome of a distributed historical process (not discussed in this paper), it facilitates the establishment of a robust and comprehensive set of tools.

Finally, we acknowledge that this methodology might lead to somewhat subjective results. Nevertheless, the classification carried out herein establishes a robust cognitive framework for the implementation of these complex and innovative instruments. With

2. Examples of TRL questions from the US Department of Energy Manual: “have integration studies been started? (...) Does the pilot plant operate under realistic conditions? (...) Do prototypes represent actual form, fit, and function?”. For more, see: <<https://bit.ly/3Lhgxfu>>.

this analysis, Brazilian public administrators can now select public procurement instruments that are congruent with the objectives of the innovation policies they implement.

3 THE MODERN INNOVATION POLICY MIX: THE POWER OF DEMAND

According to the neo-Schumpeterian evolutionary perspective, innovation originates from multiple sources, with indigenous technological development serving as just one among them. While it remains the most substantial source for disruptive innovations, it is not the most prevalent. A variety of forces influence the innovation process, and these forces differ based on the object under consideration. Multiple feedback loops and interactions among R&D, scientific knowledge, and market findings influence the various stages of the creative process (Kline and Rosenberg, 2010).

Innovation Policy and Scientific and Technological Policies represent distinct yet interrelated interventions. As will be discussed, certain procurement instruments are better adapted for technological discovery, while others are more suited to final development and innovation. However, all of them share a common objective: introducing novelty into the economic system.

From a national development perspective, the primary aim of PPI is to generate an additionality effect on private spending for innovation, transforming contracts into co-creation initiatives rather than just commercial relationships. From an evaluation perspective, the most relevant question is whether these procurement initiatives modify firms' expectations and behavior towards increased innovative efforts. If the answer is affirmative, failures can be contextualized (Mazzucato, 2021).

In essence, public procurement fosters stable and robust demand for private supply, promoting numerous socioeconomic objectives, including innovation. The reintroduction of the demand side into the innovation policy mix was initially suggested by Edler and Georgiou (2007), who classified current innovation policies into two primary branches.

The first branch concentrates on the supply side, ensuring adequate operational conditions (both financial and non-financial) for the entire innovation system. This branch encompasses seven instruments, including equity support, fiscal measures, support for public sector research, support for training and mobility, grants for industrial R&D, information and brokerage support, and network measures. These instruments are well-recognized among Brazilian policymakers and stakeholders and have formed the foundation of the country's prior innovation policies.

Conversely, the authors advocate for the reintroduction of the demand side, aiming to stimulate innovations and expedite the diffusion of innovations through heightened demand. This could involve defining new functional requirements for products and services or improving market articulation. This can be achieved by employing four primary instruments: systemic policies, regulation, support of private demand, and public procurement. The focus of this paper is the latter instrument.

In PPI, the government capitalizes on its purchasing power to fulfill immediate needs cost-effectively while simultaneously fostering and stimulating private innovation. The government strategically uses its demand to establish consumer markets for specific innovations and technologies, effectively pulling innovation forward.

Though PPI is a relatively recent concept originating from Europe, it has historical roots in the US, albeit without a robust theoretical foundation (Brennan, Macauley and Whitefoot, 2012; Edler and Uyarra, 2013; Edquist and Zabala-Iturriagagoitia, 2012; Georghiou et al., 2014; Thai, 2001; Uyarra, 2016; Uyarra et al., 2020; Uyarra et al., 2014; Vonortas, Bhatia and Mayer, 2011). Contrary to Edquist and Zabala-Iturriagagoitia (2015), we perceive PPI to include Pre-Commercial Procurement (PCP), where the government purchases R&D or prototyping services to bring about innovations, not just the acquisition of innovative commercial products or services.

This approach is crucial because, as will be discussed in the context of Brazil, R&D efforts and the introduction of innovation can be interconnected within the same process. Distinguishing them would be artificial and inconsistent with legal possibilities. In consideration of Kline and Rosenberg's Chain Linked Model of Innovation Process, we contend that our PPI concept better suits actual innovation dynamics. Therefore, we prefer the term Public Procurement "for" innovation and not Public Procurement "of" innovations.

In Brazil, the government can acquire R&D services, prototypes, scale-up activities, and new products/services under the PPI concept through regular bidding processes or specific instruments designed to foster innovation and R&D. As illustrated in the Brazilian case by Rauen and Paiva (2019), procurement only produces results when there is explicit intent to do so. Mere purchasing does not adequately stimulate private innovation in suppliers (Schmidt, 2014). The procurement contract must explicitly aim to instigate innovation; otherwise, no inducement for innovation transpires. This is why PPI strategies are imperative.

The essence of PPI lies in leveraging public demand for solutions (existing or yet to be developed) to establish a market for innovative suppliers who, through a contract, become partners with the State. This has resulted in a new application of PPI: mission-oriented innovation policies within the context of an Entrepreneurial State

(Mazzucato, 2011; 2021). Incorporating PPI into this innovation strategy offers two primary benefits. First, it injects new funding into the innovation system without imposing a budgetary burden,

while explicit innovation budgets are often housed in a department/ministry of innovation or industry, innovation needs to be part of how government operates daily – including how it purchases goods and services across all its departments. This allows innovation to trickle through the procurement budgets, which might be four times as large in one department as the entire innovation budget among departments (Mazzucato, 2021, p. 121).

Second, it allows the State to guide the technology development specified in a contract. As a result, the strategic use of public procurement has become the most vital single tool in the mission-oriented innovation policies toolbox.

However, compared to traditional instruments like credit or grants to firms, PPI is far more complex, especially when the government assumes most of the purchasing risk. This increases the chances of government failure and complicates accountability.

Here, it is essential to remember the importance of avoiding the fetishization of innovation, which, in this case, is manifested by neglecting the primary function of public purchase: meeting a concrete demand. In PPI strategies, technology and innovation are tools, not goals in themselves. New legal possibilities in Brazil consider all these factors, including a fresh approach to accountability that embraces failure and tolerates uncertainty.

4 LEGAL CHANGES AND NEW SOCIAL ACCOUNTABILITY FOR PPI IN BRAZIL

In Brazil, the government stands as the principal purchaser in the economy, with total government procurement reaching US\$ 180 billion in 2019, accounting for 9.2% of the country's gross domestic product – GDP (14.0% in 2008) – as per Ribeiro and Inácio Júnior (2022). This immense purchasing power can either behave like an elephant in a china shop or serve as a directed vector for solving significant societal challenges.³

Recent legal amendments in Brazil have introduced several new federal regulations that allow for proper handling of the uncertainty and risk inherent in the innovation process. Despite the advancements made with PPI and other instruments, a significant

3. These figures also account for the purchase from State control companies like Petrobras.

amount of formalism still exists, particularly in the New Law of Bidding and Contracts (NLBC). In fact, many experts believe that the amendments could have been more ambitious (Fassio, 2021; Fassio et al., 2021).

But considering the high level of political polarization and the past with many corruption scandals, we believe that the legal changes have resulted in substantial advancements in PPI and procurement processes. These include increased tolerance for government risk-taking, abolition of penalties for failure due to technological uncertainty, greater process flexibility, the introduction of new tools, and the ability to negotiate Intellectual Property Rights (IPR) when innovation is involved.

Accountability is a central issue in PPI. The nature of innovation demands a balance between the principles of public administration, which mandate contracting efficiency, and the innovative process, which requires flexibility and an acceptance of risk and uncertainty. Despite the challenges posed by accountability in innovation policies and public procurement, Brazilian examples such as the PCP of the Sars-COV 2 vaccine from Fiocruz (Oswaldo Cruz Foundation), the development of the KC-390 airplane, and the ongoing PCP from the Brazilian Spatial Agency (AEB) demonstrate that it is possible to purchase innovation while simultaneously maintaining an adequate accountability system (Nascimento et al., 2022; Rauen, 2020b; Ribeiro, 2017).

Regarding accountability and to direct managers' actions in accordance with the principles of public administration, Chioato and Lins (2022) list nine specific elements: comprehensive planning, leadership and people management, risk management, results-oriented management, openness to the market and the scientific community, integrity, transparency, explicit motivation for decisions, and robust documentation processes.

Indeed, fostering innovation inherently involves risk-taking and uncertainty activities, and it is impossible to completely eliminate failure. However, this fact should not discourage the government from pursuing innovation. Rather, it should adopt a portfolio management approach, spreading risk across a coherent set of efforts.

Project portfolio management allows for a more comprehensive understanding of the innovation landscape and the ability to assess the specific features and risks of each project. This approach helps to mitigate potential side effects and ensures that government personnel responsible for implementing PPI possess the necessary knowledge to make informed decisions on a case-by-case basis.

Again, it's important to avoid the fetishization of innovation and recognize that not all problems and challenges can be solved through innovation alone. Traditional solutions

can still effectively address certain issues. A balanced approach that combines innovative and traditional methods is vital for effective public administration.

Furthermore, it is also crucial to recognize the possibility of both market failures and government failures. The higher the complexity of the acquisition item, the greater the likelihood of failure. In order to mitigate the risk of suboptimal societal outcomes, governments should allocate resources to the education and training of personnel engaged in the execution of innovative strategies.

5 RESULTS FROM THE RECENT LEGAL CHANGES IN BRAZIL

This paper introduces ten public procurement instruments that can be utilized to promote private innovation. Among these, three are not exclusively focused on innovation, but one is a novel addition. The remaining seven instruments are innovation-specific, with four being completely novel.

5.1 New uses for traditional instruments

The earlier mentioned legal amendments have not only introduced a wide range of new public procurement instruments but have also expanded the application possibilities of existing ones. These include the Electronic Hybrid Auction, which encompasses both sealed and open bidding, a more flexible evaluation criterion based on the Best Price-Quality Ratio (BPQR), and the Expression of Interest Procedure (EIP). These traditional instruments hold particular relevance within the scope of this paper.

In 21st-century Brazil, the Open Reverse Auction, especially when conducted electronically, is considered the benchmark in procurement. Theoretically, it ensures isonomy, impartiality, and efficiency. However, as demonstrated by Romitelli and Fassio (2022), this benchmark functions optimally when dealing with readily available, standardized products or services, and when information asymmetry is low. In the context of the modern functions of the State, which often involve the procurement of complex and innovative products or services, especially those involving R&D, utilizing reverse auctions for innovation acquisition tends to be inefficient in Brazil (Pellegrini et al., 2017).

Conversely, Ribeiro and Inacio Júnior (2022) illustrate that the largest share of federal government acquisitions takes place through Hybrid Auctions, encompassing both sealed and open bidding. Thus, despite the rigidity associated with this method, it cannot be disregarded in an innovation strategy. Romitelli and Fassio (2022) raise questions about whether employing a hybrid auction based solely on the lowest price can also be utilized to promote innovation.

After examining the rationale behind this instrument in terms of acquiring homogeneous goods at the lowest cost, the authors arrived at a surprising answer to the question. They suggest that as long as the objective is to disseminate innovations rather than develop or introduce them, it is possible to employ this instrument as a PPI strategy.

Romitelli and Fassio (2022) propose that the promotion of innovation diffusion through Hybrid Auctions can be achieved by regularly updating the Price Registration System (Sistema de Registro de Preços)⁴ and consistently incorporating innovative offerings. As part of this process, they recommend excluding obsolete solutions from the list of available products and services in the system.

In this approach, the government would continually assess the market and focus on seeking new products and services. Purchases would still be made at the lowest price, but competition would be limited to innovative products and services.

Spanó, Carvalho and Prol (2022) demonstrate how the BPQR method can foster incremental innovations in the Brazilian economy. Their research presents an innovative approach to utilizing a traditional instrument. The authors illustrate that the BPQR ratio can be used to incentivize the creation and dissemination of incremental innovations through various examples. However, it is not suitable for acquisitions involving technological risks or requiring other specialized criteria.

The main advantage of utilizing the BPQR ratio in bidding lies in its simplicity. However, the authors caution against excessive specification of the desired outcome, as it may restrict suppliers' creativity. The key principle is to allow suppliers to propose their own solutions. The authors demonstrate that this instrument can integrate traditional price criteria with sophisticated technological performance criteria, treating products and services as more than mere commodities. Therefore, incorporating technical quality criteria enables the selection of innovative suppliers.

The EIP, studied by Mourão and Monteiro (2022), was initially prevalent only in public infrastructure concessions to the private sector. Its expanded authorization for use was granted with the introduction of the NLBC.

The EIP is not a procurement instrument per se but rather an administrative tool that assists in public procurement processes and reduces information asymmetries between procurers and suppliers. It can serve as a means for potential suppliers to

4. Procedure in which interested parties register prices of products and services for future purchase by the government.

present solutions to relevant administrative problems, similar to the unsolicited proposal presented in the North American Federal Acquisition Regulation (FAR).⁵

The authors emphasize that the utilization of the EIP necessitates the administration's capacity to assimilate knowledge and possess comprehensive technical expertise to comprehend the legal, institutional, and technological implications of the proposals. In essence, it is crucial to prevent a situation of "capture of the State."

Regarding PPI strategies, the EIP can serve as a mechanism for the private sector to introduce innovations that were previously unknown to the government. When executed appropriately, it can facilitate the incorporation of new ideas and technologies by the state.

5.2 Specific instruments for PPI and the TRL

Among the various public procurement legal instruments available in Brazil, seven are directly associated with PPI. Four of these instruments are new additions, namely: i) Competitive Dialogue (CD); ii) Innovation Prizes (INP) – which allows for negotiations on IPR; iii) PCP;⁶ and iv) Public Contract for Innovative Solutions (PCIS).

On the other hand, three instruments of the seven are well-established and widely recognized: i) Additional Preference Margins (APM); ii) Technological Offset in Defense (TOS); and iii) Partnerships for Productive Development in the Health Industry (PPD).

Table 1 provides a summary of the key features of these seven instruments, while figure 1 illustrates their connection to the TRL concept.

5. Available at: <<https://bit.ly/3AMn9hm>>.

6. We consider the PCP as a new instrument because its proper regulation dates from 2018.

TABLE 1
Instruments for PPI in Brazil by selected characteristics (2022)

Instrument	Type of procedure	Legal basis	Innovation phase	The object of the contract	Main use	Assumption of technological risk by the government	Main advantages	Limitations and risks
Pre-commercial procurement	Direct contracting.	Law No. 10,973/2004, art. 20; Decree No. 9,283/2018, Chapter III, Section V; Law No. 14,133/2021, art. 75, item V.	Development and introduction.	R&D services with or without prototypes. Possibility of contracting the results on a commercial scale.	A problem whose solution does not exist in the market and requires R&D.	From no assumption (fixed price) to complete risk-taking (cost reimbursement plus fixed fee).	Designed to be attractive in situations of technological risk. Allows large-scale acquisition. Public companies can use it.	High management cost. Legally requires the presence of technological risk.
PCIS	The special bidding process for tests and possible acquisition.	Complementary Law No. 182/2021, Chapter VI.	Final development (high TRL), introduction, and dissemination.	Application testing of products or services with the possibility of large-scale acquisition.	To understand the actual impacts of multiple innovations.	From no assumption (fixed price) to complete risk-taking (cost reimbursement plus fixed fee).	Allows payments in the testing phase. Substantial reduction of information asymmetries.	High management cost. It requires two separate contracts. There is a monetary limit to contracts.
INP	The bidding process for an award.	Law No. 14,133/2021, art. 30 and art. 93, paragraph 2.	Final development, introduction, and dissemination.	Artifact, software, or service in prototype form or already on a commercial scale or; specific technological development.	Social mobilization and market signaling.	In general, there is not. Competitors develop for themselves. However, it could have been (some) support for competitors during the contest.	Low management cost and speed of execution.	It does not guarantee adoption by the market, whether public or private. It does not allow large-scale public procurement.

(Continues)

DISCUSSION PAPER

Instrument	Type of procedure	Legal basis	Innovation phase	The object of the contract	Main use	Assumption of technological risk by the government	Main advantages	Limitations and risks
TOS	The additional contractual requirement in bidding or direct contracting of Defense Products.	Ordinance MD No. 3,662/2021.	National development with possible introduction and diffusion of innovations.	Knowledge, information, methods, techniques, and methodologies are necessary and sufficient for the correct functioning of a given technology internationally purchased.	The need to internalize strategic technologies.	There is not. The supplier has already carried out the development.	Binds the purchase with the transfer of the built-in technology.	High management cost. It could make the major acquisition more expensive.
PPD	Direct contracting.	Law No. 14,133/2021, Items XII and XVI.	Introduction and diffusion (through technology transfer).	Strategic products for the Unified Health System through the transfer and absorption of technologies.	Decrease the external technology vulnerability of the Unified Health System.	There is not. The supplier has already carried out the development.	Binds the purchase with the transfer of the built-in technology.	High management cost and lengthy process. Possibility of technology obsolescence throughout the contract.
Additional preference margin for national goods and services (APM)	The possibility is linked to the bidding.	Law No. 14,133/2021, items XII and XVI.	Introduction and diffusion.	Products and services on a commercial scale resulted from previous national R&D efforts.	Ensure the consumer market for products or services developed in the country.	There is not. The supplier has already carried out the development.	Low management cost and speed of execution.	It makes acquisition more expensive and reduces competition.

(Continues)

(Continued)

Instrument	Type of procedure	Legal basis	Innovation phase	The object of the contract	Main use	Assumption of technological risk by the government	Main advantages	Limitations and risks
CD	Type of bidding process.	Law No. 14,133/2021, art. 32.	Introduction and diffusion.	Product or service on a commercial scale.	Complex problems that require innovation, but with doubts about which innovation to employ and which business model is most appropriate. Need for dialogue with potential suppliers.	There is not. Not suitable for acquisitions that require funding for R&D activities.	Allows negotiation and dialogue with potential suppliers.	High management cost. Risk of capture and technological lock-in.

Author's elaboration.

All PPI instruments in Brazil were specifically designed to address particular challenges and promote innovation with well-defined outcomes. Therefore, the procurement process for PPI instruments always begins with the identification of a problem that needs to be solved.

Moreover, Brazilian legislation allows for the negotiation of IPR in PPI projects, recognizing that PPI can generate innovation and new knowledge. This legal provision was introduced with the Innovation Law in 2004 (Law No. 10.973/2004), strengthened by its revised version in 2016 (Law No.13.243/2016), and ultimately incorporated into the NLBC.

Among the seven PPI-specific instruments, the PCP stands out as the most disruptive. This instrument enables direct procurement, bypassing the traditional bidding process, and is designed for the development of solutions that are not yet available in the market. In essence, the government purchases R&D services, making it a public procurement with inherent technological risks. Brazilian legislation allows for the acceptance of failure and encourages extensive interaction with potential private suppliers. In PCP, the government can assume the full project risk or negotiate it to some extent.

Rauen and Barbosa (2019) demonstrate that PCP is suitable for procurements involving technological uncertainty and projects at lower TRL, as illustrated in figure 1. Conversely, Nascimento et al. (2022) show that the instrument is also relevant when the desired solution exists in international markets but is not readily available in Brazil, such as defense systems and military artifacts.

Additionally, PCP includes a purchase option that can be exercised when R&D efforts prove successful (TRL 9 in figure 1). This option allows for the procurement of commercial products or services on a large scale, without requiring a new selection process. Nascimento et al. (2022) note that PCP in Brazil demands a high level of training and preparedness among government employees. Nevertheless, it remains one of the most powerful tools to generate new technologies to meet social demands and is particularly relevant in a mission-oriented policy framework.

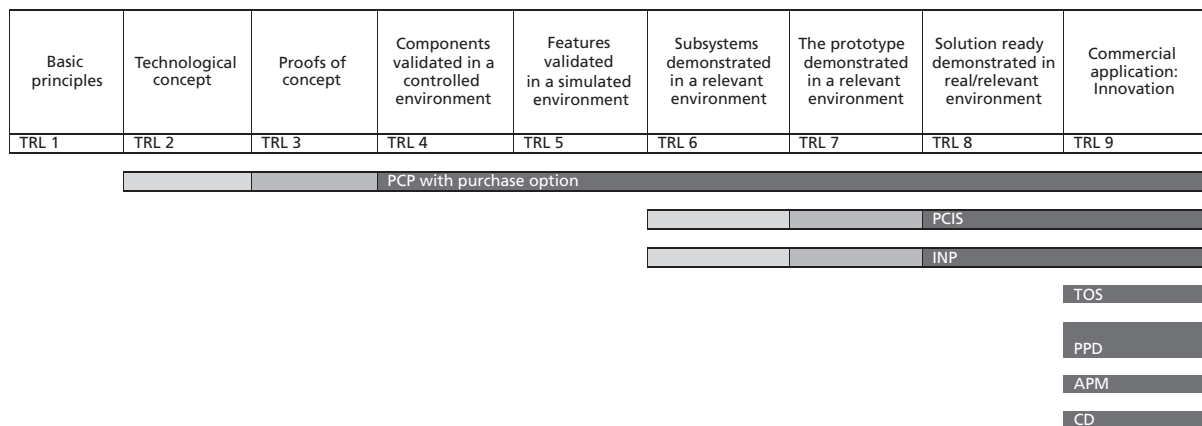
The PCIS is a novel instrument designed to facilitate collaborations between start-ups (Govtechs) and the government. Although not exclusively restricted to this type of firm, it was specifically tailored to accommodate their needs. The PCIS follows a two-phase procurement process with on-site testing, wherein multiple potential suppliers are contracted to test their solutions in real scenarios. The testing phase is paid, and the results inform the selection of a single supplier for the subsequent contract. In the second phase, a contract is awarded for the large-scale supply of commercial items based on the successful outcomes of the testing phase.

The PCIS offers excellent incentives for startups, as they can receive payment even during the testing phase, providing financial support before the commercial contract is established.

Mendonça, Portela and Maciel Neto (2022) demonstrate that the PCIS serves to evaluate the actual performance of innovative products and services before regular procurement takes place. This unique bidding modality was established in the Startup Bill (Complementary Law No. 182/21) and the core objective is to reduce information asymmetry between the buyer and potential suppliers through real tests.

Unlike other instruments, the PCIS imposes maximum limits on the value of both testing contracts (approximately US\$ 633,000 based on the 2021 PPP exchange rate) and potential large-scale contracts (around US\$ 3.2 million). These limits provide clarity and guidance regarding the financial scope of the PCIS projects.

FIGURE 1
PPI instruments in Brazil: the main object of the purchase, accordingly to the TRL



Source: NASA’s original methodology.

Author’s elaboration.

Obs.: As the line becomes lighter in color, it indicates that the instrument’s suitability for the task decreases.

INP are recognized as ex-ante inducement strategies in leading capitalist economies, although they have not been widely implemented in Brazil (Souza and Penna, 2017; Kei, 2008). Rauen (2022) highlighted that the limited adoption of INP in Brazil was primarily attributed to the legal constraint that prevented the sharing of property rights with the winners, thereby offering no incentives for private suppliers to participate. This situation is characteristic of innovation systems with inadequate funding where the money prize is not enough. However, recent modifications to the NLBC have removed this limitation, allowing for the free negotiation of IPR associated with the innovation prize.

The central concept behind INP is to mobilize society around important issues that are not adequately addressed through regular market mechanisms. INP does not involve large-scale supply but rather offers rewards in the form of financial (direct funds, grants, credit) or non-financial incentives (training, certification, recognition, definition of standards etc.) based on predefined criteria. Generally, there is no risk-sharing involved. However, public administration can establish intermediate prizes to support small competitors (Rauen, 2022).

INPs are primarily suited for activities related to high TRLs that involve prototyping, with inherent risks but without dedicated funding. However, they can also facilitate the diffusion of innovations that have already been introduced (TRL 9). Ex-ante inducement prizes targeting lower TRLs are more accurately classified as scientific prizes rather than INP. While INP cannot be utilized to procure large-scale commercial products, it can help reduce information asymmetries prior to subsequently regular purchases.

In international procurement, the procuring entity may request various forms of compensation. One such compensation can be related to the technology incorporated into the solution. TOS aims to stimulate the development of endogenous technology through obligations imposed on international procurement contracts for defense-related products and services.

As demonstrated by Giesteira and Matos (2022), TOS is widely employed in Brazil, particularly within the military sector. Many significant technological advancements in Brazilian defense companies have been driven by this instrument. The private aerospace sector, along with its various related industries, has particularly benefited from this strategy in the past.

In 2021, the Ministry of Defense issued an improved strategy for offset (Ordinance MD No. 3.662/2021). Under this strategy, selected national private companies can gain technology transfer and technological training investments. The objective is to leverage the technology incorporated in the internationally acquired solution to foster endogenous technological development.

TOS is designed to streamline technological development by enabling national companies to access the necessary technology for their own technological efforts. By definition, offset is provided through compensations attached to international procurement of commercial products. Therefore, the acquired technology can be classified at higher TRLs (8 and 9). The rationale behind TOS is similar to that of PPD, which aims to enhance the healthcare sector.

PPD is a federal strategy aimed at reducing the trade deficit in the pharmaceutical sector caused by a lack of domestic suppliers for the Unified Health System (Sistema Único de Saúde – SUS). Pimentel, Paranhos and Chiarini (2022) illustrate the complex and challenging history of this instrument. PPD has undergone multiple legal changes over the years, faced accountability issues, and experienced discontinuities. These factors have prevented its full potential from being realized.

To summarize, the Ministry of Health creates a list of strategic drugs, and government laboratories, in collaboration with national private companies or independently, can approach international private producers willing to transfer technology in exchange for an exclusive supply contract over several years of these strategic drugs. This process allows the Ministry of Health to acquire medication at a reduced cost, while the public laboratory gains access to the technology required to supply the Ministry in the future. PPD and TOS support the development of endogenous technology by skipping certain stages in the research project and ensuring that projects start at higher TRLs, as shown in figure 1.

International considerations are also crucial for APM, TOS, and PPD. However, APM has a different rationale. As argued by Arcuri and Gonçalves (2022), it functions more like a “Buy Brazilian” initiative. In this strategy, which was established in 2010 and reintroduced in 2021, preference is given to products or services manufactured or assembled in Brazil, even if they are up to 10% more expensive than imported alternatives. Preference can also be granted to products or services developed within the country, even if they are up to 20% more expensive. The first scenario is referred to as the Preference Margin, while the second is known as the Additional Preference Margin. Only the latter is linked to national R&D or innovation projects.

The primary objective here is to create demand for domestic innovations, even if it entails paying up to a 20% premium. Since the Margin of Preference is granted only for the acquisition of products and services already available in the market, this instrument is categorized as targeting TRL 9 (figure 1).

Finally, as demonstrated by Foss and Monteiro (2022), CD are a novelty in the Brazilian legal framework and draw inspiration from European practices. They represent a specific type of bidding process used in situations where the most suitable innovative solutions for a complex problem are unknown. CD has not yet been employed in the country due to its recent legal introduction (late 2021). In this instrument, a qualified set of suppliers is initially selected, and a dialogue ensues with the aim of reducing information asymmetries. Subsequently, a supplier capable of providing the solution on a commercial scale is chosen.

The authors highlight that CD can be motivated by the innovative nature of the solution. However, this instrument is not suitable for financing activities involving technological risks, such as R&D. Its primary utility lies in promoting the introduction and diffusion of innovations rather than their development. One of the main advantages of the Brazilian CD is its high level of negotiation, where all aspects of the contract can be discussed, including the contractual strategy. It stands as a robust and valuable PPI instrument, particularly in cases where there is uncertainty regarding the optimal solution or contract type.

As depicted in figure 1, the PPI instruments in Brazil encompass all TRLs except one. When combined with the instruments that operate on the supply side, such as credit, subsidies, and direct investment, it becomes evident that Brazil possesses a comprehensive and robust set of innovation policies (Rauen, 2020a). This mix of policies provides support and incentives for innovation across various stages, from early-stage R&D to the introduction and diffusion of innovations in the market.

6 FINAL REMARKS

This paper presents a comprehensive overview of the new public procurement instruments for innovation in Brazil. It highlights the wide variety and immense potential of possibilities available to public managers. These instruments cover all phases of the innovation process and technological development, addressing challenges including the well-known “Valley of Death.” They provide support ranging from early-stage technological development with low maturity levels to the market diffusion of incremental innovations.

When these demand-side instruments are combined with supply-side instruments, the policy mix becomes even more robust. The legal changes have been flexible enough to allow for the integrated use of these instruments. For instance, an INP can be complemented with research grants, credit, venture capital, or other forms of creative support. Similarly, a PCP can be preceded by EIP. The rationale of TOS can also be applied to international purchases of various goods, not just defense-related ones. There are numerous possibilities, and it is crucial for managers to understand the mechanics of each instrument and assess the efficiency of promoting their joint use based on specific cases.

These new legal possibilities will require a significant effort from the Brazilian government to train and empower public servants. Public institutions will need to transform into learning institutions to some extent. This presents a concrete challenge for the administration and opens avenues for future research. The future research agenda

in the field of PPI in Brazil should focus on building microstructures that incentivize, ensure accountability, and enhance technical capacity for the implementation of these diverse new possibilities.

It is important to note that the transformative power of PPI in Brazil will be amplified if the business environment improves. Recent experiences in innovation policies have demonstrated that, in addition to explicit instruments, implicit measures that align with the same goals are essential. In other words, while PPI can change the reality of the innovation system, the overall system needs to be supportive of those who seek to innovate.

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