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Innovation policy dismantling: strategies and causes in contemporary Brazil

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This paper analyzes the policy dismantling process in the Brazilian innovation system since mid-2010. The research describes how this policy change has been undertaken and explains the strategies deployed and major causes. The study is theoretically grounded in the debate of policy dismantling, meaning changes that result in cuts, reductions, or even abolition of budget, rules, capacities, and instruments of a governmental area. A mixed-methods approach, both quantitative and qualitative, is employed. First, it examines the dismantling process in the last years, focusing on the budget execution patterns of the major policy instruments and agencies in charge of innovation at the federal level. The research relies on the stakeholders' perception by conducting semi-structured interviews with experts regarding strategies, rationale, reactions, and effects. The empirical findings show the dismantling occurs in both dimensions: density (number of tools reduced) and, mainly, the intensity (budget cuts), varying according to government areas. The interviewees highlighted the prevailing strategy as active dismantling, in which the fiscal austerity aggravated by the COVID-19 crisis, an ideological shift in the government coalition, policy particularities, and a low level of prioritization in innovation by the domestic business community are the main factors that affect the politicians' preferences to dismantle. Finally, the process seriously affects the national innovation system, such as the loss of bureaucratic and policy capacity, brain drain, and lag in technology, productivity, and consequently, in the country's economic performance.

Keywords: policy dismantling; innovation; decision making; political economy; Brazil.

Desmonte da política de inovação: estratégias e causas no Brasil contemporâneo

O objetivo central do artigo é analisar o processo de desmonte das políticas públicas no sistema nacional de inovação brasileiro desde meados de 2010. A pesquisa descreve como esse tipo de mudança política foi realizada e, principalmente, explica as estratégias adotadas e as principais causas. A investigação fundamenta-se teoricamente no debate sobre o desmonte das políticas, ou seja, mudanças que resultam em cortes, reduções ou mesmo extinção de orçamento, normas, capacidades e instrumentos de uma área governamental. Uma abordagem de métodos mistos, tanto quantitativos quanto qualitativos, é utilizada. Primeiramente, examina-se o processo de desmantelamento nos últimos anos, com foco nos padrões de execução orçamentária dos instrumentos da política de inovação e das agências responsáveis no nível federal. O estudo investiga as percepções dos *stakeholders* sobre estratégias, justificativas, reações e efeitos desse processo a partir da realização de entrevistas semiestruturadas. Os resultados empíricos são intrigantes de várias maneiras. O desmonte ocorre em ambas as dimensões: densidade (redução do número de instrumentos e programas) e, principalmente, intensidade (cortes orçamentários), variando de acordo com as áreas do governo. Os entrevistados destacaram que a estratégia predominante é de desmonte ativo, em que a austeridade fiscal agravada pela crise da COVID-19, uma virada ideológica na base de governo, particularidades políticas e a baixa priorização em inovação por parte do empresariado nacional são os fatores determinantes que

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afetam as preferências dos políticos pelo desmantelamento. Finalmente, o processo tem sérios efeitos adversos ao sistema nacional de inovação, como perda de capacidade burocrática e política, fuga de cérebros e defasagem em tecnologia, produtividade e, por conseguinte, desempenho econômico do país.
Palavras-chave: desmonte de políticas; inovação; processo de tomada de decisão; economia política; Brasil.

Desmantelamiento de la política de innovación: estrategias y causas en el Brasil contemporáneo

El objetivo principal del artículo es analizar el proceso de desmantelamiento de las políticas en el sistema nacional de innovación brasileño desde mediados de 2010. La investigación describe cómo se llevó a cabo este tipo de cambio político y, principalmente, explica las estrategias adoptadas y las causas principales. La investigación se fundamenta teóricamente en el debate sobre el desmantelamiento de políticas, es decir, cambios que resultan en recortes, reducciones o incluso extinción del presupuesto, normas, capacidades e instrumentos de un área de gobierno. Se utiliza un enfoque de métodos mixtos, tanto cuantitativos como cualitativos. Primero, examina el proceso de desmantelamiento en los últimos años, centrándose en los patrones de ejecución presupuestaria de los instrumentos de política de innovación y las agencias responsables a nivel federal. El estudio investiga las percepciones de los *stakeholders* sobre estrategias, justificaciones, reacciones y efectos de este proceso a partir de entrevistas semiestructuradas. Los resultados empíricos son intrigantes de varias maneras. El desmantelamiento se da en ambas dimensiones: densidad (reducción del número de instrumentos y programas) y, principalmente, intensidad (recorte presupuestario), variando según las áreas de gobierno. Los entrevistados destacaron que la estrategia predominante es de desmantelamiento activo, en la que la austeridad fiscal agravada por la crisis de COVID-19, un giro ideológico en la base de gobierno, las particularidades políticas y la baja priorización de la innovación por parte del empresariado nacional son los factores determinantes que afectan las preferencias de los legisladores por el desmantelamiento. Finalmente, el proceso tiene graves efectos adversos sobre el sistema nacional de innovación, como pérdida de capacidad burocrática y política, fuga de cerebros y rezago tecnológico, productivo y, en consecuencia, el desempeño económico del país.
Palabras clave: desmantelamiento de políticas; innovación; proceso de toma de decisiones; economía política; Brasil.

1. INTRODUCTION

The paper's primary goal is to analyze the policy dismantling process in the governance arrangement of the Brazilian innovation system since mid-2010. The research focuses on describing how this policy change has been undertaken in the federal government and, primarily, explaining the main ideas and underlying causes that culminated in the dismantling processes of different dimensions of its policy mix, meaning the combination of instruments with multiple goals and means (Rogge, 2018). Therefore, the inquiry aims to understand this critical phenomenon, emphasizing decision-making, how they were implemented, and possible effects on the National Innovation System (NIS).

Innovation policy consists of an intervention formulated and implemented by the government, including its different agencies and spatial levels (national, regional, state, or municipal). Its primary purpose is to support, promote, and catalyze the generation, introduction, diffusion, adoption, and use of innovations. These, in turn, mean products, services, processes, or business models to be used, commercially or not (Edler & Fagerberg, 2017), that add new value to the firms, public sector, or society.

The advance in understanding this current phenomenon is essential since promoting innovation is a vector for inclusive and sustainable socio-economic development (Lundvall, 2010; Mazzucato, 2013; Reynolds et al., 2019; Cirera et al., 2020). Moreover, innovation also contributes to improving the well-being of citizens and building solutions to urgent global and social challenges, such as the Coronavirus pandemic. Building a NIS that promotes this process is always desired but has yet to be achieved by most countries. It is a long-term, complex, and, above all, multicausal phenomenon of construction (Lundvall, 2010). The State plays diverse roles, including funder, regulator, and skill trainer.

Despite the consensus regarding the potential returns of countries' innovation capacity, most governments fail to adequately design and implement policies to build an institutional environment favorable to economic, industrial, and high-technology development (Cirera & Maloney, 2017). As a result, this paradox tends to reflect in a hostile business setting, technological dependence, low labor productivity, and economic complexity, which is the Brazilian case. Although the nation improved its innovation governance arrangement from the 1990s to the mid of the last decade by diversifying the number of policy instruments and constantly increasing its budget, it has changed with the reversal of this situation materialized by a recent trend of dismantling its policy mix. In addition, this policy mix is also negatively affected by the historical features that drive the country away from a mature and well-functioning NIS (Lundvall et al., 2009), including instability, fragmentation, and particularistic behavior of economic players (Negri & Rauen, 2018; Reynolds et al., 2019).

The policy dismantling, meaning changes that result in cuts, reductions, or even abolition of budget, rules, capacities, and instruments of a governmental area (Bauer, 2014), is noted both in density (number of instruments implemented) and intensity (the degree of prioritization, e.g., a decrease of personnel involved and budget) of the innovation policy mix. The same trend can be observed in different areas of the National Innovation System, such as education, science & technology, industry, and commercial policies. Several key programs were extinct or had their budget drastically decreased during the last six years.

Therefore, crucial research questions emerge: how these policy changes were undertaken? What are the prevailing dimensions and strategies used? Considering its adverse effects on the country's innovative capacity and long-term development trajectory, what are this phenomenon's main effects and determinants? Are there organized reactions among this policy subsystem stakeholders? To answer them, the paper employs an analytical framework aimed to explain the features and causes of dismantling that usually involve a complex process including a variety of complementary factors, such as the country's socio-economic situation, changes in the ideological orientations of the ruling coalition, interest groups influence and supranational pressures that culminate in changes in preferences, decisions, and actions regarding a particular policy subsystem (Bauer & Knill, 2013).

In methodological terms, the paper is a quantitative-qualitative approach grounded in official document analysis, multidisciplinary bibliographic research, interviews with experts from universities and the private sector, and top government officials engaged in the innovation policy mix. In order to mitigate bias, the twelve interviewees have different professional backgrounds and vast experiences in the last two decades, including different administrations with opposite ideological and political orientations. The interviewees were selected based on the snowball sampling or chain-referral method, in which the interviews are chosen based on a referral from prior participants (Trochim et al., 2015). Besides this introduction, the paper has three other sections. Next is dedicated to presenting the types of dismantling and the analytical framework used to explain its causes. The methodology strategy is briefly described in the empirical part, followed by the innovation policy dismantling process over the last years, and then the stakeholders' assessments and perspectives are discussed. The last section outlines the final remarks and future research agenda.

2. EXPLAINING POLICY DISMANTLING: A THEORETICAL FRAMEWORK

This section discusses the theoretical basis of this research, including the policy dismantling concepts, its dimensions, implementation strategies, and how the phenomenon can be explained. Lastly, the paper outlines insights regarding how the bureaucracy can react to this type of policy change.

The approach to policy dismantling is crucial because it is related to one of the critical topics of public policy: the analysis of policy change. Although it is not a new subject in the field of study, it predominates the focus on policy expansion, implementation, and evaluation. The dismantling of policies is also an increasingly relevant topic. It has been addressed, since the 1970s, with other nomenclatures - termination of public policies, deregulation, and welfare state dismantling. The latter became notorious with Paul Pierson's (1994) seminal research on the significant cuts in social policies during the conservative governments of Ronald Reagan (USA) and Margaret Thatcher (UK).

Nevertheless, this theoretical lens gained even more prominence with the liberal turn that marked the reforms of different focuses at the end of the last century and, recently, after the 2008 financial crisis when some developed nations, under the justification of budget constraints and the need to fiscal austerity, have undertaken contraction efforts, especially in social and environmental policies (Bauer et al., 2013).

The term 'policy dismantling' consists of changes resulting in cuts, reductions, or even abolishing the budget, rules, laws, organizational structures, capabilities, and instruments of a policy or government area (Bauer, 2014). It is, therefore, an institutional change that affects the State's degree of commitment to a particular policy subsystem, meaning the primary unit of analysis to understand policy processes (Howlett et al., 2013). The phenomenon, however, is not homogeneous and can be analyzed from different and complementary perspectives.

First, regarding the description of the process, changes can occur in two dimensions of the policy mix (Bauer & Knill, 2013):

1. Density: quantitative modifications of the policies and instruments, e.g., reduction of public programs effectively implemented or extinct in a certain period.
2. Intensity: qualitative modifications in the policy mix can be measured by the degree of prioritization granted by the government to an area. It can occur substantially or informally. The first occurs via calibration of the policy instruments, such as the reductions in the value of social benefits, fees, and exemptions and the policy's range or target audience. At the same time, informal change focuses on capacity changes and administrative procedures essential for the implementation process, such as operational resources, budget, and staff.

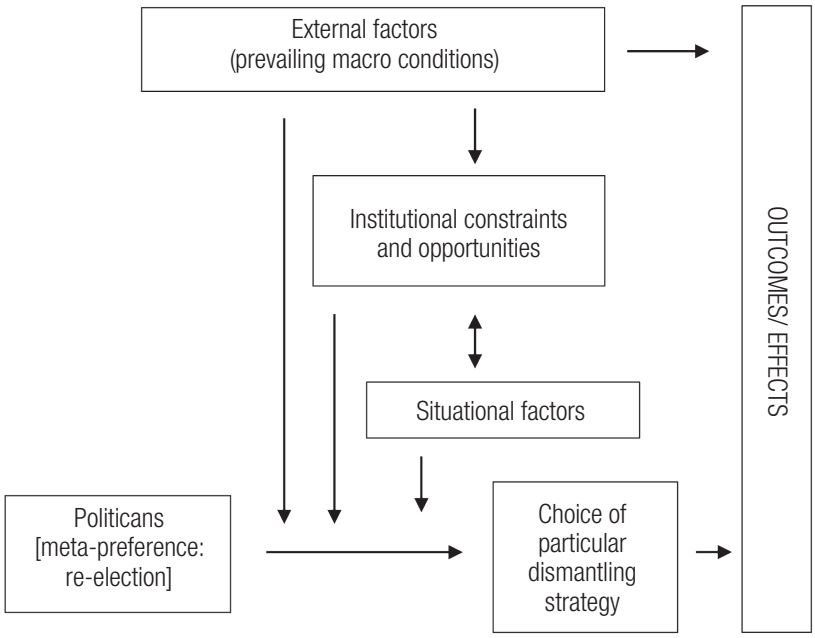
Considering the complexity and comprehensiveness of innovation policy, Edler et al. (2016) created a typology for it, which helps to frame related instruments and agencies in charge of this policymaking. They organize it according to their primary goals, i.e.:

I. Increase investments in research and development.
II. Improve skills.
III. Enabling access to specialized knowledge.

IV. Strengthen the capabilities of the whole system and explore complementarities.
V. Increase the demand for innovation.
VI. Improve innovation frameworks, including regulation and standards.

To explain how the dismantling is undertaken, Bauer and Knill (2013) argue that two crucial questions must be addressed: i) under which conditions do politicians engage in policy dismantling; ii) which strategies of policy dismantling do they choose? Then, the authors formulated an analytical framework to help understand it, considering that the processes may vary according to the area's priority level on the government agenda, political costs and benefits of changes, and policy particularities. Figure 1 displays the framework and its components:

FIGURE 1 ANALYTICAL FRAMEWORK FOR POLICY DISMANTLING EXPLANATIONS



Source: Bauer and Knill (2013).

The model departs from the premise that politicians, including elected officials and top-ranked bureaucrats, are rational actors who maximize their goals, i.e., to ensure their reelection or stay in office. So, why would they deliberately and consciously engage in a usual potentially unpopular direction, such as policy dismantling? In this 'game,' these key actors' preferences, either in the Executive or Legislative branches, are affected by three factors during their political costs and benefits calculation of which strategies to choose (Bauer & Knill, 2013). In their decision process, they behave with

bounded rational (Simon, 1955) when evaluating the outcomes and effects of their objectives and the policy area in a broader sense.

The framework highlights three main aspects that influence the politicians' preferences to engage in policy dismantling: situational and external factors and institutional constraints and opportunities. The first is conjunctural and rarely predicted, such as natural catastrophes, scandals, or accidents. External shocks can trigger policy dismount by macroeconomic conditions, such as fiscal crisis, inflation, recession, etc., leading to austerity-type pressures on programs and budget cuts. External factors also occur due to disruptive technological changes, new ideas (e.g., neo-liberalism), or political events, such as an unforeseen election. Lastly, institutional opportunities and constraints, which vary according to the characteristics of different political-administrative arrangements and policy subsystems, also affect the politicians' engagement or opposition to changing the status quo. These may include Legislative voting rules, the number of institutional veto players, the constitutional court's role in policymaking, and closeness to the election cycle (Bauer & Knill, 2013).

These factors may interfere with the actors' cost and benefits calculations and, therefore, shape their preferences and choices in which dismantling strategy to follow. This is the other key component of the framework that encompasses different features and consequences to the policy mix. Despite the difficulties in framing the dismantling strategies, Bauer and Knill (2013) develop four ideal types varying in the extent to which a political decision to dismantle is actively and consciously taken or not. The typology also involves whether the political actors wish to hide or reveal their dismantling activities. These strategies may change during the policy dismantling process and even be coexisted, especially in a broad policy mix, such as the innovation field that typically encompasses many governmental areas (science & technology, education, finance, etc.).

Dismantling by Default is the most discrete strategy, generally relying on the policy reduction justification due to changing external conditions, such as recession or inflation. This strategy usually guarantees low visibility because there is no public decision that attracts attention, debates, and open opposition to the dismantling process. Its effects tend to generate non-adjustment of substantial intensity in the instruments of the policy mix.

The second type - *Dismantling by Arena Shifting,* is considered an opaque strategy as the previous one, as it also relies on low visibility. However, it is generated by transferring the whole policy responsibility to a different arena, e.g., another agency in the Executive branch, government level, or even private or non-profit sectors. The delegation, decentralization, or concession to an outsider organization can decrease the costs directly credited to politicians and impact manipulation of the formal intensity dimension of the dismantling, such as gradually decreasing enforcement capacities, administrative capabilities, and procedural requirements.

On the other side, *Dismantling by Symbolic Action* has high visibility. Its primary goal is to ensure that dismantling intention is clearly and directly a decision of the political actors. They expect to profit from their revealed preference, for instance, by announcing the reduction or termination of a particular policy density or intensity of a particular policy or re-labeling programs. The main feature of this strategy is that governments pretend to cut public budgets and address the efficiency of spending without actually doing it.

The last strategy, *Active Dismantling*, also focuses on high visibility with a strong and clear preference for dismantling. However, in this case, politicians are not only willing to be associated

with the process, but they may genuinely want to disassemble the existing policies. As with the other strategies, it is also triggered by many factors mentioned in the framework. The effects of this option tend to be a complete decrease in density (abolition of policies or instruments) or a reduction in substantial intensity (reducing social benefits, research grants, financial subsidies, etc.).

Therefore, if the choice of a particular dismantling strategy depends on the political actors' costs and benefits analysis and further engagement, it is also reasonable to expect that other 'game' players will organize and mobilize against this process (Bauer, 2014). Nonetheless, using as metaphor, in this case, Isaac Newton's law – "for every action, there is an equal and opposite reaction" does not apply. In democratic regimes, characteristics of the polity can make it difficult for 'unilateral strategies' of policy dismantling. However, it only occurs because the supporters have greater executive control over policymaking.

Policy dismantling is still a new subject in the Brazilian public administration's field of study. However, relevant research on it has recently been published, covering different areas and employing various methodological tools. For instance, in the book of Gomide et al. (2023), the dismantling processes from 2016-2022 are analyzed in many governmental areas, such as social and economic development, infrastructure, environment, etc. The authors conclude that dismantling processes in Brazil were predominantly active and explicit, as well as two pivotal events – the 2016 presidential impeachment and the approval of the Spending Ceiling Law, were determinants of severe budget cuts, especially social ones. In this particular area, Direito et al. (2022), analyzing the Single Registry for Social Programs (Cadastro Único), identified dismantling signs since 2019, despite uncertainties and growing demand for social protection. Finally, Bonelli et al. (2023) address the phenomenon in the environmental policy in the Legal Amazon and demonstrate that an active dismantling process has been ongoing since the beginning of Bolsonaro's administration, provoking paralysis and setbacks in deforestation inspection and control policies and posing severe risks to the environmental protection in the country. Understanding how the opposition to dismantling behaves is equally relevant, considering they can avoid, postpone, or reduce drastic policy changes, such as program termination or complete budgeting cuts. Besides the politicians, another key player is the bureaucracy. According to Bauer et al. (2021), civil servants can act in this situation in three ways: working, shirking, and sabotaging. The first supposes that the bureaucracy's behavioral intentions are allied with the dismantle supporters, who tend to obey and execute the politicians' decisions strictly. On the contrary, civil servants can also prefer to shirk and sabotage if appointed to dismantle their policy mix. To some extent, they protect the agencies and the policy system from the harms that attack public administration's structures, resources, personnel, norms, and accountability, usually resulting in dismantling.

In Brazil, the tense relationship between dismantling and bureaucracy in the context of democratic backsliding was investigated by Lotta et al. (2023). The authors find different strategies of political oppression and bureaucratic reaction, which vary depending on their formality (formal or informal) and the scale of practice (individual or collective). They conclude that political control and bureaucratic reaction are dynamic relationships involving interactions and learning over time.

3. DISMANTLING THE INNOVATION POLICY IN BRAZIL: STRATEGY AND CAUSES

3.1 Methods

To analyze the policy changes of a National Innovation System in a country with a complex political, administrative, and institutional arrangement, such as Brazil, requires different methodological approaches. Therefore, this paper employs a mixed method, both quantitative and qualitative.

The first will help to describe the dismantling process in the last years and understand which strategy is predominant in the Brazilian case; the inquiry focuses on the budget patterns attributed to innovation policy instruments and public agencies in charge of the essential functions in the NIS. The ideal analytical strategy would be using the Federal Government's Pluriannual Plans (PPA) as primary sources of information since it encompasses all government programs and actions over four years. However, the recurrent changes in the Plan's methodology, the programs' names, and the lack of detail in its information reduce the conditions to frame the budget programs/actions objectively and homogeneously in specific innovation policy instruments.

The empirical analysis is based on data from the Annual Budget Law (Chamber of Deputies), the Brazilian Development Bank (BNDES), and the federal government's Transparency Portal. This information enables us to explore the dimensions of intensity and density of the policy changes (Bauer & Knill, 2013), consequently providing insights to assess which dismantling strategy has been undertaken. The selection of these agencies and instruments is based on the typology of Edler et al. (2016), previously described.

Regarding the dismantling explanations, the research focuses on qualitative data gathered through semi-structured in-depth interviews with leading Brazilian experts from different areas of this policy mix, such as industry, science & technology, education, and entrepreneurship. The twelve (12) interviewees comprised a broad span of individuals from different professional backgrounds and vast experiences in academia, the corporate sector, and top government positions during the last two decades. It is worth highlighting that, in this policy field, well-known experts are used to occupying different roles in the public, private, and academic sectors during their careers, which provides a more comprehensive perspective in their analysis.

The inquiry chose snowball sampling to reach the interviewees, a technique in which you sample participants based on prior participants' referrals (Trochim et al., 2016). In short, purposive and nonprobability sampling is recommended to reach a group of individuals that are hard to find or relevant for a particular subject. In this research, stakeholders either have advanced knowledge about innovation policymaking or have been crucial to it.

The answers provided critical assessments of the policy changes in the country and perspectives on the effects on the Brazilian NIS and the economy in general. The interviews have been transcribed and coded, allowing the identification of the key insights presented by each interviewee. Then, their statements were compared in line with the two primary theoretical grounds used in this paper – policy dismantling (Bauer & Knill, 2013) and the reactions to this phenomenon (Bauer et al., 2021), which offered possibilities to find consensus as well as diverging viewpoints amongst the interviewees. Finally, the interviews were all conducted online, and the experts gave explicit permission to record and use the material as well as had the opportunity to consent after receiving the final paper version.

3.2 Active dismantling in a fast move

As discussed in the theoretical section, dismantling is a topic less discussed in the policy analysis field. However, it has gained more relevance in the last decades. In Brazil, the approach is emergent because, since the 1990s, the government's emphasis and academic attention were towards several efforts to build policy capacities as the democratic Constitution 1988 set ambitious goals and new roles for the state. Nevertheless, between 2015 and 2016, a recent turnaround dominated most Brazilian policy areas, predominantly characterized by instruments and programs extinction allied with drastic budgeting cuts. Therefore, the first research question is: which dismantling strategy has been deployed? Before addressing the current dismantling process, a brief overview of the innovation policy mix in Brazil seems necessary.

Historically, this area has been linked to industrial policies that have changed significantly in the last decades. According to Arbix (2016), between the post-war and the 1980s, the context was grounded in the economic model of import substitution, with state leadership and trade protection policies supported by the premise that industrialization would act as a vector of competition, generation of technologies and national companies' competitiveness. During this period, it is worth mentioning the creation of public agencies that are still essential to the governance arrangement: the National Council for Scientific and Technological Development (CNPq) and Coordination for the Improvement of Higher Education Personnel (Capes), both in 1951; the Financier of Studies and Projects (FINEP), in 1967 and, in the mid-1980s, the Ministry of Science and Technology (Castro, 2020).

As a result, policy governance, i.e., means the dynamic arrangements of actors, institutions (rules of the game), ideas, arenas of interactions, and policy instruments related to innovative activities in a given country or region (Cavalcante, 2021), is realized through a set of public organizations with different areas of activity but with a clear mission: to promote other fronts of innovation in the country. Although with varied configurations, they include ministries, state companies, foundations, autarchies, universities, and research centers, with a fragmented pattern of functioning, with more sectoral and less holistic coordination. In an illustrative and not exhaustive effort, Reynolds et al. (2019) organized the Brazilian public institutions according to their primary functions, adapted in Figure 2 below:

Most of them are public organizations that perform central and complementary functions within the Brazilian innovation system, implementing a combination of policy instruments that have been modified in the last two decades. This comprehensive policy mix includes direct and indirect financing tools (tax incentives), the creation of new public organizations and councils fostering innovation, human capital formation programs, and regulatory changes, both on the supply and demand side of innovation policies (Mazzucato & Penna, 2016; Zuniga et al., 2016). Therefore, according to Negri and Rauen (2018, p. 13), this governance arrangement "[...] has many of the same instruments used in the most developed world". This range of policy instruments encompasses the Edler et al. (2016) typology as well as some functions described in Figure 2, primarily financing, that we will be discussed further. Despite this expansion process, which intensified in the century's first years, the field has recently experienced a reverse worrisome.

FIGURE 2 INSTITUTIONS OF THE NATIONAL INNOVATION SYSTEM BY TYPE OF FUNCTION

Notes: ABDI – Brazilian Agency for Industrial Development; BNDES – National Bank for Economic and Social Development; Embrapa – Brazilian Agricultural Research Corporation; Fiocruz – Oswaldo Cruz Foundation; Embrapii – Brazilian Company for Research and Industrial Innovation; CNPq - National Council for Scientific and Technological Development; CAPES - Coordination of Improvement of Higher Education Personnel; FNDCT – National Scientific and Technological Development Fund; FINEP - Financier of Studies and Projects; CNPEM – National Center for Research in Mines and Materials; IPEA – Institute of Applied Economic Research; CNDI – National Council for Industrial Development; MEI - Entrepreneurial Mobilization for Innovation; SENAI - National Service of Industrial Learning.

Source: Adapted from Reynolds et al. (2019).

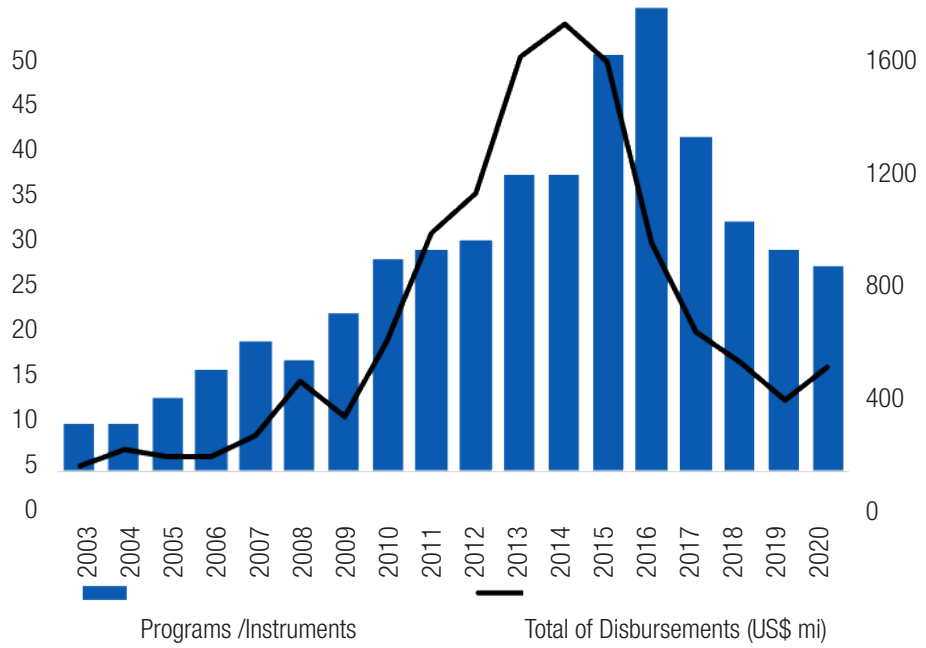
An example was the Inova Empresa, one of the last sophisticated and effective plans in this policy governance (Arbix, 2016) that Finep manages with the purpose of promoting R&D in companies with financing instruments' integration. The program was launched in 2013 with a budget that, in the first year, exceeded US$ 3.35 billion in resources to support firms' innovation[1]. It included different support strategies and focused on complementary economic areas. Still, since 2015, the program has not launched a new line of financing. It is restricted to one instrument: FIP Inova Empresa, a single exclusive or proprietary fund with a limit of US$ 37.4 million, dedicated to investments in larger firms.

[1] Real values deflated with correction by the government official index in January of 2021.

Another institution involved in implementing Inova Empresa was the National Bank of Development (BNDES), which has historically led the initiatives of funding support to firms investing in their innovative capacities in Brazil. Similarly to Finep, the Bank's portfolio also undergoes an intense process of dismantling, both in terms of density (number of policy instruments) and intensity (total disbursements). Between 2013 and 2016, investments were approximately US$ 140 million in the annual average of the period, distributed in different modalities and economic sectors of the Inova Empresa. In 2020, however, only three are still ongoing (I-Defense, I-Energy, and I-Mineral), and the total disbursement dropped to US$ 4 million, i.e., less than 3% of the program's first-year budget.

In addition, after expanding the BNDES financial lines in projects of technological nature, such as connectivity, advanced manufacturing, professional training, and solar energy generation, among others, since 2015, the engagement in the innovation system has also gone towards the dismantling processes. Graph 1 depicts the changes in the number of programs/financial instruments and the respective disbursements:

GRAPH 1 EVOLUTION OF BNDES PROGRAMS/INSTRUMENTS AND DISBURSEMENTS RELATED TO INNOVATION, 2003-2020 (US$ 1 MI)



Note: values deflated with correction by the government official index - Jan/2021.

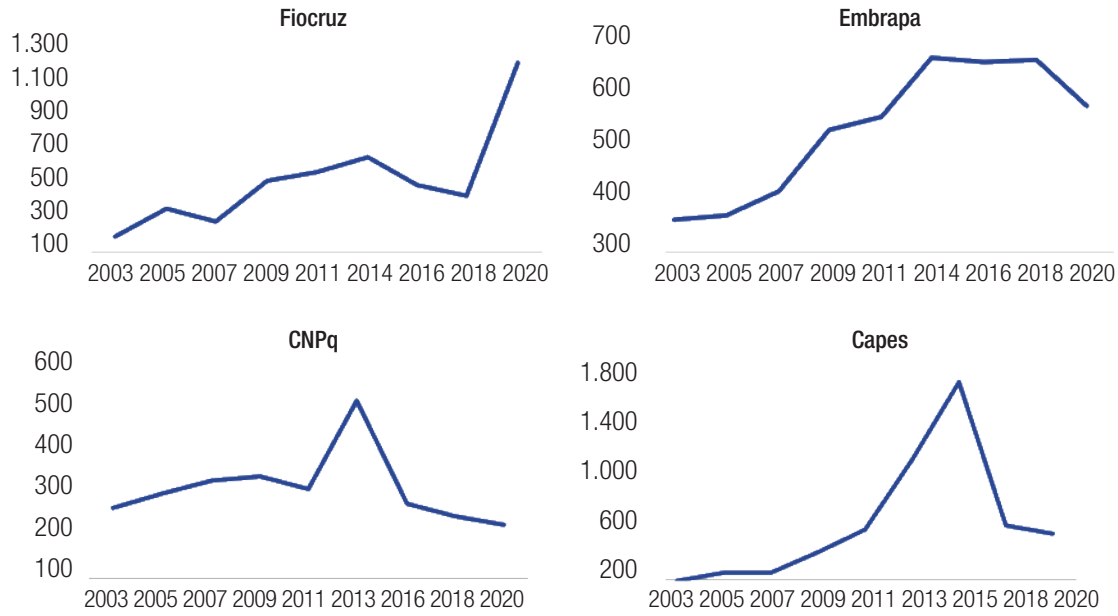
Source: Service of Citizen Information (e-SIC) from BNDES.

The advance of the BNDES' activities on innovation is evident after 2006, reaching its peak ten years later. In the middle of the last decade, the expansion process gives way to dismantling in density and intensity. The number of these programs and instruments was gradually reduced, from 50 to 22 in 2020, directly impacting the innovation funding. This, in turn, went from US$ 15 million in 2003 to US$ 1.5 billion eleven years later and, since then, an intense reduction that reached 23% (US$ 350 million) of the 2014 total budget.

The policy tools related to investments in R&D are not restricted to the focus on firms since public institutions also carry out a relevant set of innovation promotion or production initiatives. In this sense, the following graphs show the evolution of four central organizations for the Brazilian SNI in different areas of activity: Oswaldo Cruz Foundation (Fiocruz), Brazilian Agricultural Research Corporation (Embrapa), National Council for Scientific and Technological Development (CNPq) and Coordination of Improvement of Higher Education Personnel (Capes).

They are public agencies with diversified designs and linked to distinct ministries but converge by acting directly or indirectly in different types of innovation policy instruments, such as improving skills, providing access to specialized knowledge, strengthening the capacities of the entire system, and exploring complementarities, increase demand for innovation, and facilitate exchange and dialogue (Edler et al., 2016).

GRAPH 2 EVOLUTION OF ANNUAL BUDGET EXECUTION BY SNI AGENCIES, 2003-2020 (US$ 1 MI)



Note: Values deflated with correction by the government official index (Jan/2021).

Source: Câmara dos Deputados (2023).

Graph two clearly shows the occurrence of budget expansion followed by a continuous reduction of these expenditures. The only exception was Fiocruz, which had been reducing executions in 2015 but has shown a considerable increase in the last two years. This is explained by the actions to face the Coronavirus pandemic. In 2020, the original endowment to the foundation projected a reduction of 7% compared to the previous year. Still, with the emergency COVID-19 crisis, the institution received about US$ 750 million for researching and producing vaccines against this disease (Fiocruz, 2021).

Another emblematic program encompassing different types of innovation policy instruments in Brazil was Science Without Borders, a joint initiative of the Ministries of Education and Science, Technology, and Innovation, also operated by Capes and CNPq. The policy aimed to promote the consolidation, expansion, and internationalization of science and technology, innovation, and Brazilian competitiveness through exchange and international mobility. Created in 2011, the program exceeded US$ 840 million in four years, but it underwent a dismantling strategy with a total extinction between 2016 and 2018[2].

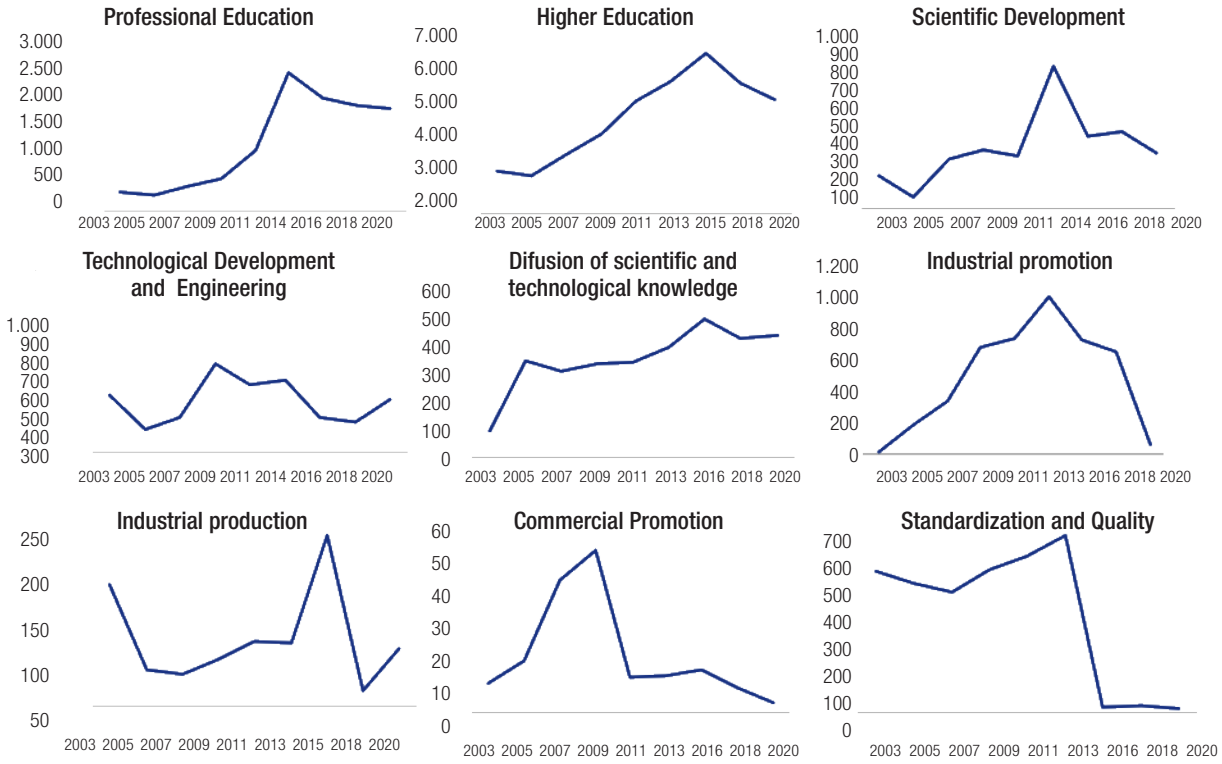
The National Program for Access to Technical Education and Employment (Pronatec) also aimed to improve the labor force's skills and competencies, especially in professional and technological education. Launched in the same year as Science without Borders, it reached almost US$ 750 million in the budget executed in 2014. Still, it has undergone a retraction type of dismantling since then, as the funding was gradually reduced until it was finalized entirely in 2019[3].

The last analysis of the policy mix dynamics addresses the execution of budgetary sub-functions related to innovation governance within the federal government. The sub-function is the partition of the function that includes a set of programs and has a transversal pattern crossing a variety of agencies and governmental areas. Graph 3 displays the changes in the spending of nine subfunctions of various dimensions of the SNI[4].

The first two involve expenditures in professional and university education and, therefore, are part of instruments for improving human capital (Edler et al., 2016), such as training and research programs in organizations related to professional education networks and S&T and public universities. In both educational sub-functions, the dismantling has been evident since the second half of the last decade. With different patterns but following the same expansion-dismantling logic, the following three subfunctions encompass various science and technology programs focused on building innovative environments and capabilities within SNI. The policies include defense, telecommunications, energy, health, and sustainability initiatives. Although expenditures are higher than at the beginning of the century, they are still a long way from when they peaked in prioritization in the federal budget between 2009 and 2016.

[2] Retrieved from https://www.portaltransparencia.gov.br/programas-de-governo/08-ciencia-sem-fronteiras?ano=2018
[3] Retrieved from https://www.portaltransparencia.gov.br/programas-de-governo/14-pronatec?ano=2018
[4] Retrieved from https://www.portaltransparencia.gov.br/pagina-interna/603317-funcao-e-subfuncao

GRAPH 3 EVOLUTION OF BUDGET EXECUTION, BY SUB-FUNCTIONS, 2003-2020 (US$ 1 MI)



Note: Values deflated with correction by the government official index (Jan/2021).

Source: Câmara dos Deputados (2023).

The situation is even more worrisome in the industrial and commercial areas that aim to strengthen the capabilities of the entire system, explore system complementarities and increase the demand for innovation (Edler et al., 2016). If in trade promotion, the budget reduction began at the beginning of the last decade, the sub-functions of industrial policy reached their peak in 2015, which may be the result of the prioritization of this agenda in the government reflected in the implementation of the macro-programs Inova Empresa and Brasil Maior Plans, for instance. In all of them, the funding provisions declined, indicating that 2022 is the lowest level of the historical series. The last subfunction is standardization and quality, which aims at improving innovation structures, including regulation and standards (Edler et al., 2016). In this case, the data shows a moderate expansion between 2003-2013 but a sharp drop with the residual budget remaining in recent years.

In sum, the quantitative analysis of the budget execution for the national innovation policies has experienced an active dismantling strategy, and except for the COVID-19 emergency spending at Fiocruz, the other policy instruments that expanded, mainly after 2003, started in 2016 to suffer comprehensive and multiarea dismantling. The phenomenon is perceived in reducing policy density (number of instruments effectively implemented) and intensity (prioritization and budget allocation in agencies and sub-functions). In addition, the degree of dismantling varies according to the policy area. At the same time, education and R&D in agriculture suffered less, and the impacts on S&T and

industrial policy were much more damaging. Finally, it is worth remembering that, since the middle of the last decade, within the scope of the federal government, there has not been a macro policy for guidance and coordination of the SNI, which despite the notorious problems of execution, minimally aimed to articulate actors and instruments central elements of this governance arrangement.

4. STAKEHOLDERS' PERCEPTIONS

In this section, the paper presents the experts' assessments and perspectives about the characteristics of the innovation policy changes in the last years. The analysis is structured as the interview to organize the discussion according to the policy dismantling's theoretical concepts: changes' dimensions and strategies, decisions rationale, reactions, and effects.

4.1 Dismantling features

To begin with, the most convergent perception of the experts is that the innovation policy mix has recently been through evident changes, especially at the federal level. All interviewees agreed that modifications in the innovation governance instruments are in the course. However, they have different opinions regarding when these changes started and their effective magnitude.

Some interviewees indicated that the dismantling began showing signs of the reduction of the economic cycle around 2013/14 (I4, I8), while others identified more significant changes in Rousseff's second term (2015) and after her impeachment process in 2016 (I1, I2, I6). Their view about cooling trends or reduction towards some policies also varies according to the area of expertise; for instance, industry and S&T suffered modifications in the policy instruments and budget before education. Moreover, when questioned about the size of changes, the majority agree that they are substantial; some highlight this process as a brutal dismantling (I1), the collapse of the NIS (I11), or a "profound dematerialization based on the deliberate disarticulation of policies" (I12).

As discussed earlier, dismantling a policy mix can follow two different dimensions: the number of programs and instruments (density) or qualitative modifications (intensity), measured by the degree of prioritization granted by the government to an area with effects on crucial aspects of the implementation process, such as operational resources, budget, and staff involved (Bauer & Knill, 2013). They all converge with the perception that dismantling could be noted in both dimensions. Nonetheless, most experts highlight that most policy modifications have focused on government program funding, which can differ according to the innovation policy area, e.g., greater in S&T and industry than in education (I3, I4). As interviewee 11 put it:

> It is the biggest crisis in the development system, the crisis of an architecture built and consolidated with long-term financing institutions long-term…for example, the S&T budget corresponds to less than a decade ago.

The dismantling of the intensity dimension, primarily in the funding of the policy mix and its agencies, becomes worrisome as innovation, in its essence, is a market failure (I3). This hazardous enterprise requires constant investment (6). Besides the termination of several instruments and the financial reduction, experts also mentioned dismantling the policy management and governance basis (I1, I5, I6, I11). As a result, it tends to directly affect the already weak coordination mechanisms in

the policy mix, the need for more goals and prioritization, and the reduction of bureaucratic capacity to design and implement the programs. In this sense, interviewee 1 stated, "In the case of S&T, the process has eroded the Ministry's two main agencies – Finep and CNPq."

Regarding the type of dismantling strategy adopted, since mid-2010, by the federal government, most of the interviewees agreed that the prevailing is active (Bauer & Knill, 2013), i.e., marked by high visibility and clear preference to dismantle, which is also in line with the research of Bonelli et al. (2023) and Gomide et al. (2023). However, the policymakers' willingness to undertake the process differs among the Administrations, as Interviewee 6 supported: "Dilma and Temer cut, but they tried believing." The experts defended that these changes are being gradual, fragmented, and without much fanfare or not declared as such, in other words, an 'embarrassed dismantling'" (I11). Similar to the relative consensus regarding the occurrence of innovation policy's mix reduction, they also agree that the dismantling process was not hidden by governments, which to some extent, had a distinct level of visibility among Administrations. Still, overall their perceptions indicate a prevailing active dismantling.

4.2 Rationale

So, if this is not a popular or award-winning set of decisions, why are politicians willing to embark on this adventure? What are the main reasons behind the innovation policy dismantling since mid-2010 at the federal level? As a complex and comprehensive political phenomenon, the experts were asked to identify, among the range of factors displayed by the theoretical framework of this research, which would be determinant to influence the politicians' preferences to engage in the policy dismantling.

The general perception is that different drivers triggered the process in a complementary and dynamic way over the analyzed period. However, the experts did not cite any aspects of situational factors, institutional constraints, or opportunities relevant to explaining the dismantling of the Brazilian federal government's innovation policy. Therefore, the determinants, based on the interviews, rely mainly on the external shocks or exogenous factors of this particular policy subsystem, which may involve macroeconomic conditions (fiscal crisis, inflation, recession, etc.)., a wave of new ideas or political events (elections or ideological changes in the ruling coalition).

Although the interviewees emphasized the policy dismantling's causes differently, one variable they share in their opinions is the impact of the fiscal crisis. More specifically, the financial constraints generated by the recession that the country has experienced since 2015 impacted and kept affecting the politicians when they make budget allocation decisions. Besides, some of the experts highlighted that the approval of the 'spending ceiling' (Constitutional Amendment 55 of 2016[5]) institutionalized the dismantling path of the innovation policy mix by creating an effective legal barrier for financing the policy tools of the NIS with an official justification for it, also identified in the book of Gomide et al. (2023), mainly in the social and environmental areas of government. The second most mentioned aspect in the rationale behind the changes in the ideological turnover in the presidential coalition occurred in 2016, after President Rousseff's impeachment. Since then, right-wing parties have governed Brazil with a declared and intense emphasis on the neoliberal agenda of economic reforms.

[5] The amendment establishes that the government can only spend the same amount paid in the previous year, adjusted only for inflation. The measure limits for 20 years all federal expenses of a given year to the previous year's budget, as corrected by an official index (IPCA).

Consequently, a complete transformation in the country's development project, with innovation clearly out of the government's priority agenda (I2, I3, I4, I5). In this sense, interviewee 12 points out that: "innovation policy is not seen as an important solution to the country's problems; it is not a state policy." Likewise, the current situation is considered the 'demonization of industrial policy in the federal government, caused by three related factors: fiscal crisis, non-prioritization in the agenda, and simplification of liberal economic theory (I7).

The experts also added two other critical reasons for the dismantling, endogenous: the policy particularities and the domestic business view and interest in innovation. The first was considered necessary because of the difference and mismatch between the short-term political goals and the long-term needs embedded in the innovation capacity building and outputs (I1, I4). Moreover, the policy mix's sustainability, including its instruments implementation and financing, is hampered by the low level of institutionalization, typically because politicians generally do not understand the logic and peculiarities of how a national innovation system operates (I1, I4, I6). As regards business, many interviewees highlighted that the private sector historically in Brazil also does not prioritize innovation as a driver for profits and competitiveness (I7, I12). The perceptions of non-innovator firms in the country may come from the discredit of the corporate sector regarding the results of innovation and subsequently culminate in a poor degree of business engagement and funding (I10). As an interviewee stressed: "the Brazilian business doesn't care for innovation" (I3).

Finally, as an external factor, the Coronavirus brought even more complications to the context with its severe and unprecedented economic, political, and social implications. In this sense, interviewee 2 provides a tentative summary by reinforcing that the dismantling process is "a variable geometry, first the rupture of 2016, which led to transition, paralysis, and fall of the government revenues and expenditures, aggravated by the world COVID-19 crisis".

4.3 Reactions and effects

Policy changes tend to provoke a variety of impacts not only in the public sector but also in the universities, industry, services companies, and startups, among others. Consequently, it is natural to expect that a dismantling process, intense as observed in the innovation's policy mix, would provoke reactions among these stakeholders. Given the scope of the Brazilian NIS, the experts agreed that the responses existed but were diverse among the different leading players related to the subsystem and primarily disorganized.

The state bureaucracy is one of these players that performs crucial tasks in all phases of policymaking. Because of that, they are usually among the first to suffer the consequences of dismantling strategies. As mentioned, this case affects the decline of technical competencies in the ministry and public innovation agencies (I1, I5, I6, I11). According to Bauer et al. (2021), civil servants may act in three ways: working, shirking, and sabotaging. The majority of the interviewees did not identify the bureaucracy as a locus of resistance; only three cited it and highlighted that civil servants, in general, have opted to work or shrink as their organizations or even the National Council of Science and Technology (I1, I4, I11, 12) became less relevant in the policy subsystem during this period (since mid-2010). Consequently, sabotage is not a strategy to protect the attacks on public administration's structures, resources, personnel, norms, and accountability, usually resulting from the dismantling.

Overall, the experts underscored that, like the bureaucracy, the other key players, especially from business, industry, and science organizations, are not as independent of the government. This institutional arrangement leads to a predominant sectorized and particularistic behavior rather than an organized one, culminating in minor criticisms and low intensity of general reactions as expected. This situation reflects an insufficient capacity to resist effectively and a low degree of accountability of the policy subsystem (I1, I3, I4, I5, I6, I7, I8, I11, I12).

However, it does not mean that there is no resistance. Probably, the most significant victory against the policy dismantling was the approval of Law 177 (2021), which modernizes the management of the National Fund for Scientific and Technological Development (FNDCT) and primarily protects it against blockages of resources by the public administration (I1, I4, I6, I7, I8, I11, I12). The interviews did not provide one only responsible for the new legislation because it was the fruit of intense and collaborative lobbying pressures of the country's innovation activists and organizations in the Legislative Arena.

When asked about assessing the changes' effects on the National Innovation System's functioning and the country's current and future scenarios, the interviews also provided many implications. The answers converge to the extent that the impacts are seen as significant, affecting the innovation capacity and performance of the economy. However, the difficulties in measuring this dimension of the phenomenon were also highlighted.

First, one main concern is the loss of policy capacity in the subsystem (I1, I5, I11), which is quite interconnected to the unlearning process that the dismantling brought along (I3, I8, I11, I4). This negative output was cited as a problem for the public sector that needs to improve its capabilities to design and implement programs and initiatives. The lack of appropriate assessment before the decision to dismantle was also highlighted as a loss of opportunity to understand better the effectiveness of the instruments implemented and to adapt them to improve their results (I2, I4). This behavior diverges from the public administration's trend of evidence-based policy. Still, it is also an inconvenience to the firms and universities that suffer from the lack or the poor quality of government support and partnerships. Some experts emphasized that the dismantling process has led to uncertain contexts (political, economic, and administrative), decreasing the needed investments and provoking opportunity losses for entrepreneurs in the competitive global market (I7, I8, I12).

Another recurrent effect mentioned was a risk or the intensification of the brain drain, i.e., the emigration of highly trained or intelligent people from Brazil to seek better job opportunities abroad. The Brazilian diaspora of high skills professionals can compromise one whole generation, impacting the depreciation of human capital, which is essential for the innovative capacity of any economy (I2, I8, I4). Interviewee 11 added: "[...]the reduction of research capacity, brain drain – a central issue that had been reversed around 2010, since Brazil had become a pole of attraction for foreign researchers, who found better working conditions here than in their countries of origin, including Europeans".

For the economy, in a long-term perspective of development, the dismantling increases the process of deindustrialization in compass with the decline of labor productivity, helping to transform Brazil into an importer of innovation and an exporter of agricultural and mining commodities (I6, I8, I7, I9, I10). In sum, as interviewee highlighted the prevailing view of innovation policy in the government:

> Innovation is not an end; it is a strategic project for development, for resuming productivity. This national development agenda is now in second place, weakening its institutions. Without innovation and industrial policies, our economic advance will be by imitation.

Lastly, some experts demonstrated specific concerns about the reconstruction after the policy dismantling (I1, I5, I6, I12). Although they diverge on the timeframe for the process, varying from a few years to a decade, the recovery will be complex and demand many complementary efforts in different areas. The focus should address the reversal of the bureaucratic capacities and policies and promote the engagement and dynamism of the innovation ecosystem's players.

5. FINAL REMARKS

This paper aims to describe and explain the policy dismantling process in the innovation policy mix of the Brazilian government since mid-2010, based on multidimensional and diversified methodological ways. A mix-method approach was employed to provide a comprehensive overview of how this process has been executed, including its dimensions, strategies, causes, reactions, and effects on the NIS and the country's economy.

The research subject is relevant for different reasons. There is a relative consensus that innovation, allied with technological upgrading, is a critical driver for economic progress and competitiveness in developed and developing countries (Cirera et al., 2020) as well as can contribute to solutions for urgent societal challenges and improve citizens' living standards (Edler & Fagerberg, 2017). Besides, Brazil historically has struggled with the innovation paradox, i.e., the failure to adequately design and implement quality policies to foster economic, industrial, and high-technology development (Cirera & Maloney, 2017). On top of that, the policy dismantling in the country is on the opposite way of the guidelines promoted by developed nations, which are massively investing in different fronts of the NIS to cope with the dynamic economic, social, and environmental transformations of the pandemic world (Organisation for Economic Cooperation and Development [OECD], 2021).

The empirical findings are intriguing in many ways. The analysis of the innovation policy instruments and budgets demonstrated that dismantling occurs in both dimensions: density (number of tools reduced) and, mainly, intensity (budget cuts). The dismantling with different patterns covered various key government areas and started showing signs around 2013 and accelerated after 2016. The interviews also reinforced the data analysis; most experts agreed with these results. Moreover, the interviewees highlighted the prevailing strategy as active dismantling with distinct and complementary reasons to explain it. In a nutshell, fiscal austerity aggravated by the COVID-19 financial implications, an ideological turn in the government coalition since 2016, policy particularities, and a low level of prioritization in innovation by the domestic business community are combined the main factors that affect the politicians' preferences to dismantle. Finally, the resistance efforts of different key stakeholders, except for the Law 177 (2021) approval, are not seen as capable of reverting the current situation, which is reverberating in serious adverse effects on the national innovation system, such as the loss of bureaucratic and policy capacity, brain drain and lag of technology, productivity, and economic performance.

Therefore, the paper's contribution is two-fold: practical and theoretical. Firstly, the findings indicate a serious situation for the NIS that imposes new challenges to the beginning of the new

government to revert and rebuild this policy mix. In terms of theory, the research brings a unique approach and insights to the policy dismantling literature because it not only describes this process in a government field that has not been the focus of the analysis but also shows through the lens of pivotal players of this governance arrangement what were the dismantling rationale, features, effects, and reactions. It is worth mentioning the inquiry's limitations. The first involves the decreasing degree of transparency and accountability regarding the information and data of the policy instruments that used to be important in the innovation governance at the federal level, which is, in fact, an additional indicator of the dismantling (Bauer et at., 2021). Secondly, regarding the dismantling effects, as it naturally has a mid to long-term perspective, assessing the practical consequences on the NIS and the Brazilian economy tends to be uncertain and unpredictable.

Notwithstanding, the subject relevance provides a fertile ground for future research that may focus on analyzing the innovation policy dismantling of the regions (state and municipalities) and comparing this phenomenon among developing nations, such as Latin American countries. Another interesting focus can be how the innovation policy coordination evolves and the roles and behavior of key players, such as ministries, universities, and, especially, the business sector, during this period. From a broader perspective, an in-depth analysis of the dismantling process inside innovation policy agencies or a comparison between this area with others (health, environment, infrastructure, etc.) can be helpful to the policy subsystem not only to understand this type of policy changes but also may help to further design a policy mix with more robustness and resilience to external shocks and uncertainties typical of developing countries such as Brazil.

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AUTHORS' CONTRIBUTION

Pedro Luiz Costa Cavalcante: Conceptualization (Lead); Data curation (Lead); Methodology (Lead); Project administration (Lead); Writing - original draft (Lead); Writing - review & editing (Lead).

DATA AVAILABILITY

The dataset supporting the results of this study is not publicly available.

APPENDIX

Interview list (in alphabetical order, not in the sequential order used in the paper):

1. Senior Vice President of Elsevier Research Networks and former Scientific Director at the São Paulo Research Foundation (FAPESP).
2. Former Minister of Planning and former President of the BNDES.
3. Coordinator of the Center for Research in Science, Technology and Society at the Institute of Applied Economic Research (IPEA).
4. Director at the Brazilian Society for the Progress of Science (SBPC).
5. Professor and President of the Brazilian Academy of Sciences (ABC).
6. Professor and Analyst at the Brazilian Agency for Industrial Development (ABDI).
7. Professor and Technology and Innovation Superintendent (Brazilian National Confederation of Industry - CNI).
8. Professor, former Executive Secretary of the Ministry of Science and Technology, and former President of FINEP.
9. Professor and Legislate Consultant at the Federal Senate.
10. Former Secretary of Innovation (Ministry of Economic Development) and Deputy Secretary of Economic Development (State of São Paulo).
11. Professor and former President of the Brazilian Centre for Strategic Studies and Management (CGEE).
12. Professor and Coordinator of Innovation Management Laboratory (University of São Paulo).